Handbook of Personality Development

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Modeling Intraindividual Stability and Change in Personality

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The question of stability and change is one of the most important in personality and is perhaps the most fundamental question in the area of personality development. Over the past 25 years, researchers have established that rank-order stability is high for most traits (Costa & McCrae, 1988, 1994; Roberts & DelVecchio, 2000), although mean-level stability varies by trait (McCrae & Costa, chap. 7 in this volume). In other types of personality variables (self-efficacy, goals, motives), there is less rank-order and mean-level stability (Helson, Soto, & Cate, chap. 17 in this volume). However, the techniques typically employed to estimate rank-order and mean-level stability in personality variables (or any other type of variable) conceal important information on individual differences. Personality psychology is strongly identified with the science of individual differences, yet it has overlooked the possibility of individual differences in stability and change. Almost 30 years ago, life-span developmentalists advocated the idea of individual differences in intraindividual change (Baltes, Reese, & Nesselroade, 1977), but it remained a largely theoretical notion until statistical techniques were invented in the 1980s that permitted adequate testing of this concept (Bryk & Raudenbush, 1992; Rogosa, Brandt, & Zimowski, 1982). As a result, a much more complex, and more accurate, way of con-
ceptualizing stability and change in personality is now available. This chapter discusses these techniques and how they can advance the conceptual science of personality development.

**INDIVIDUAL DIFFERENCES IN INTRAINDIVIDUAL STABILITY AND CHANGE**

The dominance of older methods, such as repeated analysis of variance measures (ANOVA), narrowed the focus of early research on personality development. Despite research that utilized intraindividual methods as far back as the 1940s (Baldwin, 1946; Henry, 1941), scholars were trained to think in terms of either change in means or in relative positioning in a distribution (rank orders). Much of the important early work on personality stability and change concentrated on one or both of these forms (Conley, 1984, 1985; Costa & McCrae, 1988; Finn, 1986), and much of it has now been synthesized via meta-analysis (Roberts & DelVecchio, 2000). Means and correlations, however, do not allow the study of personality stability as an individual differences phenomenon. Rather, they tell if a trait increases or decreases over time, or if people maintain the same rank order over time, in a sample or population. Repeated measures means and correlation, as valuable as they are, largely conceal individual differences in stability and change (Aldwin, Spiro, Levenson, & Bosse', 1989; Lamh, 1981). As a result of over reliance on these statistics and the preponderance of them in the literature, many researchers have concluded that personality is stable for all or most individuals, without actually evaluating the extent of the individual differences in stability. Do some individuals remain stable and others change? Do some change in one direction, whereas others change in the opposite direction?

Recent studies indicate that researchers in adult personality development are now using techniques that can estimate individual differences in stability and change (these techniques are described later; Helson, Jones, & Kwan, 2002; Jones, Livson, & Peskin, 2003; Jones & Meredith, 1996; Mroczek & Spiro, 2003a, 2003b; Roberts & Chapman, 2000; Small, Hertzog, Hultsch, & Dixon, 2003). Each of these studies has demonstrated that for many personality variables (although not all), individual differences in stability and change exist. Jones et al. (2003) termed this *heterogenous change*, meaning that some people change, others do not, and the direction or pattern of change (e.g., linear, quadratic) varies across people. Half a dozen studies on at least four different longitudinal samples have now shown that there are indeed individual differences in personality change. Put more simply, there is a range of change.

These empirical demonstrations of individual differences in change are consistent with a long-standing theoretical concept originating 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 *individual 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 individual signals that this is a form of differences among persons, and the term intraindividual change denotes within-person stability and change. The notion of such within-person 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 and do differ from one another in whether they are stable or changing on various personality dimensions. Thus, as has been pointed out previously (Mroczek & Spiro, 2003a), the mutual exclusivity of the often-used phrase “stability or change,” although sensible in some contexts, is less tenable with respect to the issue of personality development. The phrase stability and change better describes how personality develops, at least in the adult years. Some people change whereas others remain stable.

Although the principle of individual differences in intraindividual change has been in the social scientific literature for more than 30 years, it was not tested empirically until relatively recently. The main reason was that adequate statistical models were unavailable until the mid-1980s. Even then, it took time for these techniques to diffuse from the statistical to the psychological community. The next section describes some of these statistical models.

**MODELS FOR ESTIMATING STABILITY AND CHANGE: MLM AND SEM**

A variety of methods is now available that allow modeling of change over time (McArdle, 1991; Meredith & Tisak, 1990; Muthen, 2002; Raudenbush & Bryk, 2002; Rogosa et al., 1982; Singer & Willett, 2003; von Eye & Nesselroade, 1992). Some of these techniques are based on structural equation models (e.g., McArdle, 1991; Meredith & Tisak, 1990), whereas others are grounded in a multilevel modeling (MLM) framework. The latter type of model goes by many names (increasing confusion in the literature): random coefficient or random effects models, generalized estimating equations, mixed models, and hierarchical linear models (e.g., Raudenbush & Bryk, 2002; Singer & Willett, 2003). One method, however, bridges SEM and MLM approaches: growth mixture modeling (Muthen, 2002). No study of personality change has used the Muthen (2002) technique yet, although Small et al. (2003) and Jones and Meredith (1996) employed SEM techniques. All of the other studies in the literature have used MLM approaches to growth curves in personality (Helson, Jones, & Kwan, 2002; Jones, Livson, & Peskin, 2003; Mroczek & Spiro, 2003a; Roberts & Chapman, 2000). Therefore, this discussion describes in greater detail growth curve estimation within a MLM modeling framework (Singer & Willett, 2003; Willett & Sayer, 1994). First, there is a brief comparison of MLM versus SEM approaches to analyzing change.

When MLM modeling techniques for estimating change are employed, they are often called individual growth, or individual trajectory, models. The reason is because individual-level trajectories are estimated, as opposed to modeling data primarily from sample-based variances and covariances, as is done in structural equation modeling (SEM) approaches to the analysis of change. When SEM is used, the term latent growth curve (LGC) is usually employed. However, the advantage gained in using LGC over MLM is that the former permits measurement models that allow superior estimation of error via latent variables; another is that mediation can be examined more directly via path models. However, the advantage gained in using MLM over LGC is flexibility in handling missing data and unequal spacing between
measurement occasions. In many longitudinal studies, the intervals between measurements are often unequal across participants, either by circumstance or design, creating spacing between measurement occasions that are of varying length. MLM approaches have no problem with such data (Singer & Willett, 2003). Researchers should weigh the relative importance of flexibility in handling missing data versus superior estimation of measurement error in making a decision about whether to use MLM- or SEM-based approaches to growth curves. However, the available data may make this decision for the researcher (e.g., Mroczek & Spiro, 2003a).

GROWTH CURVES IN A MULTILEVEL MODELING FRAMEWORK

The MLM modeling approach to growth curves is described in this section in a more formal way. Yet, before applying such a model, the researcher must obtain data of a particular quality. Growth curve models require longitudinal data that contain at least three measurement occasions for all or most persons. Over 40 years of commentary has made clear that two measurement occasions are suboptimal for estimating change, in particular prohibiting the accurate estimation of rate of change, or slope (Raudenbush & Bryk, 2002; Rogosa et al., 1982; Singer, 1998; Singer & Willett, 2003). To carry out growth modeling adequately, the minimum number of measurement occasions required is three, although for estimation of curvilinear models (e.g., quadratic, cubic) more waves are required.

Once at least three measurement occasions have been obtained, the data must be arranged in “person-time” (or “person-period”; Singer & Willett, 2003). This requires nesting measurements within persons. Each measurement occasion for a person must be placed on a separate row in the data matrix, with the participant ID serving to identify the multiple observations on a single individual during the analysis. In essence, individuals have their own data matrix that is nested within the larger data matrix. In this type of data arrangement, participants can vary not only with respect to length of measurement interval, but also with regard to number of measurements. Some people may have three measurements, others four, still others five or more, and some individuals may have only one or two (incidentally, this is not a problem if data are missing at random). This reflects the reality of longitudinal studies, where participants are often not available at the desired times of measurement, or drop out during the follow-up period. This kind of variability in spacing of measurements, common in long-term studies, present no data analytic problem for growth curves estimated in a MLM modeling framework. However, it violates key assumptions in the repeated measures ANOVA model, and also poses some difficulties for latent growth models estimated via SEM.

Fixed Effects

The MLM approach to individual growth models yields fixed and random effects. Fixed effects are parameters (coefficients) that characterize the overall trajectory for the sample. Random effects are parameters that characterize the variability around the fixed effects (i.e., interindividual differences). In a simple linear growth curve model, where there is no quadratic (curvature) term, there are two fixed effects, an intercept and a slope.
The intercept is the average amount of outcome (e.g., extraversion, conscientiousness) where the temporal metamer (time, age, etc.) equals zero. If the temporal metamer is years passed since an event (e.g., birth, baseline assessment, intervention), then the intercept defines the leftmost point of the trajectory. It is where the growth curve or trajectory passes through the y-axis. However, if age is the temporal metamer, then the intercept is the amount of that personality dimension when age equals zero, and it obviously makes little sense to think of a newborn having developed a psychological construct such as extraversion or conscientiousness.

Therefore, it is often desirable to re-center the temporal variable in order to place the zero point at a more conceptually meaningful spot (Biesanz, Debb-Sossa, Papadakis, Bollen, & Curran, 2004). This could be the mean entry age of people in a longitudinal study, the mean overall age across all time points, or even the mean age at study exit. The temporal metamer could also be person centered, in which each participant’s personality measurements over time are centered at a value specific to each person, for example, their mean age across all occasions. In such a model, change in personality is interpreted as change from an individual’s own average. It is the amount that individuals vary from themselves over time. By contrast, re-centering age around the grand mean for all people in the study has the effect of placing the intercept in the middle of the entire age distribution. As a result, the intercept is the predicted amount of the personality dimension at a fixed age. Grand mean and person mean centering are the most commonly used re-centering techniques in growth modeling, and each has its advantages and disadvantages. Regardless of the choice a researcher makes, re-centering should have the effect of improving interpretation of the intercept or average level (Biesanz et al., 2004).

The fixed effect for slope is the amount of change in the personality dimension of interest, per unit of time. If time is clocked in years, then the slope represents amount of personality change per year. The fixed effect for slope quantifies rate of change. Together, the intercept and slope define the shape of the overall trajectory, if it is purely linear. This tells if a personality variable increases, decreases, or remains stable over a period of time. It also tells if personality increases quickly, or decreases slowly. These fixed effects for intercept and slope, however, define only the overall, sample-level trajectory; but MLM models yield more than this. They also estimate the individual differences around the intercept and slope. These are the random effects, and lead some to label these techniques “random coefficient models.”

Random Effects

Random effects estimate individual variability around a growth parameter. The random effect for the intercept is the estimate of variance around the intercept parameter. It simply captures individual differences in the level of the personality variable that is examined. This is usually not very interesting because, at least in the case of personality dimensions, researchers usually know that they differ significantly across people. What is typically much more interesting is the random effect for slope, because it reveals if rate of change varies by person. Imagine change in neuroticism over a 20-year period. Some people may have trajectories that rise or fall steeply; these individuals possess large slopes. Others display less steep slopes. Others still
may show no change, and possess flat (zero) slopes over time. A slope of zero implies stability. What this illustrates is a range of slopes—some large, some small, some zero, some positive, and some negative. Such individual differences in rate of change exemplify the aforementioned life-span principle of interindividual differences in intrapersonal change (Baltes et al., 1977).

Linear and Quadratic Growth Models in Personality

The initial model to be estimated in an analysis of change is an unconditional means model (Singer & Willett, 2003), also known as an intercept-only model (Raudenbush & Bryk, 2002). This model fits only an overall mean and the variance around that mean across all persons and measurement occasions. The time variable is not included in the equation at this step (Singer & Willett, 2003). The fixed effect in the unconditional means model is simply the grand mean across all measurements. One random effect, the variance around the intercepts, is estimated as well. This captures the between-person differences in intercept, or simply, the individual differences in level of the personality variable of interest, irrespective of measurement occasion. The remaining variability is the within-person variance, plus error. These estimates of between- and within-person variances are useful in that the former tells how much of the variability is due to between-person differences, whereas the latter represents how much people vary from themselves. The unconditional means model also provides a benchmark that the researcher can use to evaluate successive models (e.g., by comparing a measure of model fit such as the log likelihood or the Akaike information criterion; Raudenbush & Bryk, 2002).

The next step is to add the time variable into the equation. This is the linear growth model. If time is clocked via age, then a formal definition of the model using extraversion can be expressed as:

\[
\text{Extraversion}_i = \pi_{0i} + \pi_{1i} (\text{age}_i) + \epsilon_i
\]  

(1)

The amount of extraversion for individual \(i\) at measurement occasion \(j\), is a function of the person's age at that measurement occasion \(\text{age}_i\). The intercept, \(\pi_{0i}\), is the predicted amount of extraversion where age = 0 (or if recentered, at some age). The linear coefficient, \(\pi_{1i}\), is the rate of change (slope); it is the predicted annual amount of change in extraversion for person \(i\). \(\epsilon_i\) represents the errors on each person \(i\) at occasion \(j\). In a sample, each participant's trajectory is described by this equation. Together, these intercepts and slopes define the overall, sample-level intercept and slope, that is, the fixed effects. The variability in intercepts and slopes across \(i\) persons are the random effects.

The linear growth model may prove adequate for characterizing change in some personality variables, but it is possible that a more complex model is required for others. Adding a squared function of the temporal variable to the linear growth model creates the quadratic growth model, which estimates curvilinearity. More formally, and again using extraversion, the quadratic model is expressed as:

\[
\text{Extraversion}_i = \pi_{0i} + \pi_{1i} (\text{age}_i) + \pi_{2i} (\text{age}_i^2) + \epsilon_i
\]  

(2)
The quadratic coefficient, \( \pi_{ij} \), estimates amount of curvature for person \( i \). Note that three fixed effect parameters are estimated in the quadratic model: intercept, slope, and curvature. Due to the estimation of an extra term, it is recommended that four or more measurement occasions be used, a number larger than the usual minimum of three. A researcher can fit a MLM model with at least two or three observations on some subjects, as long as some portion of the subjects have four or more occasions to permit estimation of the Level 1 model. Four occasions, at minimum, are required for the quadratic model. Similarly, if cubic functions of time are estimated, then to test for a second bend in the curve, at least five measurement occasions are required. In any case, the usual progression in growth curve modeling is to test simpler models first, and then gradually move toward more complex models, if higher order models are conceptually justified. An unconditional means model should be estimated first, then a linear growth model, then a quadratic growth model (Singer & Willett, 2003). As argued elsewhere (Mroczek & Griffin, in press) in the behavioral sciences, complex phenomena such as cubic growth are rare, and it is rarer still to find theory that predicts such phenomena.

**EXPLAINING INDIVIDUAL DIFFERENCES IN PERSONALITY CHANGE: LEVEL 2 MODELS**

The linear and quadratic growth models described in the prior section are Level 1 models (Raudenbush & Bryk, 2002). In the language of multilevel modeling, they reside at the first level; fundamentally, they describe within-person the temporal pattern of a personality variable (although certain between-person parameters are estimated as well). Even the fixed effects, which reflect sample-level parameters, are nevertheless based on the within-person relation between time or age and a personality dimension. If the slope or curvature variance (random effects) is significant at Level 1, then the investigator may go on to Level 2 models. Level 2 models introduce predictors or other explanatory variables to account for the observed individual differences in personality change. These models can potentially explain why some people change on a personality dimension whereas others remain stable.

The use of Level 2 models is illustrated in a recent study that applied individual growth models to personality trait data (Mroczek & Spiro, 2003a). Death of spouse was used to predict change in neuroticism over a 12-year period in older adults. The Level 1 model determined that there was statistically significant variability among persons in neuroticism slopes over 12 years. At Level 2, death of spouse was introduced into the model as a between-person variable. In the sample of older men, some had experienced the death of their spouse within the 2 years prior to the 12-year longitudinal period, and others had not. This dichotomous variable significantly predicted both intercept and slope of neuroticism. People whose spouses had died started out higher on neuroticism than those who had not endured this tragic life experience, but then displayed slopes that went down at a faster rate over the next 12 years. In other words, neuroticism was temporarily elevated immediately after the death of a spouse, but then reverted back in the years following. The between-person variable "death of spouse" accounted for some, but not all, of the individual variability in neuroticism slopes over a 12-year period. This finding indicates that rates of change in traits can be modified depending on life circumstances. It also speaks to
the possibility that certain traits, like neuroticism, may have components that are sensitive to context, in addition to components that are stable over time.

WHAT GIVES RISE TO INDIVIDUAL DIFFERENCES IN INTRAINDIVIDUAL PERSONALITY CHANGE?

Various factors can bring about differences among people in personality trajectories. People differ with respect to the environments to which they are exposed, their genetic makeup, and the active ways they bring about change in themselves or their environments (Caspí & Roberts, 2001; Lerner & Busch-Bossen, 1981; Levenson & Crumpler, 1996; Roberts & Wood, chap. 2 in this volume). These individual differences in external and internal factors, as well as interactions between them, may produce individual differences in the developmental trajectories of personality dimensions.

A number of contextual variables have been shown to influence personality change. Cramer (2003) found that defense mechanisms predict change in Big Five traits over long-term periods (several years). Roberts and Chapman (2000) documented that role quality influences personality change. Clausen and Jones (1998) hinted that disorderly careers and divorce may disrupt personality stability and bring about trait change. Martin and Mroczek (in press) indicated that work and family overload in adults at midlife are associated with mean differences in Big Five traits when compared to younger or older adults. Additionally, personality trajectories may vary due to environmental-based variability associated with history-graded normative influences that may be indicated by birth cohort (Baltes, 1987; Nesselroade & Baltes, 1974). Indeed, evidence has suggested that there are birth cohort differences in level of (Twenge, 2000, 2001) and rate of change in extraversion and neuroticism (Mroczek & Spiro, 2003a).

Additionally, age-graded life events, especially relationship events, can alter personality trajectories (Neyer & Asendorpf, 2001). In older adulthood, death of spouse or remarriage are relationship events that can influence personality trajectories (Mroczek & Spiro, 2003a). Age-graded changes in health may also affect personality trajectories. If individuals’ health deteriorates to the point where they are unable or unwilling to socialize with others, then this could create a shift toward less extraversion, greater neuroticism, and perhaps less agreeableness.

The previous findings and hypotheses illustrate the life-span developmental tenet of plasticity or adaptability (Alwin, 1994; Baltes, 1987; Roberts, 1997), which states that developmental constructs such as personality retain some degree of suppleness and malleability throughout the life span. Roberts (1997) argued that personality is an “open system” that remains sensitive to contextual life experiences and socialization processes through the life span, and the aforementioned studies have borne this out to some extent. The notion of plasticity, however, should not be taken too far, lest researchers make the claim that personality dimensions are as malleable as mood. Indeed, some personality dimensions may be more changeable than others, and Hooker and McAdams (2003) offered a model that makes explicit predictions about what types of personality constructs should be more likely to remain stable and what types should show change over the life span. For example, they argued that social-cognitive personality constructs such as mas-
tery, goal strivings, and coping styles are more likely to change than traits constructs such as extraversion or neuroticism.

Most of the theoretical and empirical work on what predicts personality change has focused on environmental or contextual explanations. Biological influences have generally been ignored. This is unfortunate, because there is new evidence that individual differences in genes (whether or not a person possesses a particular variant), and individual differences in exposure to particular contexts (whether or not one was abused as a child), as well as their interaction, give rise to individual differences in certain personality outcomes, such as antisocial behavior and tendency toward depression (Casp et al., 2002, 2003). Similar combinations of genetic and contextual factors may predict individual differences in long-term personality trajectories as well.

Explaining variability in personality trajectories, especially in rates of change, is an important task facing personality development researchers. Yet those who have attempted to account for such individual differences in change have often run into difficulties. Frequently, the hypothesized predictors do not predict well. One reason for this may be that personality trajectories are more responsive to idiosyncratic factors such as genetic makeup or nonnormative life events than normative or age-graded biological or contextual events (Baltes et al., 1977). Variability in personality trajectories may reflect, to some degree, very specific circumstances in individual lives, or individually distinct interventions, such as psychotherapy, pharmacologic therapy, or personal traumas. One way around this is to identify people whose trajectories show either great change or stability, and determine what environmental or biological factors may have promoted such high stability or change. Another possibility is to incorporate time-varying covariates into personality growth curve models. This refers to variables with values that may change over time, and are entered into the growth curve model at Level 1 as a covariate. Such models have been used in modeling change in well-being over time (Lucas, Clark, Georgellis, & Diener, 2003). Life events or health events are placed in the model when they occur, allowing for more proximal prediction. These kinds of models eventually could prove superior to static-predictor (between-person, or Level 2) models in accounting for individual differences in personality trajectories, because they mimic the vicissitudes of life more accurately.

**SHORTER-TERM CHANGE IN PERSONALITY: PROCESS APPROACHES**

Up to this point, the focus has been on prior research and theory relevant to long-term personality stability and change. Work in this area has focused on durations that last years. Yet, many other areas of personality conceptualize change that occurs over week, days, or even within a single day. The process approach to personality focuses on these shorter durations. Although it often assesses change, it is not change in the sense of trajectories declining over periods of years. The type of change assessed in the process approach is dynamic action. This is in part a remnant of the process approach's lineage in classic behaviorism, with its emphasis the unfolding of behavior over short periods of time (e.g., studies of learning curves and reinforcement schedules). One of the hallmarks of the process approach, daily diary and experience sampling studies,
Similarly seek to determine the characteristic ways that people respond to different situational stimuli. The trait approach, with its emphasis on structure, is less concerned with reactions to situations, and in some ways, the structure (trait) and process approaches to personality reflect the distinction immortalized in Cronbach’s (1957) “two disciplines of scientific psychology” (Mroczek & Spiro, 2003b).

The two approaches, structure and process, are like the structural and dynamic components of an automobile. Cars have structural components that do not contain any moving parts, such as the chassis, frame, headlights, windshield, and windows. These make up the basic structure of a vehicle, and are analogous to basic structural features of personality such as the Big Five traits (Goldberg, 1993). Cars also have dynamic components that either contain moving parts or involve a chemical or physical process. Examples of dynamic components include the transmission, the steering and braking systems, and the internal combustion engine. These parts have structural elements, of course, but they differ from purely structural elements in that they involve processes that unfold over time. To brake a car takes time and invokes a dynamic process as calipers are engaged, friction is applied, and wheels are slowed down gradually. Braking is a process (governed by physical principles) in this sense. Other dynamic components involve chemical processes. Inside an internal combustion engine, gasoline is fed into cylinders where the dynamic action of pistons explodes the fuel, creating heat and energy that powers and propels the vehicle. Although this process involves structures, such as the engine block itself, it is in essence a chemical reaction. The burning of fuel to create energy and motion is not structural, but a process that occurs over a period of time, in this case, over a period of seconds. In essence, there is a stimulus (fuel), action (explosion of fuel), and a response (energy). This also implies a time element; a stimulus occurs first, some action happens, and there is a response—this takes some time, even if it is just seconds.

Personality also involves stimulus-response processes such as those occurring inside a car. Coping styles are processes invoked by stressors and unfold over time (Lazarus & Folkman, 1984). The stimulus (stressor) leads to action (the feeling of stress or threat) and a response (negative affect, problem-solving behavior). This is not a structure, but structural elements of personality, such as trait neuroticism, certainly influence this reaction to stimuli that encompass coping, as well as reactivity to stress (Almeida, in press; Bolger & Schilling 1991; Mroczek & Almeida, 2004; Tennen, Affleck, Arami, & Carney, 2000). Defense mechanisms also involve stimuli that invoke a response (Cramer, 2003). The response is the defense itself, and the process of stimulus invoking response unfolds over time, although usually a short period of time. Goal attainment and goal-focused behaviors, a popular set of variables among social-cognitive personality researchers, involve processes that occur over longer periods of time, usually days or weeks, making daily diary and experience sampling methods common in this area (Christensen, Feldman-Barrett, Bliss-Moreau, Lebo, & Kaschub, 2003; Fleson, 2001, 2004; Fleson & Jolley, chap. 3 in this volume). In all these examples, the process is dynamic, involving a sequence of events. Just as the physical and chemical processes that power a car are not discrete events but rather a sequence of events, personality processes involve particular sequences of events over some period of time.

Cattell (1966) recognized this distinction between structure and process, and incorporated these ideas in his concept of the data box. In the three-dimensional data...
box, persons make up one dimension, occasions (or situations) a second, and variables a third. Pairs of data box dimensions can be combined to represent a distinct type of data and a unique way of conceptualizing personality. For example, R-technique focuses on variability across persons on a set of variables, holding occasion constant. R-technique is the essence of the structure approach to personality. It concentrates on variability across persons, or between-person variance. Or, the researcher may choose to focus on within-person variability across occasions (or situations), on a single variable; Cattell called this S-technique. S-technique is the essence of the process approach to personality. It concentrates on variability within persons. The data box, although 40 years old, is an invaluable tool for understanding how structure and process approaches to personality relate to one another (Mroczek & Almeida, 2004; Mroczek & Spiro, 2003b; Nesselroade, 1988). Despite this value, few have used the Cattellian data box to understand personality development, although Ozer (1986) made the most thorough and notable attempt thus far.

Long-Term Change in Personality Processes

An important issue in personality development concerns how structure variables such as traits and process variables, such as goal-focused behavior, change over time (Hooker & McAdams, 2003). Over the past 25 years, there have been many studies examining stability and change in structure variables, in particular, traits (Costa & McCrae, 1988, 1994). Yet, personality processes have never been examined longitudinally. This reason for this is fairly simple. Traits are relatively easily assessed at a given measurement occasion. Processes are not so easily assessed at a given time point because they usually involve several variables that act in a sequence. For example, stress reactivity is a process. A person reacts to a stressor with some level of negative emotion, which varies with the severity of the stressor as well as with the person’s characteristic sensitivity to stressors (Bolger & Schilling, 1992; Lazarus & Folkman, 1984; Mroczek & Almeida, 2004). This process is somewhat involved, and usually involves daily, or multiple daily, measurements for a period of a week or more (Ettensohn, Nesselroade, Featherman, & Rowe, 1997; Tennen et al., 2000). Such daily diary or experience sampling studies are difficult and expensive to carry out, and once completed, samples are rarely followed up to go through the ordeal once again. As a result, there are no long-term longitudinal studies of processes in personality (e.g., over many months or years).

However, this is changing. About 15 years ago, Nesselroade (1988, 1991) recognized that processes do not necessarily remain stable over time, and indicated the need to invent methodologies to deal with them over the long term. He proposed a “measurement burst” design, in which intensive periods of measurements (hourly, daily, or weekly assessments) are nested within long-term longitudinal studies (Nesselroade & Boker, 1994). In recent years, a few investigators (including ourselves) have begun deploy measurement burst designs, but it is too early for this work to have borne fruit.

MACRO AND MICRO LINKAGES

One of the interesting possibilities of such measurement burst designs are macro-micro linkages. Is variability at the daily or weekly level related to variability
at the yearly level? To take an example, is daily variation in positive affect over the course of a week related to variability in positive affect over the course of a year? Are people who display high affect variability over the course of a week the same people who display high affect variability over the course of a year or a decade? Such symmetry has been labeled ergodicity (Molenaar, Huizenga, & Nesselroade, 2003). Ergodicity is a concept from physics indicating that a process that holds for a given entity (e.g., a molecule) holds for a much larger grouping of entities. For example, if the speed at which a particular molecule travels through the air is the same as the speed that a whole group of these molecules travel through air, then ergodicity holds. If the two levels—individual and group—act in dissimilar ways, then it is nonergodic. Molenaar et al. (in press) argued that there are parallels in life-span development. Some variables or processes in human development behave in an ergodic fashion, whereas others do not.

An example of ergodicity may be useful here. Take exercise and blood pressure. At the between-person level, individuals who exercise more have lower blood pressure than people who exercise less (a negative correlation). At the within-person level, on occasions when individuals exercise their blood pressure is higher than occasion when they are not exercising (a positive correlation). In fact, this within-person process usually leads to between-person differences in the case of exercise and blood pressure. It may be the case that personality traits and personality processes display similarly ergodic processes. Perhaps the process of handling stress over and over again (e.g., coping processes) actually alters individual differences in certain traits over time (e.g., neuroticism).

The findings of long-term personality growth curves may mimic some of the findings of short-term personality processes and dynamics. Fleeson (2004) argued that within-person variability provides a new frontier for personality psychologists. He spoke mainly of short-term variability, especially in terms of responses to situations. However, such short-term variability may be related to long-term variability. Such studies would bring together traditional personality psychologists interested mainly in structure or process (or both), with those studying long-term personality development. As covered earlier, there is a nascent literature on growth curve models of personality dimensions. There is a maturing literature on dynamic processes, using daily diary and experience sampling designs, but such processes have not been modeled in long-term longitudinal studies.

Two types of designs bring together long- and short-term models. The first is a design in which a single daily diary or experience sampling study is nested within a multyear longitudinal study. Variability at the daily level can be used to predict (or be predicted by) variability at the annual level. The second is one in which multiple daily studies are nested within the multyear longitudinal study (e.g., Nesselroade & Boker's measurement burst design). Then, daily variation is modeled on two levels, short term and long term; then the latter results are used to predict (or be predicted by) long-term change in nonprocess variables such as traits. In such designs, structure and process variables can be modeled simultaneously. Researchers could look at how structures influence processes and repeated processes may affect structures. Modeling of both in the same study would allow structure and process approaches to come together.

However, statistical challenges await those who make the first attempts at these new types of analyses. It means modeling change on both the left- and right-hand sides
of the equation, and in some cases, multilevel change on one side of the equation. If short-term dynamics (as assessed in an experience sampling design) are used to predict long-term change (in a growth curve design), then change is being modeled on both the independent and dependent variable sides. Certain structural equation models can handle such complex data structures, but often have unrealistic assumptions or restrictions. For example, multiple diary studies would almost necessarily be collected at different times from measurements of nonprocess variables such as traits. This would create variable spacing problems that could present difficulties for structural models. On the other hand, the modeling of such complex change would likely create challenges in an MLM framework. Substantive investigators will have to work closely with developmental methodologists and statisticians to formulate adequate models for answering these interesting but complicated research questions.

FUTURE DIRECTIONS

Longitudinal studies that model intraindividual personality stability and change are increasing in number, and will become more common. As more longitudinal databases accumulate, and as statistical techniques for analyzing these data diffuse more widely, the area of personality development will see many more sophisticated studies in the future. Specifically, four types of studies will be particularly valuable.

First, researchers have applied growth curve and latent growth models to only a handful of personality dimensions so far (Helson et al., 2002; Jones et al., 2003; Jones & Meredith, 1996; Mroczek & Spiro, 2003a; Roberts & Chapman, 2000; Small et al., 2003.) Most have been traits, although growth models of certain major traits (e.g., impulsivity) have not yet been carried out. Nevertheless, the trait domain has seen the largest number of long-term longitudinal studies and application of growth models of change. Other nontrait areas of personality have been very slow to carry out long-term studies of the constructs of interest, let alone apply modern techniques for analyzing change.

Second, personality development researchers need to continue examining potential predictors of change. For some personality dimensions, undoubtedly change occurs in lockstep, that is, everyone changes in the same direction and at the same rate. Yet these dimensions will likely be in the minority, and most will be governed by the life-span principle of individual differences in intraindividual change (Baltes et al., 1977). Among dimensions that show individual differences in change, with some people changing at various rates (and some not changing at all), such individual variability must be accounted for.

Further, both environmental and biological predictors need to be investigated and time-varying predictors must be utilized. Some predictors will be static and unchanging over time, such as gender or ethnicity. These static variables may prove to be valuable predictors, accounting for some of the individual differences in a personality dimensions pattern of change (e.g., women may rise faster on conscientiousness than men). However, more interesting is the possibility that time-varying covariates shift either level or rate of change in personality dimensions. Perhaps the best recent examples, using a well-being dimension, are two studies by Lucas, Clark, Georgellis, and Diener (2003, 2004). In Lucas et al. (2003), marital status, which varies over time as many people slip in and out of marriage (and often back again), was used to predict
changes in long-term life satisfaction. Lucas et al. (2004) used employment status, which also can vary over time, to predict changes in life satisfaction over a 15-year period. Use of time-varying covariates are an exciting new vista for the analysis of change in personality. Another exciting new technique is the coupled-change growth model (MacCallum, Kim, Malarkey, & Kiecolt-Glaser, 1997; Sliwinski, Hofer, & Hall, 2003), which can permit the personality development researcher to examine if change in one dimension is related to change in another dimension. For example, Mroczek and Spiro (2003a) documented significant individual differences in the rate at which extraversion and neuroticism change. These were done in separate growth curve models, but an interesting further question is whether changes in one are related to changes in the other. A coupled-change model could answer this question.

A second future direction is concerned with potential predictors of personality change. The third future direction proposes the use of personality change as a predictor itself. As noted in several studies (Helson et al., 2002; Jones et al., 2003; Jones & Meredith, 1996; Mroczek & Spiro, 2003a; Small et al., 2003), some personality dimensions display individual differences in rate of change. Are these differences in rate of change themselves predictive of important outcomes? For example, it is known that levels of some personality traits at a given point in time predict subsequent mortality (Friedman et al., 1993; Wilson, Mendes de Leon, Bienas, Evans & Bennett, 2004). However, does change in these traits (impulsivity, neuroticism) also predict how long a person will live? Also, decline in particular cognitive dimensions predict later mortality. This is the well-known gerontological finding of terminal decline (Small & Backman, 1998). Are there similar effects for decreases or increases in personality dimensions? Does a sharp decline in extraversion signal impending death? Future studies of change in personality should take up these questions, although there are certain statistical challenges that must be overcome. The suggested analyses would involve a combination of growth curve with proportional hazards models (Cox, 1972). Such a combination would require a less desirable two-step process, or some innovative mixing of the two models to allow simultaneous estimation. There has been some developmental work on integrating latent variable models with proportional hazards models, but it has not addressed the specific issue of using change parameters (e.g. slopes) as predictors of mortality (Masyn, 2003). Nevertheless, there is promise that, eventually, researchers will be able to estimate change and use parameters of change to predict mortality and other discrete events in a simultaneous model.

Fourth, and finally, what is the relation, if any, between microlevel change (daily level variation) and macrolevel change (long-term growth curves)? This will also help to bring together structure and process (person and situational) approaches to personality. The statistical challenges inherent in such models have already been discussed, but they are well worth solving, as they will provide a wealth of valuable results that could transform not only the area of personality development, but of personality psychology itself. Indeed, each of the four areas of future direction have such potential.

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9. MODELING INTRAINDIVIDUAL STABILITY AND CHANGE


