Journal of Gerontology: PSYCHOLOGICAL SCIENCES
2003, Vol. 58B, No. 3, P153–P165

Modeling Intraindividual Change in Personality Traits: Findings From the Normative Aging Study

Daniel K. Mroczek[1] and Avron Spiro III[2]

[1]Department of Psychology, Fordham University, Bronx, New York.
[2]Normative Aging Study, VA Health System, and Department of Epidemiology and Biostatistics, Boston University School of Public Health, Boston, Massachusetts.

To advance an intraindividual life-span approach to the issue of stability and change, we studied personality trait trajectories in adulthood. Growth curves for extraversion and neuroticism were estimated for over 1,600 men (initially aged 43–91) in the Normative Aging Study, who were followed over 12 years. We found significant individual differences in intraindividual change for both traits, as well as different trajectories for extraversion and neuroticism. The overall extraversion trajectory was best defined by a linear model, but neuroticism was characterized by quadratic decline with age. We then considered several variables as predictors of individual differences around these overall trajectories. Birth cohort, marriage or remarriage, death of spouse, and memory complaints were all significant predictors, explaining variability in both level and rate of personality trait change. These findings suggest that there is a good deal of variability in personality trajectories, and that some of this variability can be explained by birth cohort as well as by age-graded life events.

ONE of the most persistent questions in psychology is whether personality remains stable or changes over time (Caspi, 1998; Caspi & Bem, 1990; Caspi & Roberts, 1999, 2001; McCrae & Costa, 1990; Roberts & Chapman, 2001; Robins, Fraley, Roberts, & Trzesniewski, 2001). Many theorists and researchers have considered this controversy, and their positions span the continuum from stability (Conley, 1984, 1985; Costa & McCrae, 1994; Finn, 1986) to change (Brim & Kagan, 1980; Helson & Kwan, 2000; Helson, Kwan, John, & Jones, 2002; Helson, Jones, & Kwan, in press; Kagan, 1980). Unfortunately, the question of stability and change has long been framed as a yes–no question: stability *versus* change. The present study took a different approach and conceptualized personality stability as an individual differences phenomenon. This intraindividual approach permits a more accurate framing of the stability-change issue, recognizing explicitly that some people can change whereas others remain stable, and that this can vary across personality dimensions or time (Cattell, 1950, 1966).

To illustrate this life-span perspective, we sought to determine whether there were significant individual differences among trajectories of two major personality traits (extraversion and neuroticism) over a 12-year period in a large sample of older men. Many have argued that these and other personality traits remain unchanged during adulthood (Costa & McCrae, 1994), although others have maintained that they can change, at least for some people (Baltes, 1987; Caspi & Roberts, 1999, 2001; Spiro, Butcher, Levenson, Aldwin, & Bossé, 2000). However, few researchers have examined this question by using intraindividual techniques. Exceptions include Jones and Meredith (1996), who applied these techniques to six dimensions of personality, Roberts and Chapman (2001), who applied them to dispositional well-being, and Helson, Jones, and Kwan (in press), who used them with California Personality Inventory scales. However, to our knowledge, no study has applied an intraindividual approach to traits that are part of the five-factor model. Therefore, our primary aim was to examine whether trajectories (in particular, rates of change, or slopes) of extraversion and neuroticism varied across persons. Our secondary aim was to determine whether such trajectories differed by birth cohort or by other predictors suggested by life-span developmental theory.

Individual Differences in Intraindividual Change

Most research on personality stability has centered on bivariate correlation coefficients that focus on stability and change at the aggregate level (i.e., consistency in the relative rank order of persons across pairs of occasions). Such a perspective largely conceals individual differences in stability and change (Aldwin, Spiro, Levenson, & Bossé, 1989; Lamiell, 1981). Some people may be stable on a given trait, but others may change to varying degrees, and the extent of this variability across individuals is difficult to assess by means of bivariate stability coefficients. As a result, many researchers have concluded that personality is stable for all or most individuals without actually evaluating the extent of the individual differences in stability.

We maintain that research on personality stability and change can profit from an individual differences approach. Specifically, we believe the estimation of individual differences in longitudinal trait *trajectories* can yield valuable insights into the ways that peoples' personality traits change or remain stable over time. This notion originates from life-span developmental theory, which holds that not everyone is characterized by the same developmental trajectory. This idea is embodied in the concept of *interindividual differences in intraindividual change,* which implies that some people change whereas others remain stable (Alwin, 1994; Baltes, 1987; Baltes & Nesselroade, 1973; Baltes, Reese, & Nesselroade, 1977; Wohlwill, 1973). The term *interindividual differences* signals that this is a form of differences among persons, whereas the term *intraindividual change* alludes to within-person stability and change. The notion of person-level change was introduced by

Stephenson (1936) and elaborated on by Cattell (1950, 1966; see also McArdle & Woodcock, 1997; Mehta & West, 2000; Nesselroade, 1988, 1991). Individuals can differ markedly from each other in whether they are stable or changing. Thus the mutual exclusivity of the often-used phrase "stability *or* change," although sensible in some contexts, does not make sense with respect to the issue of personality stability and change. The question is better phrased as one of stability *and* change. Do some people change whereas others remain stable?

Intraindividual approaches to personality development were long hindered by a lack of well-understood methods for studying individual growth and change (Alder & Scher, 1994; Nesselroade, 1988, 1991; Spiro, Aldwin, Levenson, & Bossé, 1990). However, a variety of methods are now available that allow modeling of change over time, especially the assessment and prediction of intraindividual change (Bryk & Raudenbush, 1992; McArdle, 1991; Meredith & Tisak, 1990; Raykov, 1998; Rogosa, Brandt, & Zimowski, 1982; von Eye & Nesselroade, 1992). These approaches enable us to address the stability-change question at the personal level, which is the theoretical locus of personality change and stability.

What Gives Rise to Individual Differences in Intraindividual Change?

Few people have the same developmental trajectory because people differ with respect to the environments to which they are exposed, the genetic makeup they possess, and the active ways they bring about behavioral change in themselves (Caspi & Roberts, 2001; Lerner & Busch-Rossnagel, 1981; Levenson & Crumpler, 1996). These individual differences in external and internal factors are likely to produce individual differences in the developmental trajectories of traits. For example, birth cohort may account for differences in trait trajectories because it contains environmental-based variability associated with history-graded normative influences (Baltes, 1987; Nesselroade & Baltes, 1974). Indeed, recent evidence has suggested that there are birth cohort differences in level of extraversion and neuroticism (Twenge, 2000, 2001).

Additionally, age-graded life events, especially relationship events, can alter personality trajectories (Neyer & Asendorpf, 2001). Changes in social and work roles may also potentially bring about trait change (Roberts, Robins, Caspi, & Trzesniewski, in press). In older adulthood, death of a spouse or remarriage are important relationship events that may influence personality. For example, we might expect those whose spouse has died to become more introverted in the years following the event. We might also hypothesize that trajectories of neuroticism, a trait that is correlated with negative affect, depression, and anxiety (Watson & Tellegen, 1985), might be altered in response to negative life events such as deaths of family or friends. Age-graded changes in health may also affect personality trajectories. If a person's health deteriorates to the point where he or she is unable or unwilling to socialize with others, this could create a shift toward greater introversion.

These hypotheses are all illustrations of the life-span developmental tenet of plasticity or adaptability (Alwin, 1994; Baltes, 1987; Heatherton & Nichols, 1994; Roberts, 1997), which implies that developmental constructs remain somewhat supple and malleable throughout the life span. Roberts (1997) has argued that personality is an "open system" that remains sensitive to contextual life experiences and socialization processes through the life span. In older adulthood, such life experiences include health and cognitive declines, or external life changes such as remarriage or the deaths of spouse, family, or friends (Baltes, Lindenberger, & Staudinger, 1998; Stewart, Sokol, Healy, & Chester, 1986). The plasticity hypothesis, however, must be considered in the context of a large body of research that has shown strong continuity of personality traits over long periods of time (Costa & McCrae, 1994); such continuity also appears stronger among older adults (Roberts & Del Vecchio, 2000). We do not argue against these findings; rather we emphasize that a more complete understanding of continuity and change in personality requires a greater appreciation of the role of interindividual differences in intraindividual trajectories. Given this appreciation, it should be easy to recognize that there can be a great deal of variability in personality, even if the trajectories of many adults are stable. Other developmental constructs, such as cognition, show variability across people in rate of change over time (Schaie, 1996); personality trajectories are likely to function in a similar fashion.

On the basis of these theoretical perspectives, we selected life events as potential predictors because such events have the power to alter one's life and behavior patterns, perhaps leading to trait change. We also chose birth cohort because it may reflect historical influences that bring about variability in trait change across cohorts.

Present Study

We applied an intraindividual technique, individual growth modeling (Raudenbush & Bryk, 2002; Rogosa et al., 1982; Willett & Sayer, 1994; Willett, Singer, & Martin, 1998), to the study of personality change in adulthood. Individual growth modeling is a type of multilevel model (also known as random effects models or hierarchical linear modeling). Using this technique, we first tested the hypothesis that there were significant individual differences in intraindividual personality trajectories. We then tested whether individual differences in trajectories could be explained by selected predictor variables, using a (multilevel) growth model with covariates.

We examined change in two major traits, extraversion and neuroticism, over a broad age span (ages 43–91) among men measured repeatedly over 12 years. Extraversion and neuroticism are historically important traits with a well-known biological basis (Eysenck, 1990), and they comprise the two most well-established dimensions in the "Big Five," one of the principal models of personality trait psychology (Costa & McCrae, 1994; Goldberg, 1993; John, 1990; McAdams, 1994, 1996; McCrae, 2001). The empirical literature supports the notion that these two traits are generally stable over time, with regard to both mean-level and correlational stability (Conley, 1984, 1985; Costa & McCrae, 1994; Finn, 1986; Spiro et al., 2000). Over short periods of time (3–5 years), such correlations tend to register in the .60–.80 range (e.g., Robins, Fraley, Roberts, & Trzesniewski, 2001), although over longer periods (10–30 years) they tend to fall into the .40–.60 range (Costa & McCrae, 1994; Roberts & Del Vecchio, 2000). However, the evidence regarding intraindividual stability in extraversion and neuroticism is much less clear. Do major traits that display relatively high correlational stability also exhibit significant

variability in intraindividual trajectories? If so, can we identify correlates or predictors of such variability?

Methods

Sample

Data were from the Normative Aging Study (NAS), a longitudinal investigation of normal aging in men founded at the Boston VA Outpatient Clinic in the early 1960s (Bossé, Ekerdt, & Silbert, 1984). Most NAS participants are veterans, the majority having served during the World War II and Korean War eras. Over 6,000 men were screened for the absence of serious physical or mental illness between 1961 and 1970 to assemble a panel of 2,280 initially healthy participants. In 1988, the beginning of the follow-up period for this study, the age range for the 1,663 men included was 43 to 91 years ($M = 63$; $SD = 8$).

To examine potential bias caused by nonresponse, we compared men who completed the short form of the Eysenck Personality Inventory (EPI-Q; Floderus, 1974) one or more times from 1988 onward ($n = 1{,}663$) to NAS men who did not but were known to be alive at that time ($n = 328$). For these comparisons, we used demographic data collected either at time of enrollment in the NAS (1961–1970) or from a mail survey conducted in 1975 on work and retirement. We first compared age at baseline between the two groups, and we found no difference. Also using baseline data, we compared marital status (married vs. other) and occupation (white vs. blue collar) and found no differences. Using data obtained in 1975, we found that men who did not complete the EPI-Q were more likely to be retired [19.9% vs. 7.1%; χ^2 (1) = 30.29] and rated their health more positively [as excellent or good; 90.8% vs. 83.9%; χ^2 (1) = 7.62], but they did not differ in presence of a health problem [13.1% vs. 9.1%; χ^2 (1) = 2.51]. In essence, there were no major differences between the participants used here and nonresponders.

Design

Data for this study came from six administrations of the EPI-Q over a 12-year period. Three of the administrations occurred in 1988, 1991, and 1992 as part of mail surveys. Beginning in 1993 and continuing through 1999, the EPI-Q was mailed to each man prior to his triennial NAS biomedical exam. Therefore, the fourth and fifth occasions of measurement did not occur on all men at one point in time, but rather occurred at 3-year intervals beginning in 1993. The sixth measurement occurred in 1997, when men who had not reported for a NAS exam in the past few years were mailed a survey that included the EPI-Q. Men who completed this sixth assessment could not have completed the fifth (the two were mutually exclusive); therefore a participant could complete at most five of the six assessments.

Across the assessments, 1,663 men provided 5,664 measurements. There were 434 (26.1%) men who had data from five occasions; 480 (28.9%) with four occasions; 318 (19.1%) with three; 189 (11.4%) with two; and 242 (14.6%) who were measured only once. There were 34 different patterns of missing data; however, 3 of them accounted for over half of the data: 25.5% completed the first five assessments; 18.3% the first four, and 11.4% the first three.

Table 1. Means and Correlations for the First Three Measurement Occasions

	Extraversion			Neuroticism		
	1988	1991	1992	1988	1991	1992
N	1461	1287	1199	1456	1299	1200
1988	1.00			1.00		
1991	0.76	1.00		0.72	1.00	
1992	0.71	0.74	1.00	0.68	0.68	1.00
M	5.34	5.45	5.24	2.98	3.36	2.78
SD	2.30	2.27	2.21	2.25	2.33	2.28

One advantage of individual growth modeling (and of other intraindividual techniques) is that it permits the use of individuals who do not have data on all waves, and it allows observations collected at intervals that vary both within and across persons. Thus, we were able to include many more participants in our growth-curve estimation than would have been possible with the use of more traditional methods (e.g., repeated-measures analysis of variance) that require complete data on all participants.

Measures

Personality.—Extroversion and neuroticism were assessed with the EPI-Q (Floderus, 1974), a short measure based on Form B of the Eysenck Personality Inventory (Eysenck & Eysenck, 1968). The EPI-Q consists of 18 items, 9 each for extraversion and neuroticism. Items are dichotomous and scores range from 0 to 9 for each trait. In developing the EPI-Q, Floderus translated the items into Swedish. She later backtranslated the items into English, creating slight wording differences between the original English EPI items and those on the EPI-Q (Floderus, 1974). The EPI-Q has been used primarily in Swedish twin studies (Floderus-Myrhed, Pedersen, & Rasmuson, 1980), and it has demonstrated good construct validity (Levenson, Aldwin, Bossé, & Spiro, 1988; Mroczek, Spiro, Aldwin, Ozer, & Bossé, 1993). McCrae, Costa, and Bossé (1978) successfully retrieved clear extraversion and neuroticism components from the EPI-Q by using principal components analysis with varimax rotation. Mean extraversion at the first time point (1988, $n = 1{,}460$) was 5.34 ($SD = 2.30$); mean neuroticism at the first time point was 2.98 ($SD = 2.25$).

Birth cohort.—Potential aging effects or history-graded influences may give rise to differential trajectories over different age groups. The birth years of the NAS men ranged from 1897 to 1945, and the experiences of different birth cohorts within this range may be associated with differences in personality trait trajectories. We thus tested for birth cohort differences in intraindividual trajectories. We divided the NAS into three birth cohorts, corresponding to men who came of age prior to the Great Depression, during it, or afterward. Because the NAS is made up of mostly veterans, these cohorts also correspond to different military experiences (Spiro, Schnurr, & Aldwin, 1997). The men in the oldest cohort (born between 1897 and 1919, inclusive) would have had less wartime experience than the middle cohort (born between 1920 and 1929, inclusive), who were of prime draft age during WWII. By contrast, the youngest cohort in our sample (born between 1930

Table 2. Growth Curve Estimates for Extraversion and Neuroticism

Effect (*SE*)	Extraversion	Neuroticism	
		Linear	Quadratic
Fixed Effects Estimates			
Intercept	5.40 (.05)	2.97 (.05)	2.90 (.05)
	t (1661) = 101.35***	t (1660) = 56.92***	t (1660) = 53.31***
Slope	−0.02 (.05)	−0.44 (.05)	−0.49 (.06)
	t (3980) = 0.41	t (3989) = 9.21***	t (3988) = 8.77***
Curvature			0.12 (.03)
			t (3988) = 3.49***
Random Effects Estimates			
Variance of intercept	3.59 (.16)	3.33 (.16)	3.37 (.17)
z	20.71***	20.71***	19.76***
Effect size	0.62	0.60	0.51
Variance of slope	0.58 (.12)	0.46 (.13)	0.10 (.24)
z	4.81***	3.62***	4.21***
Effect size	0.10	0.08	0.15
Variance of curvature			0.01 (.04)
z			0.35
Effect size			0.00
Covariance of intercept, slope	−0.30 (.10)	0.03 (.09)	0.20 (.12)
z	3.12**	0.31	0.16
Effect size	0.05	0.00	0.03
Covariance of intercept, curvature			−0.26 (.13)
z			2.04
Effect size			0.03
Covariance of slope, curvature			−0.14 (.07)
z			2.11
Effect size			0.02
Residual variance	1.33	1.70	1.66
−2LL	21594	22432	22532

Notes: For both extroversion and neuroticism, N = 1,663; the number of observations is 5,643 and 5,651, respectively. Intercept refers to the predicted trait score when the participant is aged 63 and slope refers to rate of change per decade. Standard errors are in parentheses; −2LL = −2 log likelihood, a fit index.
**$p < .01$; ***$p < .001$.

and 1945, inclusive) would have served during the early years of the Cold War or in Korea. Each cohort would have had unique history-graded experiences that may have shaped lifelong personality trajectories, and we tested for such effects.

Predictors of personality change.—We considered a number of self-reported variables that might be associated with personality change, using life-span developmental theory and recent research as a guide (Baltes, Reese & Nesselroade, 1977; Caspi & Roberts, 1999; Neyer & Asendorpf, 2001; Roberts, 1997). Each variable was measured in 1987 or 1988, at or before the time of the initial personality measurement for most participants in this study. To represent health status, we used a brief measure of activities of daily living (ADLs). The four items summed to create the index asked whether one's health was good enough to (a) do heavy work, (b) walk up stairs, (c) walk half a mile, and (d) run half a mile. To assess memory complaints, we utilized a dichotomous variable that asked whether the person felt he experienced memory deterioration during the previous year. This is obviously a subjective assessment of memory, and it is best construed as memory complaints. Nevertheless, such measures of subjective memory do correlate with negative affect and depression, which are in turn highly correlated with the two traits considered here, neuroticism and extraversion (Comijs, Deeg, Dik, Twisk, & Jonker, 2002; Rabbitt, Maylor, McInnes, Bent, & Moore, 1995; Zelinski, Gilewski, & Anthony-Bergstone, 1990). To represent life events, we considered whether, during the year prior to the first assessment of personality, the man had experienced (a) death of spouse, (b) marriage or remarriage, or (c) retirement. Inclusion of these indicators as explanatory factors in a two-level individual growth model can reveal whether they can account for individual differences in trajectories as potential predictors of personality change.

Data Analysis

To examine intraindividual change and stability in traits, we estimated trajectories of extraversion and neuroticism by using individual growth modeling, as implemented in SAS (1997) Proc Mixed. Each model yielded estimates of fixed effects, which describe the intercept and slope of the overall sample trajectory, and of random effects, which describe the person-level trajectories in terms of their deviations (in intercept and slope estimates) from the overall trajectory (Rogosa, 1995). Age was centered at the sample mean (63) at the first measurement occasion and divided by 10 to convert to decades. The former was done to reduce the correlation between intercept and slope that otherwise would be inflated (Kreft, de Leeuw, & Aiken, 1995; Rogosa & Willett, 1985; Willett, 1988; although some have criticized the practice of centering,

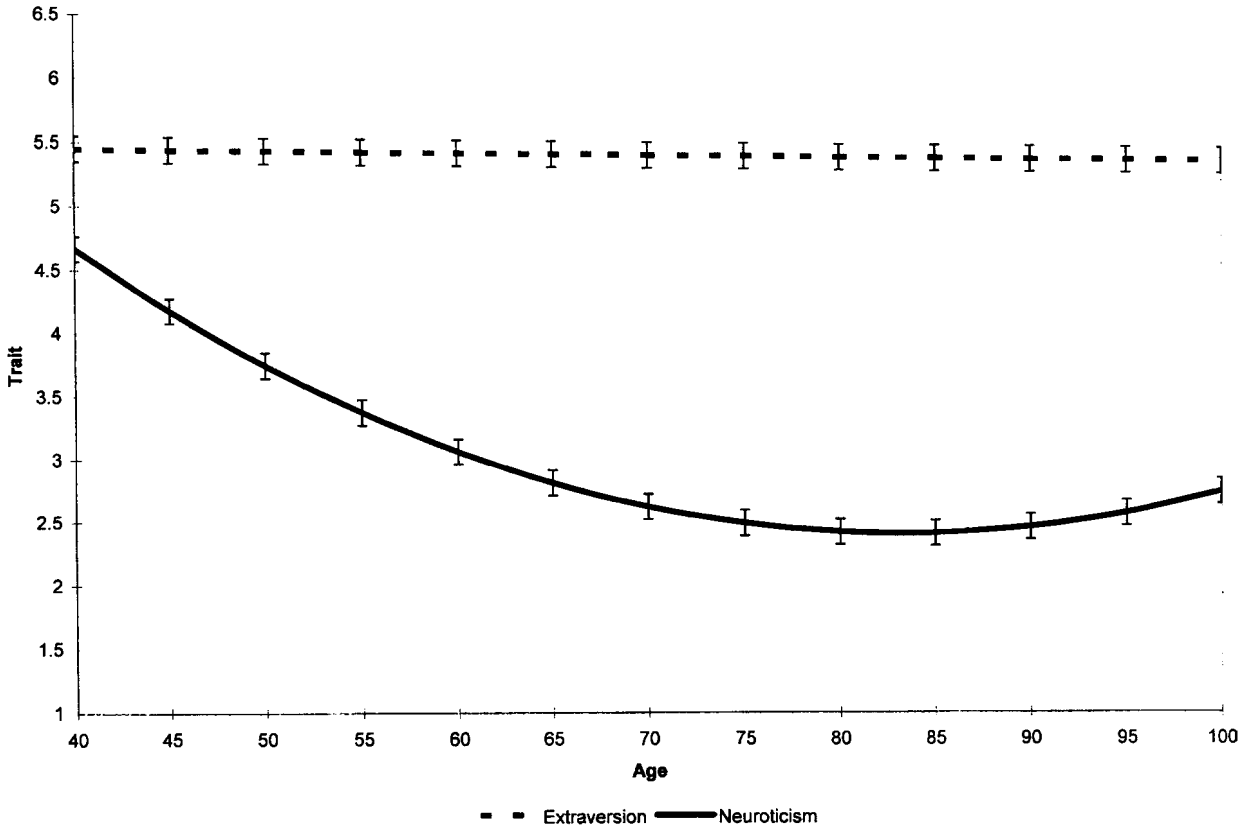

Figure 1. Overall trajectories of Extraversion and Neuroticism, with standard error bars.

e.g., Kromrey & Foster-Johnson, 1998), and the latter to simplify the squaring and cubing of age when nonlinear effects are tested. Centering age meant that the "intercept" for the overall trajectory across all men (the fixed effect estimate of intercept) was the predicted amount of trait at the age of 63; the slope was the predicted amount of change per decade on that trait. The fixed effect estimates defined the sample-level personality trajectories. The random effect estimates denote individual differences relative to the sample-level trajectory, that is, interindividual differences in personality trajectories. If the variances of these random effects are significant, this indicates interindividual differences in aspects of intraindividual change.

Results

Means, standard deviations, and stability coefficients are displayed in Table 1 for the first three measurement occasions. As already indicated, after the third occasion (1992) the NAS men were assessed every 3 years at intervals that varied across individuals. Thus we did not report means or correlations after 1992. The stability coefficients are comparable with those reported over 1–4 years in other studies (Costa & McCrae, 1994; Neyer & Asendorpf, 2001; Robins, et al., 2001), and the means look relatively stable as well, although neuroticism appears to show a slight decrease from 1988 to 1992.

Next, we regressed each personality trait on polynomial (i.e., linear, quadratic, and cubic) functions of (centered) age. For all models, we specified an unstructured covariance matrix for the random effects, because it is more suitable for data with unequally spaced intervals than are more structured matrices. For each trait we first considered a model that specified an intercept and a linear slope, and we estimated both fixed and random effects. These models allowed individuals to vary in both level and rate of change from the overall trajectory. A second model added a quadratic age effect for both the fixed and random effects. Finally, we added covariates to the best-fitting of the previous models, considering first birth cohort, and then adding health and life event measures in turn, to assess their impact on personality trajectories, controlling for birth cohort and any slope- or curvature-by-birth cohort interactions.

Intraindividual Personality Trajectories

We first considered baseline models that allowed random effects only for intercept (intercept-only model; Raudenbush & Bryk, 2002). These were used to estimate the intraclass correlation, revealing the amount of between- and within-person variance. For extraversion, the intraclass correlation is .72, meaning that 72% of the total variation in extraversion is between-person variance, and the remainder (28%) is within-person variation. The intraclass correlation for neuroticism was .67, indicating that 67% of the total variation in neuroticism was between-person and 33% was within-person. If everyone were stable over time on these traits, the only variation that would occur would be between-person variation, simply reflecting individual differences in that trait, and the intraclass

Table 3. Growth Models of Extraversion and Birth Cohort

Effects	Estimate (*SE*)	*t* (*df*)	*z*
Fixed			
Intercept	5.24 (.18)	*t* (1659) = 29.67***	
Slope	−0.16 (.11)	*t* (3978) = 1.40	
Youngest cohort (b. 1929–1946)	0.52 (.20)	*t* (1659) = 2.58**	
Middle cohort (b. 1920–1929)	0.11 (.19)	*t* (1659) = 0.58	
Oldest cohort (b. 1898–1919)	—		
Slope × Youngest cohort	0.41 (.15)	*t* (3978) = 2.78**	
Slope × Middle cohort	0.32 (.14)	*t* (3978) = 2.31*	
Slope × Oldest cohort	—		
Random			
Variance of intercept	3.58 (.16)		22.42***
Variance of slope	0.56 (.11)		3.52***
Covariance of intercept, slope	−0.33 (.09)		5.01***
Residual variance	1.33		
−2LL	21560		

Notes: N = 1,663; there were 5,643 observations. Standard errors are in parentheses; −2LL = −2 log likelihood, a fit index.

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

correlation would approach 1.00. The between-person variation does account for the majority of variability, yet substantial portions are within person, hinting that at least some personality change occurred over the course of the follow-up period. Table 2 shows fixed and random effect estimates from models that allowed individuals to vary in both level and rate of (linear) change on extraversion and neuroticism. The fixed effects are shown in the top half of the table and the random effects are shown in the bottom half. Note that for extraversion the intercept is significant but the linear slope is not, indicating that the average level of extraversion at age 63 is approximately 5.4 on the 0–9 scale, but that there is, on average, no change with age (see Figure 1). Random effects are shown in the first column of the bottom half of Table 2. The first two rows give the variances of the intercept and slope, and the third is the covariance between them. Effect sizes and *z* statistics for each variance and covariance are shown, as well as the residual variance and the −2 log likelihood, a fit index. The effect sizes reflect the proportion of total variance explained by a given random effect; it is analogous to an R^2. The variance of the intercept for extraversion is the estimated variance of the individual deviations (i.e., the random effects) from the overall intercept, and it was significantly different from zero, reflecting significant individual differences in level of trait extraversion.

What is more important is that the variance estimate for the slope was also significantly different from zero, indicating significant individual differences in rate of change in extraversion. Although the overall sample trajectory did not indicate change with age, as shown by the nonsignificant fixed effect, there was significant variability among persons in rates of change, as exhibited by the significant random effect for linear slope. Thus, there was both stability for the sample as a whole *and* change at the individual level (for at least some men) in extraversion. In addition, the covariance between the intercept and slope for extraversion was significant and negative. This means that a higher level of extraversion at age 63 was associated with a lower rate of change. In subsequent models, we tested whether extraversion was characterized by quadratic and cubic change with age, but neither model was a significant improvement over the linear model (results not shown).

The second column of Table 2 shows parameter estimates defining the neuroticism trajectories. The overall trajectory was defined by an intercept and a linear slope that were each significantly different from zero (see Figure 1). The random effects estimates of the intercept and slope variances were also significant. This indicates that the average neuroticism trajectory was one of decline, and that there were significant individual differences around this trajectory with respect to both level and rate of change. The covariance between intercept and slope for neuroticism was not significant.

We estimated quadratic and cubic models for neuroticism; no cubic effects were significant, but the quadratic effect is presented in the third column of Table 2. With respect to the fixed effects (top half of Table 2), note that all three coefficients (intercept, linear slope, and curvature) were significant, leading to a concave relation with age (see Figure 1). The bottom half of Table 2 shows the six variances and covariances of the random effects. Note that the intercept and linear slope variances were significant, but that there were no significant individual differences with respect to the curvature. Furthermore, none of the covariances among intercept, slope, and curvature were significant. In a comparison of parameter estimates of random effects variances between the linear and quadratic models (an estimate of effect size; McArdle & Woodcock, 1997; Singer, 1998), the quadratic model was associated with 118% more variability in slopes than was the linear model. Thus, we found greater individual differences in intraindividual change for neuroticism when we used the quadratic model.

Explaining Variability in Trajectories

Having detected significant individual differences among trajectories for both extraversion and neuroticism, we turned to our secondary goal, identifying predictors of these individual differences, using the life-span developmental approach as a guide to select potential explanatory variables.

Birth cohort.—As already noted, we created a birth cohort variable with three levels; we then included this as a class variable in a model testing the effect of cohort on both level and rate of change. With regard to the latter, we used interaction terms as recommended by Singer (1998). Results for extraversion are shown in Table 3. The intercept represents the average level of extraversion for the referent cohort, in this case the oldest men, and the coefficients for the youngest and middle cohorts represent the amount that they differ in intercept (level) from this group. The interaction terms (Slope × Youngest cohort; Slope × Middle cohort) capture differences from the referent group in rates of change. We depicted the three trajectories in Figure 2. The youngest cohort (born 1930–1946) had higher extraversion at age 63 than the other cohorts (18% of baseline *SD*). More importantly, the rates of change for the two younger cohorts were significantly different from that of the oldest cohort. They both increased on extraversion, whereas the oldest cohort decreased slightly. We compared random

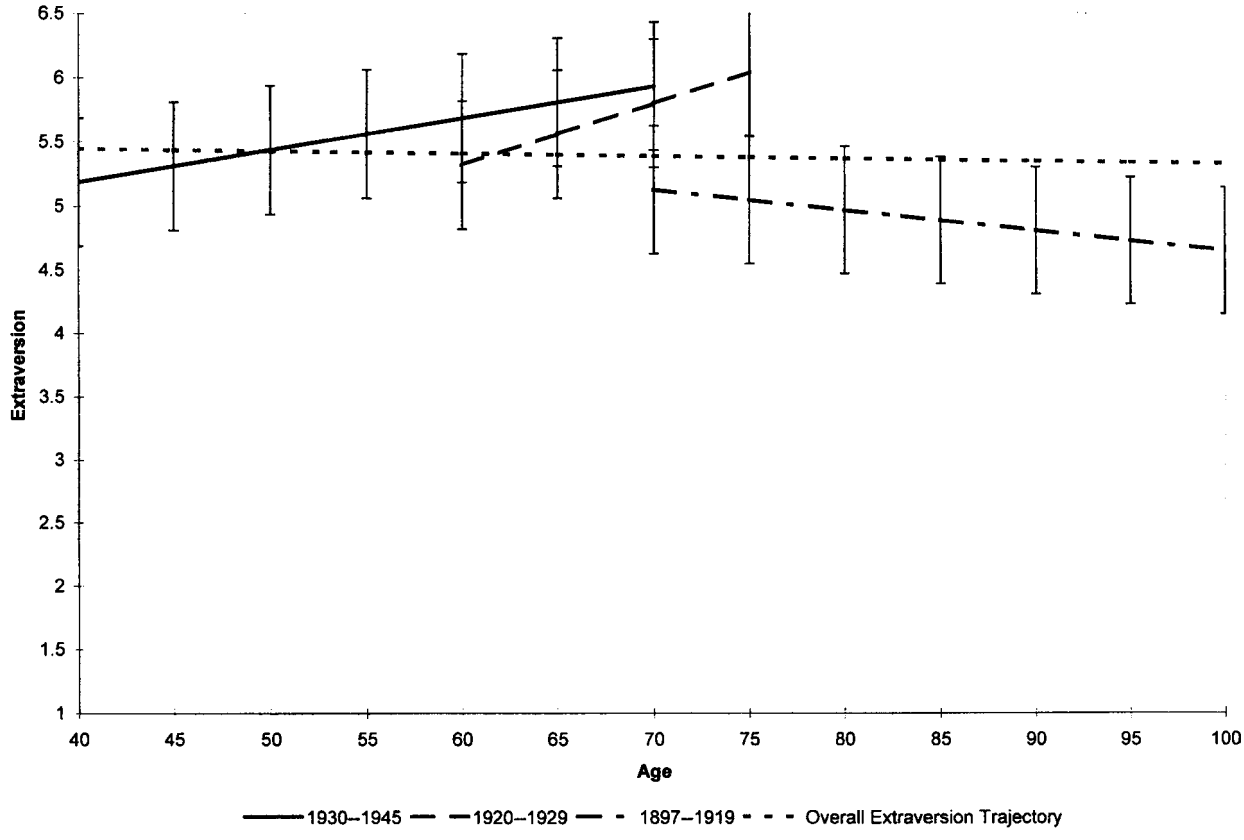

Figure 2. Extraversion trajectories by birth cohort, with standard error bars.

effects variances between the extraversion models with and without birth cohort to estimate effect size. Compared with the model with no covariate, the model including birth cohort explained 4.3% more of the individual differences in rate of change in extraversion than the model without cohort.

We found even more striking differences among birth cohorts in neuroticism trajectories, as shown in Table 4. Again, there were differences among birth cohorts in both average level and rate of change. We also included interaction terms to allow differential amounts of curvature. Although none of these terms were significant, they permitted the bend in the curve to vary among cohorts. Figure 3 depicts the neuroticism trajectories for the three birth cohorts. The oldest cohort shows the slowest decline in neuroticism with age. The younger and middle cohorts, in contrast, show marked decline. The youngest men also show the most curvature in their trajectory, with the decline in neuroticism accelerating as they age. Note that the youngest men also have a lower average level of neuroticism than their older counterparts (there was no significant difference in level between the middle and oldest cohorts). Additionally, the slope variance was .35, a substantial drop from the variance of .996 in Table 2. Therefore, 63% of the individual differences in neuroticism slopes were explained by birth cohort; this is a substantial effect size.

Health status, memory complaints, and life events.—As already noted, we used a small set of variables representing self-reported health status, memory complaints, and life events to account for individual differences in personality trajectories. Many of these variables were not available for every man; thus the *N* is somewhat smaller (1,450 vs. 1,663) in the following analyses. Having established that birth cohort had a significant effect on both extraversion and neuroticism trajectories, it remained in the model. Our health status variable, a measure of ADL, was not a significant predictor of intercept nor slope for either personality trait. However, memory complaints did significantly predict level of, but not rate of change in, extraversion (see Table 5). Men who reported memory complaints in the previous year were less extraverted (21% baseline *SD* lower) on average than were their counterparts; however, memory complaints did not predict differences in rate of change. Memory complaints also predicted level of, but not rate of change in, neuroticism (see Table 6). Men who reported memory complaints in the previous year had higher neuroticism (44% baseline *SD* lower) than their counterparts, but there were no differences in rate of change.

Of the several life event predictors we considered, two were associated with individual differences in neuroticism trajectories. As shown in Table 7, marriage or remarriage (most were remarriages after widowhood or divorce) predicted differences in rate of change in neuroticism. Men who had married or remarried displayed a faster rate of decline in neuroticism (52% baseline *SD* per decade). Thus, men who married or remarried in 1987 or 1988 decreased in neuroticism over the next 10 years at a faster pace than men who did not experience this particular life event. Another life event, death of spouse, predicted both

Table 4. Growth Models of Neuroticism and Birth Cohort

Effects	Estimate (*SE*)	*t* (*df*)	*z*
Fixed			
Intercept	3.37 (.34)	*t* (1658) = 10.02***	
Slope	−0.22 (.47)	*t* (3984) = −0.48	
Curvature	−0.02 (.16)	*t* (3984) = −0.10	
Youngest cohort (b. 1930–1946)	−1.16 (.35)	*t* (1658) = −3.29***	
Middle cohort (b. 1920–1929)	−.31 (.35)	*t* (1658) = −0.90	
Oldest cohort (b. 1898–1919)	—		
Slope × Youngest cohort	−1.23 (.50)	*t* (3984) = −2.47**	
Slope × Middle cohort	−0.29 (.49)	*t* (3984) = −0.58	
Slope × Oldest cohort	—		
Curvature × Youngest cohort	−0.36 (.21)	*t* (3984) = −1.67	
Curvature × Middle cohort	−0.19 (.21)	*t* (3984) = −0.92	
Curvature × Oldest cohort	—		
Random			
Variance of intercept	3.30 (.15)		21.52***
Variance of slope	0.35 (.11)		3.07***
Covariance of intercept, slope	−0.04 (.09)		−0.47
Residual variance	1.68		
−2LL	22401		

Notes: $N = 1{,}663$; there are 5,651 observations; −2LL = −2 log likelihood, a fit index.

**$p < .01$; ***$p < .001$.

level and rate of change of neuroticism. As shown in Table 8, death of spouse during the previous year (1987–1988) was significantly associated with a higher level of neuroticism (72% baseline *SD* higher), and with a faster decrease with age (40% baseline *SD* per decade). This may reflect some temporary elevation on neuroticism as a function of a wife's death, but it also points to a recovery period in the years that follow in which neuroticism declines at a faster rate than that for other men.

The findings in Tables 3–8 make it clear that variables suggested by the life-span approach as potential moderators of psychological trajectories, such as birth cohort and life events, did indeed explain some of the observed individual differences in personality trajectories.

Discussion

We adopted an intraindividual approach to the study of stability and change in personality. Estimating individual growth curves for over 1,600 older men, we observed significant variability in both the level and rate of change in extraversion and neuroticism with age, thus documenting interindividual differences in intraindividual change. Although many men were well characterized by the overall trajectory for a given trait, a considerable number deviated from the overall trajectory. These findings suggest that persons differ in their personality trait trajectories, even in older age. The documentation of significant variability in rates of change of major (Big Five) traits over time supports the notion of individual differences in personality change. Although some people may remain stable, clearly others change (to varying degrees).

Predictors of Change

We also identified several variables that accounted for interindividual variability in trajectories. Birth cohort was associated with such differences. As Figures 2 and 3 show, the oldest cohort displayed different trajectories than the two younger cohorts, whereas the two younger cohorts showed roughly identical patterns of personality change for both traits. These cohort analyses brought to light differences in trajectories that were masked by the overall trajectories shown in Figure 1. The seemingly stable extraversion trajectory actually shows older men becoming slightly introverted even as younger men become slightly more extraverted. On neuroticism, every cohort declined, although younger men showed a much more marked decline than older men. Even so, the finding of decline in neuroticism with age is consistent with recent research documenting declines in negative affect with age (Charles, Reynolds, & Gatz, 2001; Mroczek & Kolarz, 1998).

We also observed both similarities and differences in trajectories in overlapping age ranges as a result of the cross-sequential nature of our design, permitting some disentanglement of age and cohort effects. For example, from the age of 70 to 75, the oldest cohort showed stability or a slight decline in extroversion, whereas over that same age range, the middle cohort showed a clear rise in extraversion. On neuroticism, the oldest cohort showed only very slight decline from the age of 70 to 75, but the middle cohort showed a much steeper rate of decline over the same age range. Note that when we added the life event variables to models that included birth cohort, the effects of the latter did not diminish and remained significant. We thus infer that life event differences among cohorts are not likely to account for the differential trajectories observed among the three age groups. So what is a plausible explanation for these findings?

History-graded influences may lie beneath these cohort differences (Nesselroade & Baltes, 1974; Twenge, 2000, 2001). The two younger cohorts were born from 1920 to 1945, with most coming of age during the Great Depression and WWII. As Elder (1974) observed in his study of those coming of age during the Great Depression, many were strengthened by the burdens imposed by economic hardship and later periods of war. Perhaps these men, having experienced periods of great adversity, are showing some of the resiliency that was forged during their youth by becoming slightly more extraverted in their later years (rather than turning away from others), and becoming more emotionally stable, as implied by fast-declining neuroticism. Hardship in youth may result in resilience in older age. This is conjecture, of course, and further studies of personality and cohort are needed to discern the long-term effects of historical conditions on trait levels and rates of change.

Many have suggested that personality remains somewhat plastic throughout the life course, and that contextual effects should influence such plasticity (Baltes & Nesselroade, 1973; Caspi & Roberts, 1999, 2001; Heatherton & Nichols, 1994; Roberts, 1997). Consistent with this notion, we also identified several predictors of differences in trajectories: memory complaints, marriage or remarriage, and death of a spouse.

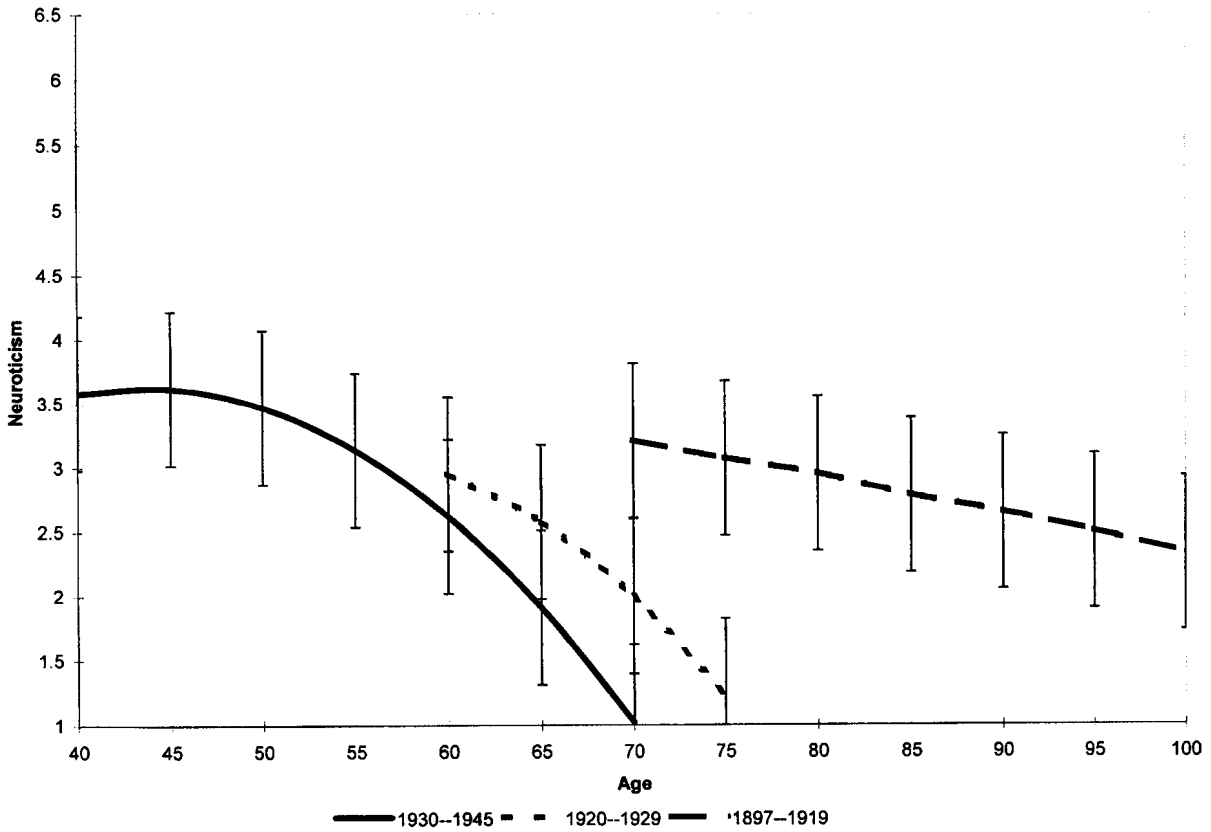

Figure 3. Neuroticism trajectories by birth cohort, with standard error bars.

Memory complaints were associated with trait level (intercept) but not rate of change. Men who complained of memory problems had lower extraversion and higher neuroticism. These findings are consistent with previous research showing that measures of subjective memory correlate with negative affect and depression (Comijs et al., 2002; Rabbitt et al., 1995; Zelinski et al., 1990).

The death of a spouse was associated with an elevated level of neuroticism and then a more rapid decrease. This finding has implications for mental health because neuroticism is strongly correlated with many indicators of mental illness, including depression and anxiety. That death of spouse was associated with a different trajectory for neuroticism may point to an underlying process by which life events influence personality, which in turn alters the risk of mental disorder. Marriage and remarriage were also associated with neuroticism trajectories. Men who had married or remarried (most were the latter) in 1987 or 1988 showed a decline in neuroticism over the 1988–1999 follow-up period. These findings are consistent with the notion that traits, although certainly having enduring aspects, also contain elements that are sensitive to life events over the life course (Baltes & Nesselroade, 1973; Roberts, 1997). We acknowledge that traits have a strong biological basis (rooted in temperament), which serves to promote personality continuity over time. Yet simultaneously traits appear responsive to certain life events, which serve to promote at least occasional change. Interestingly, rate of change in neuroticism was associated with more life events than was extraversion. This could

Table 5. Growth Model of Extraversion and Memory Complaints, Including Birth Cohort

Effects	Estimate (*SE*)	*t* (*df*)	*z*
Fixed			
Intercept	5.51 (.19)	$t(1446) = 28.76^{***}$	
Slope	−0.09 (.13)	$t(3760) = -.70$	
Youngest cohort (b. 1930–1946)	0.50 (.21)	$t(1446) = 2.37^{**}$	
Middle cohort (b. 1920–1929)	0.06 (.20)	$t(1446) = 0.31$	
Oldest cohort (b. 1898–1919)	—		
Slope × Youngest cohort	0.37 (.15)	$t(3760) = 2.43^{**}$	
Slope × Middle cohort	0.25 (.14)	$t(3760) = 1.74$	
Slope × Oldest cohort	—		
Memory complaints	−0.48 (.11)	$t(1446) = -4.27^{***}$	
Slope × Memory complaints	−0.05 (.09)	$t(3760) = -0.40$	
Random			
Variance of intercept	3.52 (.17)		21.18^{***}
Variance of slope	0.54 (.11)		4.73^{***}
Covariance of intercept, slope	−0.29 (.09)		3.031^{***}
Residual variance	1.32		
−2LL	19793		

Notes: $N = 1{,}451$; there are 5,214 observations; −2LL = −2 log likelihood, a fit index.

$^{**}p < .01$; $^{***}p < .001$.

Table 6. Growth Model of Neuroticism and Memory Complaints, Including Birth Cohort

Effects	Estimate (*SE*)	*t* (*df*)	*z*
Fixed			
Intercept	2.74 (.35)	*t* (1446) = 7.88***	
Slope	−0.14 (.48)	*t* (3766) = −0.28	
Curvature	−0.05 (.17)	*t* (3766) = −0.33	
Youngest cohort (b. 1930–1946)	−0.97 (.36)	*t* (1446) = −2.70**	
Middle cohort (b. 1920–1929)	−0.12 (.35)	*t* (1446) = −0.35	
Oldest cohort (b. 1898–1919)	—		
Slope × Youngest cohort	−1.30 (.51)	*t* (3766) = −2.56**	
Slope × Middle cohort	−0.31 (.50)	*t* (3766) = −0.61	
Slope × Oldest cohort	—		
Curvature × Youngest cohort	−0.33 (.22)	*t* (3766) = −1.50	
Curvature × Middle cohort	−0.19 (.21)	*t* (3766) = −0.88	
Curvature × Oldest cohort	—		
Memory complaints	0.98 (.11)	*t* (1446) = 9.13***	
Slope × Memory complaints	−0.05 (.10)	*t* (3766) = −0.56	
Random			
Variance of intercept	3.07 (.15)		20.12***
Variance of slope	0.33 (.12)		2.86***
Covariance of intercept, slope	0.00 (.09)		0.03
Residual variance	1.69		
−2LL	20577		

Notes: $N = 1{,}451$; there are 5,223 observations; −2LL = −2 log likelihood, a fit index.
**$p < .01$; ***$p < .001$.

Table 7. Growth Models of Neuroticism and Marriage–Remarriage, Including Birth Cohort

Effects	Estimate (*SE*)	*t* (*df*)	*z*
Fixed			
Intercept	3.15 (.35)	*t* (1427) = 8.94***	
Slope	0.01 (.50)	*t* (3737) = 0.02	
Curvature	−0.10 (.17)	*t* (3737) = −0.59	
Youngest cohort (b. 1930–1946)	−0.97 (.37)	*t* (1427) = −2.63**	
Middle cohort (b. 1920–1929)	0.08 (.36)	*t* (1427) = −0.21	
Oldest cohort (b. 1898–1919)	—		
Slope × Youngest cohort	−1.46 (.52)	*t* (3737) = −2.79**	
Slope × Middle cohort	−0.47 (.52)	*t* (3737) = −0.92	
Slope × Oldest cohort		—	
Curvature × Youngest cohort	−0.24 (.23)	*t* (3937) = −1.26	
Curvature × Middle cohort	−0.14 (.22)	*t* (3937) = −0.65	
Curvature × Oldest cohort	—		
Marriage–remarriage	0.25 (.58)	*t* (1427) = 0.42	
Marriage–remarr. × Slope	−1.18 (.56)	*t* (3737) = −2.11*	
Random			
Variance of intercept	3.24 (.15)		20.24***
Variance of slope	0.37 (.12)		3.10***
Covariance of intercept, slope	0.01 (.09)		0.02
Residual variance	1.68		
−2LL	20443		

Notes: $N = 1{,}432$ with 5,175 observations; −2LL = −2 log likelihood, a fit index.
*$p < .05$; **$p < .01$; ***$p < .001$.

mean that neuroticism has greater plasticity than extraversion, or that rate of change in extraversion is influenced less by life events and more by other types of variables.

No other variables besides birth cohort and (certain) life events were associated with individual differences in rate of change. Perhaps personality trajectories are more responsive to nonnormative influences than normative events (Baltes et al., 1977). Because nonnormative influences tend to be highly idiosyncratic, they may limit the ability of more general predictors to account for individual differences in slopes. Therefore, the reasons for many nonstable trajectories may reflect very specific circumstances in individual lives. Future studies should explore nonnormative events to determine if they account for individual differences in rate of trait change.

Measurement Issues

We must point out an important measurement issue. Our measure of personality, like nearly all such scales, was constructed by using standard psychometric procedures that select items that have high test–retest reliability. This tends to produce scales that are relatively insensitive to change. Most personality measures are built to measure the static aspects of traits, not the elements that change. Therefore, nearly all personality trait measures likely underestimate trait change (Nesselroade, 1989). The fact that we documented any change at all is somewhat remarkable, given the nature of these types of scales. However, it is also important to note that not all change registered by such scales is necessarily true change. Some change may actually be measurement error, although the models we used estimate error, give a standard error, and yield significance tests based on such error estimates.

Limitations

The most serious limitation of our study is the lack of women in the NAS. The NAS was founded by the Veteran's Administration in the 1960s, a time when women were routinely excluded from not only VA studies but from scientific studies in general. This is a drawback, and it is important to recognize the constraints on generalizability that this limitation places on our findings. Another caveat involves the type of statistical model we used. Mixed models (e.g., hierarchical linear model) are flexible in dealing with missing data and data that are spaced at unequal intervals, but they do not permit modeling of measurement error as do structural equation models. This inability of mixed models to incorporate measurement models is a drawback of our study and others that have modeled trait change by using similar techniques (e.g., Helson et al., in press; Roberts & Chapman, 2001). It is important to keep this limitation in mind when contrasting these findings with those from studies that modeled trait change by means of *SEM* (e.g., Jones & Meredith, 1996).

Table 8. Growth Models of Neuroticism and Death of Spouse, Including Birth Cohort

Effects	Estimate (*SE*)	*t* (*df*)	*z*
Fixed			
Intercept	3.26 (.35)	*t* (1439) = 9.43***	
Slope	−0.19 (.48)	*t* (3766) = −0.40	
Curvature	−0.04 (.17)	*t* (3766) = −0.22	
Youngest cohort (b. 1930–1946)	−1.09 (.36)	*t* (1439) = −3.01**	
Middle cohort (b. 1920–1929)	−0.20 (.36)	*t* (1439) = −0.55	
Oldest cohort (b. 1898–1919)	—		
Slope × Youngest cohort	−1.26 (.51)	*t* (3766) = −2.46**	
Slope × Middle cohort	−0.28 (.50)	*t* (3766) = −0.56	
Slope × Oldest cohort	—		
Curvature × Youngest cohort	−0.35 (.22)	*t* (3966) = −1.57	
Curvature × Middle cohort	−0.21 (.22)	*t* (3966) = −0.97	
Curvature × Oldest cohort	—		
Death of spouse	1.61 (.57)	*t* (1439) = 2.84**	
Death of spouse × slope	−0.90 (.43)	*t* (3766) = −2.10*	
Random			
Variance of intercept	3.24 (.16)		20.34***
Variance of slope	0.34 (.12)		2.87***
Covariance of intercept, slope	−0.01 (.09)		−0.16
Residual variance	1.69		
−2LL	20593		

Notes: $N = 1{,}444$ with 5,216 observations; −2LL = −2 log likelihood, a fit index.

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

We also cannot rule out the possibility that decline in traits may result from selection effects. For example, our finding of decline in neuroticism may be because men with higher neuroticism die younger, thus removing themselves from the sample. If persons with higher neuroticism have higher mortality at younger ages, this would bias our estimates. Finally, our study included only two traits, extraversion and neuroticism. We did not have a wider array of traits available to us. It is thus critical for future studies to assess intraindividual stability and change on the full Big Five, as well as other traits not subsumed in this framework.

Conclusions

Although it is generally recognized that persons differ in level of personality traits, this study was one of the first to establish that persons also differ on rate of change in major personality traits. There were clear interindividual differences in intraindividual change, as suggested by life-span developmental theory, and these individual differences were at least partially explained by age-graded and theoretically relevant contextual variables, as well as by birth cohort. Our results demonstrate the usefulness of intraindividual approaches for research on personality development, in terms of the answers they provide as well as the important new questions to which they give rise. We hope that these findings encourage others to use an intraindividual approach to the question of stability and change, in personality or in other behavioral domains. However, more importantly, we hope that this paper will persuade others to think in new ways about trait stability and change. Personality stability, like personality itself, is an individual differences variable. Some people are stable, but others change; those who change on one dimension may not change on another. It is time for our notions of personality stability to change.

ACKNOWLEDGMENTS

This study was supported by Grants R01-AG18436 and R03-AG16054 to Dan Mroczek from the National Institute on Aging. The waves of data used in this study were collected by means of National Institutes of Health grants to Carolyn M. Aldwin (Grant R01-AG13006), Michael R. Levenson (Grant R01-AA08941), and Raymond Bossé (Grant R01-AG02237), and by the Medical Research Service and the Health Services Research and Development Service of the Department of Veterans Affairs. The VA NAS is supported by the Cooperative Studies Program/ERIC, U. S. Department of Veterans Affairs, and is a research component of the Massachusetts Veterans Epidemiology Research and Information Center (MAVERIC).

We thank David Almeida, Carolyn Aldwin, Brendan Bunting, Niall Bolger, Karen Hooker, Rick Levenson, Todd Little, Jack McArdle, John Nesselroade, Tenko Raykov, Alice Rossi, Jesus Salcedo, and Alexander von Eye for comments on various versions of the manuscript.

Address correspondence to Dan Mroczek, Fordham University, Department of Psychology, Dealy Hall, 441 East Fordham Road, Bronx, NY, 10458. E-mail: mroczek@fordham.edu

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Received January 9, 2002
Accepted December 1, 2002
Decision Editor: Christopher Hertzog, PhD