Genetic and Environmental Influences on Personality Trait Stability and Growth During the Transition to Adulthood: A Three-Wave Longitudinal Study

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During the transition to adulthood individuals typically settle into adult roles in love and work. This transition also involves significant changes in personality traits that are generally in the direction of greater maturity and increased stability. Competing hypotheses have been offered to account for these personality changes: The intrinsic maturation hypothesis suggests that change trajectories are endogenous, whereas the life-course hypothesis suggests that these changes occur because of transactions with the social environment. This study investigated the patterns and origins of personality trait changes from ages 17 to 29 using 3 waves of Multidimensional Personality Questionnaire data provided by twins. Results suggest that (a) trait changes were more profound in the first relative to the second half of the transition to adulthood; (b) traits tend to become more stable during the second half of this transition, with all the traits yielding retest correlations between .74 and .78; (c) Negative Affectivity declined over time, and Constraint increased over time; minimal change was observed on agentic or communal aspects of Positive Emotionality; and (d) both genetic and nonshared environmental factors accounted for personality changes. Overall, these genetically informed results support a life-course perspective on personality development during the transition to adulthood.

Keywords: transition to adulthood, personality development, behavior genetics, personality traits

The transition to adulthood between the ages of 18 and 30 involves significant psychological development with regard to intimacy, identity, work, and parenthood (see Arnett, 2000, 2007). These changes are also accompanied by both stability and change in personality traits (e.g., Blonigen, Carlson, Hicks, Krueger, & Iacono, 2008; Donnellan, Conger, & Burzette, 2007; Roberts, Caspi, & Moffitt, 2001; Robins, Fraley, Roberts, & Trzesniewski, 2001). However, debates exist regarding whether exogenous or endogenous factors are more responsible for personality development during this period of the life span (Costa & McCrae, 2006; Roberts, Walton, & Viechtbauer, 2006b). Accordingly, the goal of this study was to evaluate genetic and environmental influences on

personality stability and change during the transition to adulthood using three waves of personality trait data. Specifically, we examined the etiological influences on stability and change in the higher order personality traits of the Multidimensional Personality Questionnaire (MPQ; Tellegen & Waller, 2008) using a sample of twins assessed in late adolescence (approximately age 17), emerging adulthood (approximately age 24), and young adulthood (approximately age 29).

Characterizing the Transition to Adulthood

Sociologists (Furstenberg, Kennedy, McLoyd, Rumbaut, & Settersten, 2004; Shanahan, 2000), demographers (Rindfuss, 1991), and psychologists (Arnett, 2000, 2007) have identified several themes that characterize the transition to adulthood. First, this transition takes time as individuals negotiate aspects of identity development and gradually assume adult roles and responsibilities (Arnett, 2004). In light of this fact, Arnett (2000) has proposed that the period of development from the late teens through the end of the 20s is a time of *emerging adulthood*. Indeed, he described the period of the early 20s as the "volitional years of life" (Arnett, 2000, p. 469) because individuals seem to spend considerable resources exploring issues of identity and intimacy. Second, on average, more demographic transitions occur during the years between 18 and 30 than any others in the life course (Rindfuss, 1991). Thus, by the age of around 30, most individuals have

assumed at least one of the major roles of adulthood, and therefore the 30s seem to mark the beginning of adulthood proper. Third, there appears to be a considerable amount of variability among individuals in terms of the sequencing of the life transitions between adolescence and adulthood (Rindfuss, 1991).

The salient developmental challenges and diversity of experiences people encounter in this phase of the life course suggest that the transition to adulthood represents an important period for research on personality development. Existing research suggests that many of the psychological changes that occur during this period tend to be in the direction of increased psychological maturity (Caspi, Roberts, & Shiner, 2005). Indicators of psychological well-being such as self-esteem appear to increase (Donnellan, Trzesniewski, & Robins, 2006; Galambos, Barker, & Krahn, 2006), whereas attributes such as depression, anger, and externalizing problems appear to decline (Arnett, 2000, 2007; Galambos et al., 2006). Consistent with these trends, personality trait change is generally positive: Traits become more stable in general (Roberts & DelVecchio, 2000), and individuals tend to decline in Negative Affectivity and show increases in behavioral constraint during the transition to adulthood (Blonigen et al., 2008; Donnellan et al., 2007; Roberts et al., 2001). Moreover, young adulthood appears to be the time in the life span when the majority of normative personality changes occur (Roberts, Walton, & Viechtbauer, 2006a). In light of these trends, Caspi et al. (2005) noted that "the causes of normative personality change are likely to be identified by narrowing research attention to the study of young adulthood" (p. 468).

Following this recommendation, we evaluated etiological influences on personality trait stability and change during the transition from adolescence to adulthood. Specifically, we assessed four broad personality traits assessed by the MPQ. Although arguments regarding the exact number of traits that best describe the broadest level of personality persist, diverse personality attributes can be organized around a relatively small set of higher order traits (Markon, Krueger, & Watson, 2005). It has been shown that candidate higher order trait models can be integrated such that they are not so much direct competitors as alternative ways of organizing personality dimensions within an integrated hierarchy (Church & Burke, 1994; Markon et al., 2005). The four factors that appear in more or less all structural models of personality involve Negative Emotionality or Neuroticism (NEM), Agentic Positive Emotionality or Extraversion (PEM–A), Communal Positive Emotionality or Agreeableness (PEM–C), and Constraint (CON; Caspi et al., 2005; Clark & Watson, 2008).

NEM involves a susceptibility to negative emotions as opposed to a tendency to be emotionally placid and adaptable. This domain appears to map onto neurobiological systems governing withdrawal behavior in the context of environmental threats (Watson, Wiese, Vaidya, & Tellegen, 1999) and represents a risk factor for psychopathology and interpersonal difficulties across the life span (Krueger, Caspi, & Moffitt, 2000; Watson, Hubbard, & Wiese, 2000). PEM generally involves the propensity for positive emotions such as happiness as well as behavioral surgency and vigor. This trait domain is associated with enhanced reward sensitivity (Lucas & Fujita, 2000) and extraverted, prosocial behavior (Ashton, Lee, & Paunonen, 2002). PEM has also been linked to neurobiological systems governing approach motivation (Depue & Collins, 1999). Agentic manifestations of this trait (i.e., PEM–A)

involve social potency as well as ambition in achievement-related domains, whereas communal manifestations (i.e., PEM–C) involve closeness to others, affiliation, and well-being (Humbad, Donnellan, Iacono, & Burt, 2010; Tellegen & Waller, 2008; Wiggins, 1991). CON involves the capacity to control or modulate one's behavioral reactions to internal states or external stimuli, to attend carefully and plan responsibly, and to be oriented toward long-term goals. Reduced CON is a risk factor for substance use and externalizing problems (Krueger et al., 2000) as well as general health risks across the life span (Bogg & Roberts, 2004). This dimension of personality has been linked to neurobiological markers of attentional focus and other frontal lobe functions (Nigg, 2000).

Characterizing Personality Stability and Change During the Transition to Adulthood

In addition to questions regarding which traits to assess, researchers studying personality development must also consider multiple kinds of personality stability and change (Caspi et al., 2005; Donnellan & Robins, 2009; Roberts, Wood, & Caspi, 2008). Each of these types of stability involves a different analytic method and interpretive meaning. The two most commonly studied types are *absolute* or mean-level stability and *differential* or rank-order stability.

Absolute (mean-level) stability refers to changes in group averages over time on a given trait. Absolute stability can be indexed directly with repeated-measures analysis of variance (ANOVA) models or growth curve frameworks (e.g., Vaidya, Gray, Haig, Mroczek, & Watson, 2008). During the transition to adulthood, age differences in absolute levels of personality traits seem to be well described by the *maturity principle* of personality development (Caspi et al., 2005) or the generalization that traits linked with self-control (i.e., CON) seem to increase, whereas traits linked with Negative Affectivity (NEM) seem to decrease during the transition to adulthood (Donnellan & Robins, 2009). That is, as individuals mature they become more able to control their impulses and less prone to negative emotions. These kinds of personality changes are concordant with the fulfillment of adult roles and converge well with existing developmental research concerning trends in well-being (Galambos et al., 2006).

Beyond these mean-level trends there may also be significant variability between individuals in their degree of change (i.e., individual-level change). Importantly, growth curve frameworks allow for the characterization of absolute stability and change in a way that also draws attention to intraindividual differences in change (Vaidya et al., 2008). For example, in a linear growth model, the fixed effect for the slope describes normative changes in terms of the average increase or decrease for the sample as a whole, whereas the random effect indicates the amount of variability around that average trend. Statistically significant variability around the slope, or, alternatively, a statistically significant random effect for the slope, indicates the presence of meaningful individual differences in change (see Mroczek, Spiro, & Griffin, 2006). Such variability points to the fact that some individuals increase in absolute trait levels, whereas others decrease in absolute trait levels.

Differential (rank-order) stability refers to the degree of consistency in the rank-ordering of individuals over time on a given trait.

This type of stability is most often indexed by retest correlations. Notably, such retest coefficients tend to increase across development before eventually reaching a plateau in middle to later life (ages 50–70; Roberts & DelVecchio, 2000). In other words, stability coefficients tend to be lower for adolescent samples than adult samples, a pattern that has been referred to as the *cumulative continuity principle* of personality development (Caspi et al., 2005). Moreover, personality maturity is temporally linked with increases in differential stability such that individuals who are lower in Negative Affectivity and higher in Constraint in adolescence tend to show more differential stability during the transition to adulthood (Roberts et al., 2001), and individuals with borderline personality disorder show less differential stability over time (Hopwood et al., 2009).

Despite notable consistencies in the general patterns of absolute and differential stability among personality traits during the transition to adulthood, there are also controversies (see Costa & McCrae, 2006; McCrae & Costa, 2008). The most active area of disagreement involves the explanation for personality maturation (i.e., change). One perspective argues that biologically based *intrinsic* processes underlie changes in personality in young adulthood (e.g., Costa & McCrae, 2006; McCrae & Costa, 2003, 2008), whereas another perspective argues that personality maturation is at least partially tied to participation in the social roles of adulthood (e.g., Roberts et al., 2006a; Roberts, Wood, & Smith, 2005). Consistent with this *life-course perspective*, some evidence links adult personality changes with contextual conditions such as work and romantic relationships (Neyer & Lehnart, 2007; Roberts, Caspi, & Moffitt, 2001, 2003; Roberts & Wood, 2006; although see McCrae & Costa, 2008, p. 168). A genetically informed approach is well suited to informing this broad debate because the intrinsic maturation perspective would seem to predict that most trait changes during the transition to adulthood are driven predominantly by genetic factors, whereas the life-course perspective would seem to predict that personality changes during this period are also tied to environmental factors (Bleidorn, Kandler, Riemann, Angleitner, & Spinath, 2009).

Genetically informed cross-sectional studies have made important contributions to personality psychology by demonstrating that higher order traits are substantially and similarly heritable but also influenced by nonshared environmental factors (those environmental factors that make siblings within the same family different; see e.g., Loehlin, 2001). However, longitudinal behavior genetic designs are needed to assess the genetic and environmental underpinnings of personality stability and change. In one such study, McGue, Bacon, and Lykken (1993) found that genetic factors were largely responsible for differential stability, whereas change was primarily influenced by the nonshared environmental factors among twins assessed twice around the ages of 20 and 30. Blonigen et al. (2008) used the first two waves of data analyzed in the current report to evaluate genetic and environmental contributions to personality development between ages 17 and 24. Bleidorn et al. (2009) used genetically informed growth modeling as applied to a mixed-age sample of German twins assessed at multiple waves. Both of these studies reported results consistent with the maturity hypothesis and found that genetic and environmental factors accounted for personality changes.

However, this emerging behavior genetic literature on personality development is limited in several ways. Most notably, al-

though it is widely recognized that multiple-wave studies provide the opportunity to employ more sophisticated methodological approaches (e.g., Biesanz, West, & Kwok, 2003), most genetically informed longitudinal personality research has used only two measurement waves. In fact, most phenotypic studies of personality development during the transition to adulthood have relied on two-wave studies (but see Vaidya et al., 2008, for an exception). Nonetheless, the application of growth curve modeling techniques to data sets with three or more assessments addresses important questions about personality development (Mroczek & Spiro, 2003). For example, such approaches can be used to test the adequacy of linear models of absolute growth and identify individual differences in absolute change. Twin studies that use this analytic approach are particularly important, as they can be used to decompose the origins of individual differences in change into genetic and environmental components.

In light of these advantages, the work of Bleidorn et al. (2009) represents a seminal contribution as the first multiwave behavior genetic study of personality trait stability. Nonetheless, this study assessed a relatively small sample of individuals who varied widely in age at first assessment. Thus, this work was limited in its ability to specifically characterize personality stability and change during the transition to adulthood. By comparison, the Minnesota Twin Family Study (MTFS) data, which sampled twins during this period, are well suited to address such issues and can potentially resolve contrasting views regarding the origins of personality stability and change. Specifically, given varying links of NEM, PEM–A, PEM–C, and CON to biological and environmental processes and their varying phenotypic patterns of personality development in previous research (e.g., Blonigen et al., 2008; Donnellan et al., 2007; Roberts et al., 2001; Vaidya et al., 2008), the degree to which the intrinsic or life-course perspective is supported may also vary by trait.

The Present Study

The present study was designed to address these gaps in current knowledge about the influences on personality change during the transition to adulthood. The specific goal of this project was to extend research on personality development during the transition to adulthood using three waves of data from a community sample of twins who were assessed in adolescence (mean age 17), emerging adulthood (mean age 24), and young adulthood (mean age 29) with the MPQ (Tellegen & Waller, 2008). This study offers an important extension of the previous report on personality stability and change from this sample (Blonigen et al., 2008) in its examination of an additional wave of data that was not yet available at the time of the Blonigen et al. (2008) report. This additional wave allows tests regarding the linearity of personality change during the transition to adulthood, such as whether more changes occur during the peak of emerging adulthood (e.g., ages 17 to 24) as opposed to the period between ages 24 and 29, when participants are more likely to have settled into adulthood. Moreover, this additional wave allows the application of analytic techniques used by Bleidorn et al. (2009) to understand genetic and environmental contributions to personality changes. Unlike Bleidorn et al., however, our data allow us to focus on the critical period of the life span when individuals are transitioning to adulthood. Accordingly, the results can more specifically adjudicate among intrinsic and

life-span perspectives on the underlying impetus for personality maturation during the transition to adulthood.

Method

Participants

Participants were same-sex male and female monozygotic (MZ) and dizygotic (DZ) twins from the Minnesota Twin Family Study (MTFS), which is a population-based sample of reared-together twins (Iacono & McGue, 2002). Zygosity was determined by parent and MTFS staff reports on physical resemblance and an algorithm that uses ponderal and cephalic indices and fingerprint ridge counts to assess similarity. When these estimates did not agree, a serological analysis was performed to confirm twin status. This study used MPQ data from a cohort born between 1972 and 1979 who were identified in Minnesota public birth records and recruited to participate at approximately 17 years of age (range = 16–18 years). Exclusion criteria included living more than a 1-day drive from the data collection site or serious cognitive or physical disabilities that would preclude participation. Of those recruited, 83% agreed to participate, and no significant differences were observed between participating and nonparticipating families or the Minnesota population more generally in terms of self-reported psychopathology or socioeconomic status (Holdcraft & Iacono, 2004; Iacono, Carlson, Taylor, Elkins, & McGue, 1999). However, MZ twins are overrepresented relative to DZ twins in terms of population incidence (Hur, McGue, & Iacono, 1995), and there was a slightly higher rate of agreement to participate among MZ families. At baseline there were 626 complete pairs of twins (women: $n_{MZ} = 223$, $n_{DZ} = 114$; men: $n_{MZ} = 188$, $n_{DZ} = 101$). Twins were reassessed at the average ages of 24 and 29.

Measure

Participants completed a 198-item version of the Multidimensional Personality Questionnaire (MPQ), and analyses focused on the four higher order MPQ traits: NEM (baseline $\alpha = .92$), PEM–A ($\alpha = .89$), PEM–C ($\alpha = .91$), and CON ($\alpha = .88$). At baseline, complete MPQ data were available for 1,111 participants ($n_{women} = 614$; $n_{men} = 497$); at age 24 there were 943 ($n_{women} = 553$; $n_{men} = 390$); and at age 29 there were 956 ($n_{women} = 505$; $n_{men} = 451$). Attrition analyses suggested that the baseline trait scores between those who continued versus those who dropped out at each follow-up were less than 0.10 SDs different on each of the four traits examined, suggesting that individuals who provided data at follow-ups were generally representative of the baseline sample. As in Blonigen et al. (2008), MPQ trait data were standardized with a T-scale metric using Wave 1 data.

Analyses

Phenotypic analyses.   Test–retest coefficients were used to indicate the degree of differential stability of personality traits over time. Growth curve analyses were used to estimate the degree of mean-level change in traits across the three waves, as well as individual variability in rates of change following procedures outlined in Kashy, Donnellan, Burt, and McGue (2008) for working with twin data. These models were fit using maximum-

likelihood estimation in AMOS 17.0. Slope paths were fixed to 0 for the baseline assessment, fixed to 1 for the third assessment, and estimated from the data for the second assessment (i.e., the same coefficient was estimated for both twins). This allows the model to estimate the extent to which change occurred during the first or second intervals given that an empirical value close to .58 (7 years/12 years = .58) would indicate linear growth over this time (see Preacher, Wichman, MacCallum, & Briggs, 2008, pp. 52–55). Intercept paths were fixed to 1 for each measurement occasion so that the intercept represents scores at the first assessment. Residuals were freely estimated at each wave (but fixed to the same value for each twin), and we specified a twin correlation between these residuals within measurement occasions. Twins were constrained to have equal intercept and slope parameters.

Biometric analyses.   Structural equation modeling of twin data is based on the difference in the proportion of genes shared between MZ twins, who share 100% of their genetic material, and DZ twins, who share an average of 50% of their segregating genetic material. MZ and DZ twin correlations are compared to estimate the relative contributions of additive genetic effects (a^2), shared environmental effects (c^2), and nonshared environmental effects plus measurement error (e^2) to the variance within observed behaviors or characteristics (i.e., phenotypes). Crucial to this methodology is the equal environments assumption, which assumes that MZ pairs are no more likely to share the environmental factors that are etiologically relevant to the phenotype under study than DZ pairs (Kendler, Neale, Kessler, Heath, & Eaves, 1993). Any differences in the MZ and DZ correlations are thus assumed to be due to differences in the genetic similarity of the corresponding twins.

To evaluate the origins of differential stability, we fitted a Cholesky decomposition model. Within a triangular, or Cholesky decomposition, model (see Figure 1), the variance within and the covariance between personality traits across each assessment are decomposed into their genetic and environmental components. In this model, the genetic, shared environmental, and nonshared environmental covariances can be standardized on their respective variances to produce genetic, shared environmental, and nonshared environmental correlations. These statistics reveal the extent to which a specific effect (e.g., the genetic effect) at one assessment is correlated with the same effect at another assessment. A genetic correlation of 1.0 would indicate that all genetic influences persist across assessments, whereas a correlation of zero would indicate no genetic overlap. This model thus enabled us to explicitly estimate the extent to which genetic and environmental influences contribute to the differential or rank-order stability of personality over time.

Biometric latent growth curve modeling was used to evaluate the origins of absolute stability and change (Neale & McArdle, 2000). The full biometric growth model is depicted in Figure 2. In this model, the variance in personality at any given assessment was decomposed into three portions, all of which were then further decomposed into their additive genetic, shared environmental, and nonshared environmental components. We first examined genetic and environmental contributions to the latent intercept (i.e., a_i, c_i, e_i), which captures individual differences at the first assessment. We next examined genetic and environmental contributions to variability in absolute-level changes in personality over time. The factor loadings identified in the phenotypic growth curve analyses (as described previously) comprised the slope's factor loadings at
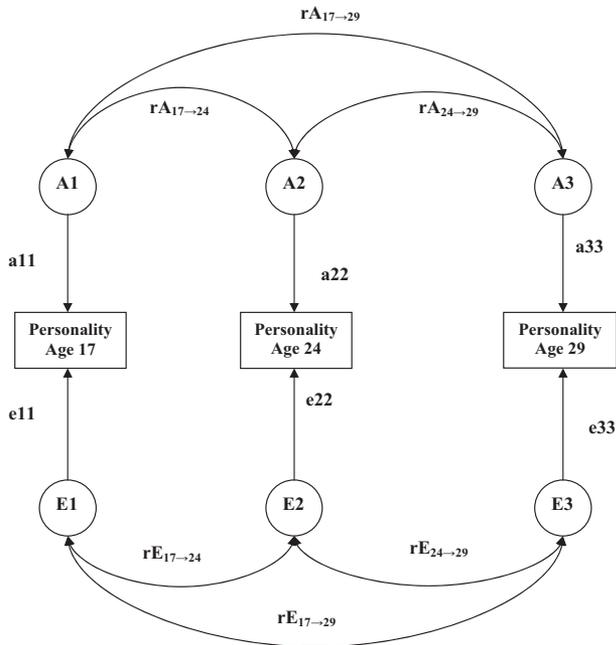
Figure 1. Path diagram of Cholesky decomposition model. The variance in liability to personality at each assessment is parsed into that that is due to additive genetic effects (A1, A2, and A3), shared environmental effects, and nonshared environmental effects (E1, E2, and E3). Though used in the model, shared environmental effects (C) are not represented herein for ease of presentation. Similarly, this path diagram represents only one twin in a pair (results are identical for the cotwin). Paths, which are squared to estimate the proportion of variance accounted for, are represented by lowercase letters followed by two numerals (e.g., a11). Genetic and environmental correlations are indicated by a lowercase r, followed by information regarding the specific correlation in question (e.g., $rA_{17\rightarrow24}$ indicates the genetic correlation between ages 17 and 24).

ages 17, 24, and 29 (i.e., 0, .75, and 1.0, respectively, for Constraint; 0, .84, and 1.0, respectively, for Negative Emotionality). We finally examined the genetic and environmental contributions to the variance remaining at each assessment after accounting for the effects of the intercept and slope factors (i.e., a_1, c_1, and e_1 at Time 1; a_2, c_2, and e_2 at Time 2; and a_3, c_3, and e_3 at Time 3, respectively).

To address incidental missing data, we made use of full-information maximum-likelihood estimation fit to raw data for both the Cholesky and the latent growth curve models, which produce less biased and more efficient and consistent estimates than techniques like pairwise or listwise deletion for missing data (Little & Rubin, 1987). Mx (Neale, 1997) was used to fit the models to the raw data. When fitting models to raw data, variances, covariances, and means of those data are freely estimated by minimizing minus twice the log-likelihood (–2lnL). The –2lnL under this unrestricted baseline model is then compared with –2lnL under more restrictive biometric models. This comparison provides a likelihood-ratio chi-square test of goodness of fit for the model, which is then converted to Akaike's information criterion (AIC; Akaike, 1987; AIC = $\chi^2 - 2df$), the traditional fit index of behavior genetics research. The AIC measures model fit relative to parsimony. Better fitting models have more negative values.
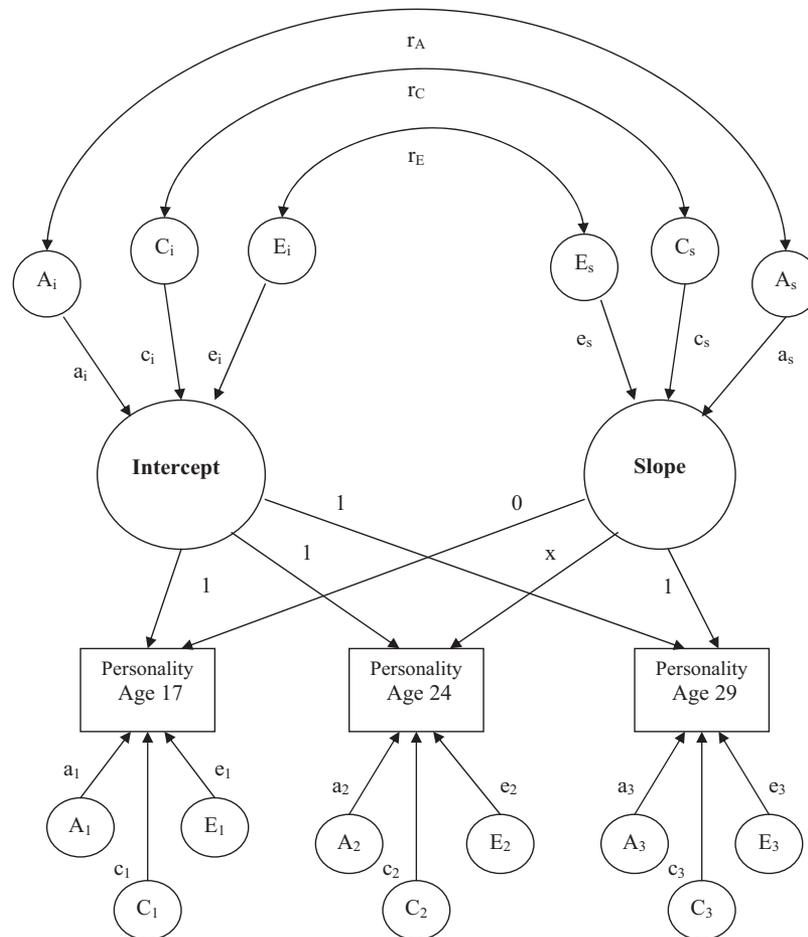
Results

Phenotypic Results

Differential stability and change. Stability coefficients are reported in Table 1 for the three intervals under investigation (ages 17–24, 24–29, and 17–29). These results were consistent with previous studies in suggesting substantial differential stability in personality traits in general, with 12-year correlations ranging from .49 to .57. More change occurred during the first wave of the study (range = .52–.62) relative to the second (.74–.78), consistent with the cumulative continuity principle of personality development. Overall, the magnitude of differential stability was similar across traits.

Absolute stability and change. Observed changes in the absolute levels of traits (see Table 1) were generally consistent with the maturity principle of personality development. Figure 3 plots changes in all four traits over the course of the study, with trait values standardized at the baseline assessment. NEM declined substantially in the first interval and more modestly in the second. CON tended to increase, with changes again being more dramatic in the first than the second interval. PEM–A and PEM–C increased slightly, but the trajectories of these aspects of PEM were somewhat different: Whereas PEM–A increased very modestly across both intervals, PEM–C increased during the first interval and decreased very modestly during the second. The overall results, however, suggest that much more developmental change occurs for NEM and CON relative to PEM-linked traits.

Greater individual-level change also occurred on NEM and CON. Individual-level variability can be conceptualized as the number of individuals who reliably change on a given variable over time (Jacobson & Truax, 1991). Using the short-term retest coefficients provided by Tellegen and Waller (2008; i.e., .89 for all traits), 50% of the sample reliably (i.e., >2 *SE*s) changed on NEM over the course of the study, 43% changed on CON, 34% changed on PEM–A, and 36% changed on PEM–C. However, these results also suggest that, although most of the changes on NEM and CON were in a similar direction (46% out of 50% of those who changed on NEM showed decreases; 38% out of 43% showed increases on CON), change in PEM was the result of both individuals who increased and those who decreased on PEM–A (18% increased and 16% decreased) and PEM–C (13% increased and 23% decreased). Thus, the direction of individual change was more uniform for NEM and CON.

Growth curve modeling allows more specific inferences regarding absolute change in these traits. Models for PEM–A or PEM–C were not interpreted because of negative variances (i.e., *Heywood cases*). Given that absolute change was not impressive in a descriptive sense, no further efforts were made to modify these models to obtain an admissible solution, and the origins of change were not pursued for these personality domains. The CON and NEM models were saturated after correcting the fit statistics for twin data (see Kashy et al., 2008), and thus no fit statistics are reported. Parameters from these models are given in Table 2, and text explaining what these and other key parameters signify can be found in the Table 2 note, as well as the notes for the other tables. The paths from the slope factor to the second measurement occasion were substantially greater than .58, consistent with descriptive results in suggesting that most of the change in

Figure 2. Path diagram of biometric latent growth curve model. For ease of presentation, this path diagram represents only one twin in a pair (results are identical for the cotwin). Variances in the intercept and linear slope factors are parsed into that that is due to additive genetic effects (A), shared environmental effects (C), and nonshared environmental effects (E). Paths are represented by lowercase letters followed by subscripted letters corresponding to their respective factor (e.g., a_i, a_s). Genetic and environmental correlations between the factors are presented at the top of the diagram (i.e., r_A, r_C, r_E). The assessment-specific residual paths load directly onto personality at each assessment and are indicated by a lowercase letter followed by a single subscripted numeral (i.e., a_1). Factor loadings for the intercept are fixed prior to analysis (x is determined by the phenotypic growth curve modeling results; .75 for Constraint and .84 for Negative Emotionality).

NEM and CON occurred between adolescence and emerging adulthood and that the rate of change declined from emerging to young adulthood. Both slope and intercept means and variances were statistically significant, again pointing to the existence of meaningful interindividual variability in trait levels and change trajectories for both of these traits. The correlations between slopes and intercepts were negative for both traits and significant only for CON.

Biometric Results

Fit statistics for the biometric Cholesky (to test influences on differential stability and change) and latent growth curve (to test influences on absolute stability and change) models are presented in Table 3. We initially estimated variances, covariances, and means for the raw data to get a baseline index of fit for each trait.

The Cholesky and latent growth curve biometric models were then compared with the baseline model to yield a chi-square goodness-of-fit test, which is then converted to AIC. All models fit their respective data well.

Differential stability and change. Parameter estimates for the Cholesky models are presented in Table 4, separately for each trait. There was evidence of significant genetic contributions to all four traits (accounting for 33%–56% of the variance), as well as significant nonshared environmental influences (accounting for 42%–61% of the variance). There was no evidence of significant shared environmental influence across any trait. These proportions of variance were essentially invariant across age, with little to no differences observed across the three assessments. These results suggest that personality is as heritable in late adolescence as it is in young adulthood.

Table 1

Stability and Change in Negative Emotionality, Agentic and Communal Positive Emotionality, and Constraint During the Transition to Adulthood

	Differential correlation			Absolute						
				M (*SD*)			Cohen's *d*			
Trait	17–24	24–29	17–29	17	24	29	17–24	24–29	17–29	*F*
NEM	.53	.74	.49	50.00 (10.00)	42.30 (10.23)	41.01 (10.05)	−0.77	−0.13	−0.90	550.79*
PEM–A	.59	.77	.58	50.00 (10.00)	50.75 (9.58)	50.43 (9.77)	0.09	0.03	0.12	16.91*
PEM–C	.52	.74	.52	50.00 (10.00)	48.97 (9.91)	48.31 (9.68)	−0.11	−0.07	−0.17	11.96*
CON	.62	.78	.56	50.00 (10.00)	54.95 (9.67)	56.62 (9.59)	0.52	0.17	0.69	322.02*

Note. Trait scores were standardized on a T scale (*M* = 50, *SD* = 10) based on Wave 1 data to facilitate interpretation. NEM = Negative Emotionality; PEM–A = Agentic Positive Emotionality; PEM–C = Communal Positive Emotionality; CON = Constraint.
* $p < .05$.

As indicated by the generally nonoverlapping 95% confidence intervals for the genetic and nonshared environmental correlations (see Table 4), genetic influences appeared to be more stable over time than nonshared environmental influences across all personality factors. More important, however, the nonshared environmental correlations generally appeared to increase with age. In particular, the nonshared environmental correlations from ages 17 to 24 were significantly smaller (as evidenced by nonoverlapping confidence intervals) than those from ages 24 to 29, suggesting increased stability in the environmental effects associated with personality stability following emerging adulthood. The same general pattern of increasing etiological stability with age was also present for genetic effects; however, these differences were less pronounced (perhaps reflecting the rather high levels of genetic stability in general). In any case, such findings serve both to highlight strong genetic contributions to the differential stability of personality from late adolescence through young adulthood and to suggest that these influences become particularly stable following emerging adulthood.

Absolute stability and change. Results from the biometric latent growth curve models are presented in Table 5. As seen there, the intercept factor for NEM was significantly influenced by both genetic and nonshared environmental forces. The shared environment contribution was not significantly different from zero. The

Figure 3. Absolute changes in personality traits during the transition to adulthood. Trait scores were standardized at the first wave using a T-score metric.

slope factor for NEM, by contrast, was influenced primarily by nonshared environmental influences. Moreover, these influences appeared to differ from those contained in the slope, as evidenced by the rather small nonshared environmental correlation between the two factors that was nonsignificant. The contributions of genetic and shared environmental influences to the slope were small and were not statistically significant. Finally, the residuals were relatively small and were solely nonshared environmental in origin. As measurement error will also be contained within the nonshared environmental residuals, such findings may or may not imply that there are assessment-specific nonshared environmental influences that meaningfully contribute to changes in personality over time. This cautious interpretation is augmented by the rather large amount of phenotypic variance accounted for by the latent intercept and slope factors (67%–83% of the variance in NEM). All in all, it appears that there are unique environmental experiences that differ across the twin siblings and that meaningfully influence absolute changes in NEM over time.

The pattern of stability and change in CON was somewhat different. The intercept factor was primarily genetic in origin (68%), although nonshared environmental influences also contributed (32%). Moreover, the slope factor was both genetic and nonshared environmental in origin. Such findings suggest that genetic influences play an important role in explaining absolute changes in CON that are associated with age. As before, these interpretations are augmented by the prominent amount of phenotypic variance in CON that is collectively accounted for by the latent intercept and slope factors (75%–88% of the variance at each age).

Discussion

This study extends research on personality development by exploring genetic and environmental contributions to differential and absolute stability and change in personality traits assessed at the beginning, middle, and end of the transition to adulthood. The results for the differential stability of phenotypic traits corroborate previous reports suggesting that differential stability tends to increase with age for most personality traits (Roberts & DelVecchio, 2000). These trends represent an example of the cumulative continuity principle of personality development—differential (or rank-order) stability tends to increase with age. In particular,
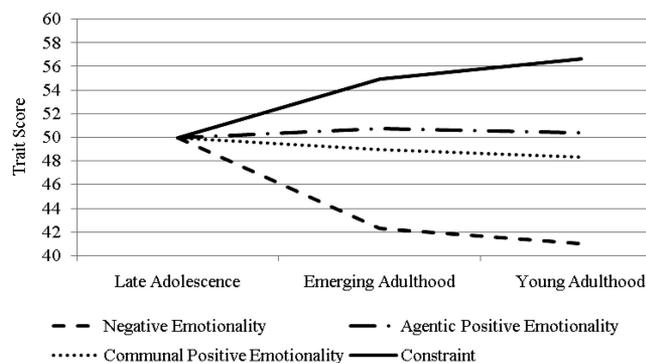
Table 2

Univariate Growth Curve Parameters for Models Depicting Absolute Stability and Change in Negative Emotionality and Constraint During the Transition to Adulthood

Trait	Intercept		Slope		Time 2 slope path coefficient	Slope–intercept correlation
	M	Variance	M	Variance		
Negative Emotionality	50.11*	70.97*	−9.18*	51.43*	.84*	−.34*
Constraint	49.94*	75.13*	6.78*	47.88*	.72*	−.35*

Note. Agentic and Communal Positive Emotionality growth models did not fit the data because of negative variances. Data were standardized in a T-score metric using Wave 1 data. Intercept means reflect estimates of these standardized scores. Significant intercept variances indicate that these means varied across participants. Slope means show that these traits significantly changed over the three waves, and slope variances show that there was variability across participants in terms of these changes. The Time 2 slope path coefficient was estimated; if change were linear, a value of .58 (7 years/12 years) would be expected. These values were both >.58, suggesting that more change occurred in the first relative to the second wave of the study. Significant slope–intercept correlations suggest that Wave 1 scores were predictive of the magnitude of change observed over time.
* $p < .05$.

differential stability is lower in the period from ages 17 to 24 than in the period from ages 24 to 29. This suggests that some important developmental periods can be characterized, in part, by different rates of personality stability. Arnett (2000) originally suggested that the period of emerging adulthood extended from the late teens to the mid-20s, and these stability coefficients are consistent with the idea that there is more personality instability during this period of the life span compared with the interval between ages 24 and 29.

Findings with respect to absolute stability and change varied more across the traits, but they generally supported the maturity principle of adult personality development (e.g., Caspi et al., 2005; see Figure 3). NEM showed overall decreases with age, but the decreases tended to be strongest in the early part of the transition to adulthood and then started to level off somewhat during the mid-20s. CON showed overall increases with age, but again change was more profound during the first interval than the second interval. PEM–A and PEM–C tended to show less systematic change than NEM or CON. Greater relative changes in NEM and CON relative to PEM–A and PEM–C during the transition to adulthood may be due to the fact that these former traits have more straightforward and more empirically consistent links to adaptation. Although both PEM-related traits increased modestly overall, patterns of change were also somewhat different across PEM–A

and PEM–C. Whereas increasing levels of PEM–A remained fairly constant during the transition to adulthood, PEM–C increased initially but then decreased somewhat. This may reflect the fact that relational patterns often tend to resolve somewhat before the attainment of careers or other agency-related achievement. For example, in Erikson's (1950) classic model, the issue of intimacy versus isolation is posited to be typical of young adulthood, whereas generativity versus stagnation is more salient during adulthood.

Beyond characterizing personality development during this period at a phenotypic level, this study provides insights into the genetic and environmental origins of stability and change and is therefore particularly relevant to deciding between competing intrinsic maturation versus life-span perspectives for the origins of adult personality development (see also Bleidorn et al., 2009). The intrinsic maturation perspective (McCrae & Costa, 2003, 2008) suggests that both stability and change are driven primarily by genetic influences. In contrast, the life-span perspective (e.g., Roberts et al., 2006b; Roberts et al., 2005) posits that personality changes occur partly as a consequence of interactions with and efforts to adapt to the social environment.

Although there was evidence for genetic contributions to stability and change in personality, these results provide support for the

Table 3

Fit Statistics for Cholesky (to Assess Influences on Differential Stability and Change) and Growth Curve (to Assess Influences on Absolute Stability and Change) Biometric Models

Trait	Model	−2lnL	df	$\chi^2(\Delta df)$	AIC
Negative Emotionality	Baseline	24,273.26	3117		
	Cholesky	24,310.44	3150	37.18 (33)	−28.82
	Growth curve	24,310.48	3147	37.22 (30)	−22.78
Constraint	Baseline	24,854.86	3117		
	Cholesky	24,881.21	3150	26.35 (33)	−39.65
	Growth curve	24,880.09	3147	25.23 (30)	−34.77
Positive Emotionality—Agentic	Baseline	24,326.69	3146		
	Cholesky	24,372.97	3179	46.28 (33)	−19.72
	Growth curve				
Positive Emotionality—Communal	Baseline	24,549.54	3145		
	Cholesky	24,590.67	3178	41.13 (33)	−24.87
	Growth curve				

Note. −2lnL = minus twice the log likelihood; AIC = Akaike information criterion.

Table 4
Standardized Parameter Estimates From the Biometric Cholesky Decomposition Model

Trait and component of variance	% Age 17	% Age 24	% Age 29	$r_{17\rightarrow24}$	$r_{17\rightarrow29}$	$r_{24\rightarrow29}$
Negative Emotionality						
A	.34*	.33*	.33*	.75* [.32, 1.0]	.86* [.47, 1.0]	.99* [.77, 1.0]
C	.05	.09	.10	—	—	—
E	.61*	.58*	.57*	.36* [.26, .44]	.32* [.23, .40]	.60* [.54, .66]
Constraint						
A	.53*	.56*	.49*	.81* [.67, .98]	.72* [.58, .88]	.96* [.86, 1.0]
C	.02	.01	.01	—	—	—
E	.44*	.42*	.50*	.44* [.35, .51]	.38* [.28, .46]	.65* [.58, .70]
Positive Emotionality—Agentic						
A	.50*	.50*	.53*	.79* [.67, .93]	.73* [.62, .88]	.96* [.91, 1.0]
C	.00	.00	.00	—	—	—
E	.50*	.50*	.47*	.39* [.30, .48]	.42* [.34, .50]	.58* [.51, .65]
Positive Emotionality—Communal						
A	.38*	.46*	.42*	.66* [.29, .85]	.69* [.32, .91]	.95* [.82, 1.0]
C	.04	.02	.06	—	—	—
E	.58*	.51*	.52*	.37* [.27, .46]	.35* [.26, .43]	.56* [.48, .63]

Note. A, C, and E represent genetic, shared environmental, and nonshared environmental influences, respectively. Univariate variance estimates are presented for each age in columns 3–5. $r_{17\rightarrow24}$, $r_{17\rightarrow29}$, and $r_{24\rightarrow29}$ index the genetic and environmental correlations across ages 17 and 24, 17 and 29, and 24 and 29, respectively. Shared environmental correlations are not presented (shown as dashes in the table) because they were uniformly nonsignificant (consistent with the nonsignificant amounts of variance in personality accounted for by shared environmental influences at all ages), and their confidence intervals ranged from –1.0 to 1.0.
* $p < .05$.

life-span perspective given that nonshared environmental factors accounted for personality changes over time (see also Bleidorn et al., 2009). For both NEM and CON, genetic factors tended to influence trait levels overall, as well as the stability of those levels, but the nonshared environment was an important influence on changes in trait levels over time. This effect appeared to be

somewhat stronger for NEM than for CON. CON involves people's ability to modulate their emotional responses to internal and environmental stimuli and is linked to the forebrain (DeYoung & Gray, 2009), a structure that continues to develop into the transition to adulthood (Giedd et al., 1999; Gogtay et al., 2004). Thus, the finding that genetic effects are stronger predictors of change in

Table 5
Biometric Latent Growth Curve Model Results

Trait	A	C	E	Total variance	Factors %
			Negative Emotionality		
Factor					
Intercept (e.g., a_i)	.455*	.013	.532*	121.56	
Slope (e.g., a_s)	.122	.086	.792*	85.01	
Genetic/environmental correlation (e.g., r_A)	−.11	—	−.46	−29.81	
Residual					
Age 17 (e.g., a_1)	.082	.000	.246*		67
Age 24 (e.g., a_2)	.029	.000	.222*		75
Age 29 (e.g., a_3)	.000	.017	.155*		83
			Constraint		
Factor					
Intercept (e.g., a_i)	.677*	.000	.323*	198.43	
Slope (e.g., a_s)	.504*	.000	.496*	120.49	
Genetic/environmental correlation (e.g., r_A)	−.40	—	−.32	−55.63	
Residual					
Age 17 (e.g., a_1)	.048	.000	.197*		75
Age 24 (e.g., a_2)	.049	.027	.124*		80
Age 29 (e.g., a_3)	.000	.000	.121*		88

Note. A, C, and E represent proportions of genetic, shared environmental, and nonshared environmental influences, respectively. The intercept factor is composed of the variance that is common or stable across time. The slope factor captures systematic change over time. Both factors were decomposed into their genetic and environmental components, and therefore each row sums to 100% of the variance within that factor. Genetic and environmental correlations between factors are also indicated (none were statistically significant). The residual estimates index the variance remaining at each assessment after accounting for that contributed by the factors. Accordingly, the variance contributed by the factors is necessary for the rows to sum to 100%.
* $p < .05$.

CON may reflect the fact that there are genetic influences on development in the forebrain that continue past adolescence. Unlike CON, NEM is linked to more primitive structures in the brain that are fairly well developed by adulthood. Negative Emotionality may be more responsive, during this age, to environmental conditions than to genetically influenced developmental processes. There are also hints in the literature that changes in NEM are linked to environmental factors such as experiences in romantic relationships (e.g., Robins, Caspi, & Moffitt, 2002).

With regard to differential stability, genetic influences were important for explaining the differential stability of those levels over time; however, experiences that were unique to each individual twin (i.e., nonshared environment) also influenced differential patterns of change, and these influences tended to increase during the second wave. This pattern suggests that environment factors that are unique to each twin act to promote greater stability in personality traits during the transition to adulthood. Moreover, the increasing level of connection between nonshared environmental influences from the second to the third wave suggests that individuals might be more consistently selecting into "stability-promoting" environments starting at around age 24. It may be the case that the selection into adult roles and relationships enhances personality stability (Roberts & Wood, 2006; Robins et al., 2002). Accordingly, the domains of love and work are likely a fruitful area of exploration for environmental influences on personality stabilization.

In addition to providing valuable data relevant for ongoing debates about the underlying causes of adult personality development, the current findings also shed light on the nature of emerging adulthood. Arnett (2000, 2004) described the transition to adulthood in Western society as involving processes of both exploration and identity consolidation. It is also a period marked by relative freedom from clearly defined roles and responsibilities. Individuals at this age are relatively free from external constraints such as the limitations on behavior imposed by parents during adolescence and the constraints imposed by formal adult roles that occur in adulthood (e.g., family and career demands). However, toward the mid-20s, individuals typically begin a process of selecting into environments that place constraints on development and may press for certain kinds of thoughts, feelings, and behaviors—they often enter into committed romantic relationships and form their own families, establish permanent residences, and settle into careers. These choices may further reinforce and accentuate personality traits that were linked with those choices in the first place, as posited by the correspTONsive principle of adult personality development (Caspi et al., 2005).

All in all, the current study suggests that genetic factors are important for understanding both personality stability and change. Nonetheless, environmental factors matter as well, which tends to support the broader transactional perspectives on adult personality development. The transactional or life-course perspective on personality development suggests that both intrinsic and extrinsic factors play a part in shaping individual dispositions. Indeed, previous genetically informed studies also point to environmental influences on personality development in adulthood (Bleidorn et al., 2009; Johnson, McGue, & Krueger, 2005). Collectively, these findings are seemingly incompatible with a pure intrinsic maturation explanation. Nonetheless, future genetically informed research is needed to definitively resolve this debate.

Despite several methodological strengths such as the use of twins and age-targeted sampling, a number of study limitations are also notable. First, controversies exist regarding the structure of personality traits; given that we observed some varying patterns across the traits, future research should test personality development using different trait models. Fortunately, recent work indicates that most omnibus trait models can be integrated within a hierarchical structure (Markon et al., 2005; Watson, Clark, & Chmielewski, 2008), suggesting that different trait models are not so much competitors as simply alternative ways of organizing personality attributes at different levels of abstraction.

Second, this study relied on a single self-report measure of personality. Beyond typical concerns associated with using any method in isolation or with self-report in particular, some evidence suggests that nonshared environmental effects may be overestimated when using self-report measures only (Riemann, Angleitner, & Strelau, 1997). Thus, future research should employ multiple methods for the assessment of personality traits. Finally, although our sampling effectively targeted an important developmental period, future research that spans wider age ranges, and with assessments that occur more frequently, is needed to more clearly depict patterns of and influences on personality change across the life span. Related to this point, findings of greater variability in the first wave of this study may relate to both developmental processes described here and the somewhat longer assessment interval (7 vs. 5 years). As such, future research is needed to confirm that this finding indeed reflects greater trait changes in the first stages of the transition to adulthood.

Overall, this study highlights the utility of an integrative and age-targeted approach for understanding genetic and environmental contributions to personality development during the transition to adulthood. Consistent with previous research, this study showed that traits tend to show quite similar patterns of differential stability but varying patterns of absolute stability. The general trend was in the direction of increased personality maturity, and it appears that the period from ages 17 to 24 was more "active" than the period from ages 24 to 29. Biometric analyses provided greater insight into the etiology of stability and change and facilitated a straightforward test of different theoretical perspectives on personality changes during development. In conclusion, increased maturity coupled with a transactional perspective appears to best characterize personality development during the transition to adulthood.

References

Akaike, H. (1987). Factor analysis and AIC. *Psychometrika, 52,* 317–332. doi:10.1007/BF02294359

Arnett, J. J. (2000). Emerging adulthood: A theory of development from the late teens through the twenties. *American Psychologist, 55,* 469–480. doi:10.1037/0003-066X.55.5.469

Arnett, J. J. (2004). *Emerging adulthood: The winding road from the late teens through the twenties.* New York, NY: Oxford University Press.

Arnett, J. J. (2007). Emerging adulthood: What is it, and what is it good for? *Child Development Perspectives, 1,* 68–73. doi:10.1111/j.1750-8606.2007.00016.x

Ashton, M. C., Lee, K., & Paunonen, S. V. (2002). What is the central feature of extraversion? Social attention versus reward sensitivity. *Journal of Personality and Social Psychology, 83,* 245–252. doi:10.1037/0022-3514.83.1.245

Biesanz, J. C., West, S. G., & Kwok, O. M. (2003). Personality over time: Methodological approaches to the study of short-term and long-term development and change. *Journal of Personality, 71,* 905–941. doi: 10.1111/1467-6494.7106002

Bleidorn, W., Kandler, C., Riemann, R., Angleitner, A., & Spinath, F. M. (2009). Patterns and sources of adult personality development: Growth curve analyses of the NEO–PI–R scales in a longitudinal twin study. *Journal of Personality and Social Psychology, 97,* 142–155. doi: 10.1037/a0015434

Blonigen, D. M., Carlson, M. D., Hicks, B. M., Krueger, R. F., & Iacono, W. G. (2008). Stability and change in personality traits from late adolescence to early adulthood: A longitudinal twin study. *Journal of Personality, 76,* 229–266. doi:10.1111/j.1467-6494.2007.00485.x

Bogg, T., & Roberts, B. W. (2004). Conscientiousness and health-related behaviors: A meta-analysis of the leading behavioral contributors to mortality. *Psychological Bulletin, 130,* 887–919. doi:10.1037/0033-2909.130.6.887

Caspi, A., Roberts, B. W., & Shiner, R. L. (2005). Personality development: Stability and change. *Annual Review of Psychology, 56,* 453–484. doi:10.1146/annurev.psych.55.090902.141913

Church, A.T., & Burke, P. J. (1994). Exploratory and confirmatory tests of the Big Five and Tellegen's three- and four-dimensional models. *Journal of Personality and Social Psychology, 66,* 93–114. doi:10.1037//0022-3514.66.1.93

Clark, L. A., & Watson, D. (2008). Temperament: An organizing paradigm for trait psychology. In O. P. John, R. W. Robins, & L. A. Pervin (Eds.), *Handbook of personality: Theory and research* (3rd ed., pp. 265–286). New York, NY: Guilford Press.

Costa, P. T., Jr., & McCrae, R. R. (2006). Age changes in personality and their origins: Comment on Roberts, Walton, and Viechtbauer (2006). *Psychological Bulletin, 132,* 26–28. doi:10.1037/0033-2909.132.1.26

Depue, R. A., & Collins, P. F. (1999). Neurobiology of the structure of personality: Dopamine, facilitation of incentive motivation, and extraversion. *Behavioral and Brain Sciences, 22,* 491–569. doi:10.1017/S0140525X99002046

DeYoung, C. G., & Gray, J. R. (2009). Personality neuroscience: Explaining individual differences in affect, behavior, and cognition. In P. J. Corr & G. Matthews (Eds.), *The Cambridge handbook of personality* (pp. 323–346). New York, NY: Cambridge University Press.

Donnellan, M. B., Conger, R. D., & Burzette, R. G. (2007). Personality development from late adolescence to young adulthood: Differential stability, normative maturity, and evidence for the maturity-stability hypothesis. *Journal of Personality, 75,* 237–264. doi:10.1111/j.1467-6494.2007.00438.x

Donnellan, M. B., & Robins, R. W. (2009). The development of personality across the life span. In P. J. Corr & G. Matthews (Eds.), *The Cambridge handbook of personality* (pp. 191–204). New York, NY: Cambridge University Press.

Donnellan, M. B., Trzesniewski, K. H., & Robins, R. W. (2006). *Personality and self-esteem development in adolescence.* In D. K. Mroczek & T. Little (Eds.), *Handbook of personality development* (pp. 285–309). Hillsdale, NJ: Erlbaum.

Erikson, E. (1950). *Childhood and society.* New York, NY: Norton.

Furstenberg, F. F., Kennedy, S., McLoyd, V., Rumbaut, R., & Settersten, R. A. (2004). Growing up is harder to do. *Contexts, 3,* 33–41. doi: 10.1525/ctx.2004.3.3.33

Galambos, N. L., Barker, E. T., & Krahn, H. J. (2006). Depression, self-esteem, and anger in emerging adulthood: Seven-year trajectories. *Developmental Psychology, 42,* 350–365. doi:10.1037/0012-1649.42.2.350

Giedd, J. N., Blumenthal, J., Jeffries, N. O., Castellanos, F. X., Liu, H., Zijdenbos, A., . . . Rapaport, J. L. (1999). Brain development during childhood and adolescence: A longitudinal MRI study. *Nature Neuroscience, 2,* 861–863. doi:10.1038/13158

Gogtay, N., Geid, J. N., Lusk, L., Hayashi, K. M., Greenstein, D., Vaituzis, A. C., . . . Thompson, P. M. (2004). Dynamic mapping of human cortical development during childhood through early adulthood. *Proceedings of the National Academy of Sciences, USA, 101,* 8174–8179. doi:10.1073/pnas.0402680101

Holdcraft, L. C., & Iacono, W. G. (2004). Cross-generational effects on gender differences in psychoactive drug abuse and dependence. *Drug and Alcohol Dependence, 74,* 147–158. doi:10.1016/j.drugalcdep.2003.11.016

Hopwood, C. J., Newman, D. A., Donnellan, M. B., Markowitz, J. C., Grilo, C. M., Sanislow, C. A., . . . Morey, L. C. (2009). The stability of personality traits in individuals with borderline personality disorder. *Journal of Abnormal Psychology, 118,* 806–815. doi:10.1037/a0016954

Humbad, M. N., Donnellan, M. B., Iacono, W. G., & Burt, S. A. (2010). Externalizing psychopathology and marital quality in long-term marriages: Results from a large combined sample of married couples. *Journal of Abnormal Psychology, 119,* 151–162. doi:10.1037/a0017981

Hur, Y. M., McGue, M., & Iacono, W. G. (1995). Unequal rate of monozygotic and like-sex dizygotic twin birth: Evidence from the Minnesota Twin Family Study. *Behavior Genetics, 25,* 337–340. doi:10.1007/BF02197282

Iacono, W. G., Carlson, S. R., Taylor, J. T., Elkins, I. J., & McGue, M. (1999). Behavioral disinhibition and the development of substance abuse disorders: Findings from the Minnesota Twin Family Study. *Development and Psychopathology, 11,* 869–900. doi:10.1017/S0954579499002369

Iacono, W. G., & McGue, M. (2002). Minnesota Twin Family Study. *Twin Research, 5,* 482–487. doi:10.1375/136905202320906327

Jacobson, N. S., & Truax, P. (1991). Clinical significance: A statistical approach to defining meaningful change in psychotherapy research. *Journal of Consulting and Clinical Psychology, 59,* 12–19. doi:10.1037/0022-006X.59.1.12

Johnson, W., McGue, M., & Krueger, R. F. (2005). Personality stability in late adulthood: A behavioral genetic analysis. *Journal of Personality, 73,* 523–552. doi:10.1111/j.1467-6494.2005.00319.x

Kashy, D. A., Donnellan, M. B., Burt, S. A., & McGue, M. (2008). Growth curve models for indistinguishable dyads using multilevel modeling and structural equation modeling: The case of adolescent twins' conflict with their mothers. *Developmental Psychology, 44,* 316–329. doi:10.1037/0012-1649.44.2.316

Kendler, K. S., Neale, M. C., Kessler, R. C., Heath, A. C., & Eaves, L. J. (1993). A test of the equal-environment assumption in twin studies of psychiatric illness. *Behavior Genetics, 23,* 21–27. doi:10.1007/BF01067551

Krueger, R. F., Caspi, A., & Moffitt, T. E. (2000). Epidemiological personology: The unifying role of personality in population-based research on problem behaviors. *Journal of Personality, 68,* 967–998. doi:10.1111/1467-6494.00123

Little, R. J. A., & Rubin, D. B. (1987). *Statistical analysis with missing data.* New York, NY: Wiley.

Loehlin, J. C. (2001). Behavior genetics and parenting theory. *American Psychologist, 56,* 169–170. doi:10.1037/0003-066X.56.2.169

Lucas, R. E., & Fujita, F. (2000). Factors influencing the relation between extraversion and pleasant affect. *Journal of Personality and Social Psychology, 79,* 1039–1056. doi:10.1037//0022-3514.79.6.1039

Markon, K. E., Krueger, R. F., & Watson, D. (2005). Delineating the structure of normal and abnormal personality: An integrative hierarchical approach. *Journal of Personality and Social Psychology, 88,* 139–157. doi:10.1037/0022-3514.88.1.139

McCrae, R. R., & Costa, P. T., Jr. (2003). *Personality in adulthood: A five-factor theory perspective* (2nd ed.). New York, NY: Guilford Press. doi:10.4324/9780203428412

McCrae, R. R., & Costa, P. T., Jr. (2008). The five-factor theory of personality. In O. P. John, R. W. Robins, & L. A. Pervin (Eds.),

Handbook of personality: Theory and research (3rd ed., pp. 159–181). New York, NY: Guilford Press.

McGue, M., Bacon, S., & Lykken, D. T. (1993). Personality stability and change in early adulthood: A behavioral genetic analysis. *Developmental Psychology, 29,* 96–109. doi:10.1037/0012-1649.29.1.96

Mroczek, D. K., & Spiro, A., III. (2003). Modeling intraindividual change in personality traits: Findings from the Normative Aging Study. *Journals of Gerontology, Series B: Psychological Sciences, 58,* 153–165. doi:10.1093/geronb/58.3.P153

Mroczek, D. K., Spiro, A., III, & Griffin, P. W. (2006). Personality and aging. In J. E. Birren & K. W. Schaie (Eds.), *Handbook of the psychology of aging* (6th ed., pp. 363–377). doi:10.1016/B978-012101264-9/50019-7

Neale, M. C. (1997). *Mx: Statistical modeling* (4th ed.). Richmond, VA: Medical College of Virginia.

Neale, M. C., & McArdle, J. J. (2000). Structured latent growth curves for twin data. *Twin Research, 3,* 165–177. doi:10.1375/136905200320565454

Neyer, F. J., & Lehnart, J. (2007). Relationships matter in personality development: Evidence from a 9-year longitudinal study across young adulthood. *Journal of Personality, 75,* 535–568. doi:10.1111/j.1467-6494.2007.00448.x

Nigg, J. T. (2000). On inhibition/disinhibition in developmental psychopathology: Views from cognitive and personality psychology and a working inhibition taxonomy. *Psychological Bulletin, 126,* 220–246. doi:10.1037//0033-2909.126.2.220

Preacher, K. J., Wichman, A. L., MacCallum, R. C., & Briggs, N. E. (2008). *Latent growth curve modeling.* Thousand Oaks, CA: Sage.

Riemann, R., Angleitner, A., & Strelau, J. (1997). Genetic and environmental influences on personality: A study of twins reared together using the self- and peer-report NEO–FFI scales. *Journal of Personality, 65,* 449–475. doi:10.1111/j.1467-6494.1997.tb00324.x

Rindfuss, R. R. (1991). The young adult years: Diversity, structural change, and fertility. *Demography, 28,* 493–512. doi:10.2307/2061419

Roberts, B. W., Caspi, A., & Moffitt, T. (2001). The kids are alright: Growth and stability in personality development from adolescence to adulthood. *Journal of Personality and Social Psychology, 81,* 670–683. doi:10.1037/0022-3514.81.4.670

Roberts, B. W., Caspi, A., & Moffitt, T. (2003). Work experiences and personality development in young adulthood. *Journal of Personality and Social Psychology, 84,* 582–593. doi:10.1037/0022-3514.84.3.582

Roberts, B. W., & DelVecchio, W. F. (2000). The rank-order consistency of personality traits from childhood to old age: A quantitative review of longitudinal studies. *Psychological Bulletin, 126,* 3–25. doi:10.1037/0033-2909.126.1.3

Roberts, B. W., Walton, K. E., & Viechtbauer, W. (2006a). Patterns of mean-level change in personality traits across the life course: A meta-analysis of longitudinal studies. *Psychological Bulletin, 132,* 1–25. doi:10.1037/0033-2909.132.1.1

Roberts, B. W., Walton, K., & Viechtbauer, W. (2006b). Personality changes in adulthood: Reply to Costa and McCrae (2006). *Psychological Bulletin, 132,* 29–32. doi:10.1037/0033-2909.132.1.29

Roberts, B. W., & Wood, D. (2006). Personality development in the context of the neo-socioanalytic model of personality. In D. K. Mroczek & T. D. Little (Eds.), *Handbook of personality development* (pp. 11–39). Mahwah, NJ: Erlbaum.

Roberts, B. W., Wood, D., & Caspi, A. (2008). The development of personality traits in adulthood. In O.P. John, R.W. Robins, & L. A. Pervin (Eds.), *Handbook of personality: Theory and research* (3rd ed., pp. 375–398). New York, NY: Guilford Press.

Roberts, B. W., Wood, D., & Smith, J. L. (2005). Evaluating five factor theory and social investment perspectives on personality trait development. *Journal of Research in Personality, 39,* 166–184. doi:10.1016/j.jrp.2004.08.002

Robins, R. W., Caspi, A., & Moffitt, T. E. (2002). It's not just who you're with, it's who you are: Personality and relationship experiences across multiple relationships. *Journal of Personality, 70,* 925–964. doi:10.1111/1467-6494.05028

Robins, R. W., Fraley, R. C., Roberts, B. W., & Trzesniewski, K. H. (2001). A longitudinal study of personality in young adulthood. *Journal of Personality, 69,* 617–640. doi:10.1111/1467-6494.694157

Shanahan, M. J. (2000). Pathways to adulthood in changing societies: Variability and mechanisms in life course perspective. *Annual Review of Sociology, 26,* 667–692. doi:10.1146/annurev.soc.26.1.667

Tellegen, A., & Waller, N. G. (2008). Exploring personality through test construction: Development of the Multidimensional Personality Questionnaire. In G. J. Boyle, G. Matthews, & D. H. Saklofske (Eds.), *Sage handbook of personality theory and testing, Vol. 2: Personality measurement and assessment* (pp. 254–285). London, England: Sage.

Vaidya, J. G., Gray, E. K., Haig, J., Mroczek, D. K., & Watson, D. (2008). Differential stability and individual growth trajectories of Big Five and affective traits during young adulthood. *Journal of Personality, 76,* 267–304. doi:10.1111/j.1467-6494.2007.00486.x

Watson, D., Clark, L. A., & Chmielewski, M. (2008). Structures of personality and their relevance to psychopathology: II. Further articulation of a comprehensive unified trait structure. *Journal of Personality, 76,* 1545–1586. doi:10.1111/j.1467-6494.2008.00531.x

Watson, D., Hubbard, B., & Wiese, D. (2000). Self–other agreement in personality and affectivity: The role of acquaintanceship, trait visibility, and assumed similarity. *Journal of Personality and Social Psychology, 78,* 546–558. doi:10.1037//0022-3514.78.3.546

Watson, D., Wiese, D., Vaidya, J., & Tellegen, A. (1999). The two general activation systems of affect: Structural findings, evolutionary considerations, and psychobiological evidence. *Journal of Personality and Social Psychology, 76,* 820–838. doi:10.1037//0022-3514.76.5.820

Wiggins, J. S. (1991). Agency and communion as conceptual coordinates for the understanding and measurement of interpersonal behavior. In W. M. Grove & D. Ciccetti (Eds.), *Thinking clearly about psychology: Vol. 2. Personality and psychopathology* (pp. 89–113). Minneapolis, MN: University of Minnesota Press.