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Stability and Change in Personality Traits From Late Adolescence to Early Adulthood: A Longitudinal Twin Study

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Abstract

We conducted a longitudinal-biometric study examining stability and change in personality from ages 17 to 24 in a community sample of male and female twins. Using Tellegen's (in press) Multidimensional Personality Questionnaire (MPQ), facets of Negative Emotionality (NEM) declined substantially at the mean and individual levels, whereas facets of Constraint (CON) increased over time. Furthermore, individuals in late adolescence who were lowest on NEM and highest on CON remained the most stable over time, whereas those exhibiting the inverse profile (higher NEM, lower CON) changed the most in a direction towards growth and maturity. Analyses of gender differences yielded greater mean-level increases over time for women as compared to men on facets of CON and greater mean-level increases for men than women on facets of Agentic Positive Emotionality (PEM). Biometric analyses revealed rank-order stability in personality to be largely genetic, with rank-order change mediated by both the nonshared environment (and error) as well as genes. Findings correspond with prior evidence of a normative trend toward growth and maturity in personality during emerging adulthood.

Personality traits may be characterized as internal dispositions and tendencies to behave, think, and feel in consistent ways (Kenrick & Funder, 1988). Moreover, personality traits are conceptualized by many to represent stable and enduring patterns of thinking, feeling, and behaving that become increasingly solidified throughout adulthood (Costa & McCrae, 1997). In support of this perspective are findings of increasing rank-order stability across virtually all dimensions of personality from childhood through late adulthood (e.g., Roberts & DelVecchio, 2000).

An alternative perspective is to conceptualize personality traits as developmental constructs that are subject to change and adaptation across the life span (Caspi, Roberts, & Shiner, 2005). Evidence to support this model includes significant mean-level changes for several personality traits during key developmental periods (e.g., Roberts, Walton, & Viechtbauer, 2006). Thus, personality may be aptly described as a dynamic individual difference variable that exhibits both stability and change over the life course. Although this dual nature of personality has been described both conceptually and empirically (e.g., Block, 1971; Donnellan, Conger, & Burzette, 2007; Roberts & Caspi, 2003; Roberts, Caspi, & Moffitt, 2001), few studies have explored the etiologic contributions to these developmental patterns within a behavior genetic framework.

The present study examined stability and change in personality using a longitudinal-biometric design. Using the Multidimensional Personality Questionnaire (MPQ; Tellegen, in press), an

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omnibus measure of personality, we explored developmental trends in personality from late adolescence to early adulthood in a community sample of male and female twins. In addition, given our genetically informative sample, we investigated the degree to which genes and environments contribute to rank-order stability and change in personality across this period.

Transitioning From Late Adolescence to Early Adulthood: Demographic and Psychological Upheaval

Late adolescence to early adulthood ("emerging" adulthood; Arnett, 2000) represents a turbulent period of adjustment marked by a host of significant life changes (Hall, 1904). Demographically, individuals undergo a series of closely spaced and formative life events (e.g., leaving home, matriculating into college, starting careers and families; Rindfuss, 1991). Psychologically, the significance of these adjustments may run deeper as individuals begin to define their identities and make commitments to various paths and roles in life (Arnett, 2000; Erikson, 1963). In addition, epidemiological studies suggest significant psychological upheaval during this period, as indicated by a peak in the prevalence of internalizing and externalizing disorders (Kessler et al., 2005), as well as a peak in both the prevalence and incidence of criminal offending followed by subsequent declines in early adulthood (Blumstein, Cohen, & Farrington, 1988). Such developmental phenomena highlight the importance of investigating this stage of the life course. One developmental construct that has been linked to these phenomena, and therefore may broaden our knowledge of their underlying mechanisms, is personality traits.

Personality Development From Late Adolescence to Early Adulthood: Rank-Order, Mean-Level, and Individual-Level Change

The transition from adolescence to adulthood offers a unique opportunity to study the most salient processes that shape the development of personality (Caspi & Moffitt, 1993). Longitudinal studies of this transition indicate distinct patterns of stability and change for several dimensions of personality (e.g., Block, 1971; Donnellan et al., 2007; McGue, Bacon, & Lykken, 1993; Roberts et al., 2001; Robins, Fraley, Roberts, & Trzesniewski, 2001; Stein, Newcomb, & Bentler, 1986; Stevens & Truss, 1985). Further, such patterns of stability and change can be operationalized in multiple ways with each index of change revealing a unique perspective on personality development during emerging adulthood.

Rank-Order Stability

Rank-order stability refers to consistency over time in the relative ordering of individuals in a population and is typically assessed via test-retest correlations. Numerous reviews on the stability of personality over the life span (e.g., Conley, 1984; Kirk et al., 2000; McCrae & Costa, 1990; Roberts & DelVecchio, 2000; Watson & Clark, 1984), as well as more focal investigations in young adulthood (e.g., Donnellan et al., 2007; Roberts et al., 2001; Robins et al., 2001), have consistently revealed moderate to strong rank-order stability for virtually all dimensions of personality. In the present study, we investigated rank-order stability of personality traits from the MPQ—a broadband personality measure consisting of a hierarchical structure that allows for an assessment of stability and change at both higher-order and primary levels of the trait hierarchy. Based on the meta-analysis by Roberts and DelVecchio (2000), as well as previously reported test-retest correlations for the MPQ over a similar age range (Donnellan et al., 2007; Roberts et al., 2001), we expected rank-order coefficients on the order of .5 to .6 for all higher-order factors and primary scales.

Mean-Level Change

Although rank-order stability can assess continuity and change in relative terms, it cannot address the degree of change in a particular trait in an absolute sense and is thus limited in its ability to capture patterns of growth and maturity. In contrast, mean-level (absolute) change reflects variations in the average amount of an attribute in a population over time. Provided that traits change in the same direction for the majority of individuals in a population, such analyses yield estimates of normative change. Block (1971) reported mean-level declines in Rebelliousness from adolescence to adulthood, while Stein et al. (1986) noted mean-level increases in Law Abidance, Congeniality, Diligence, Generosity, Orderliness, and Leadership over this period. Similarly, Robins et al. (2001), using a measure of the Big Five, observed mean-level increases in Agreeableness and Conscientiousness and mean-level declines in Neuroticism in a sample of students assessed at the beginning and end of college.

Roberts et al. (2001) investigated stability and change in MPQ personality traits from ages 18 to 26 in a sample of men and women from the Dunedin Multidisciplinary Health and Development Study (Silva & Stanton, 1996). At the primary scale level, mean-level declines were observed on Alienation ($d = -.33$) and Aggression ($d = -.48$), along with moderate increases on Control ($d = -.24$), Achievement ($d = -.47$), and Social Potency ($d = -.49$). At the higher-order level, NEM declined ($d = -.30$), whereas CON ($d = -.10$) and Agentic PEM ($d = -.62$) increased significantly. Recently, Donnellan et al. (2007) replicated this pattern of mean-level change in MPQ traits (i.e., decreases in NEM, increases in CON) in a sample of men and women from the Iowa Family Transitions Project assessed from late adolescence to early adulthood (Conger & Conger, 2002). These findings, however, differed somewhat from Roberts and colleagues (2001) in that a greater mean-level decrease was observed on NEM ($d = -.95$) and a greater mean-level increase was observed for CON ($d = .56$), along with smaller changes (in some cases in the reverse direction) for several indicators of PEM.

Despite their differences, the findings of Roberts et al. (2001) and Donnellan et al. (2007) are largely congruent with the literature and reveal a normative trend toward growth and maturity during the transition into adulthood. Moreover, this trend is consistent with the meta-analysis by Roberts et al. (2006) showing mean-level increases in Conscientiousness, Emotional Stability, and (to a lesser extent) Agreeableness beginning in young adulthood. Per Roberts et al. (2001) and Donnellan et al. (2007), “maturity,” in the context of personality development, may be broadly defined as successful adjustment and adaptation to the demands of one's life, as well as the capacity to form healthy interpersonal relationships. In MPQ terms, this definition may be operationalized as high self-control and responsibility (i.e., High CON), high agency and social efficacy (i.e., High Agentic-PEM), and low neuroticism, aggression, and other aversive emotional states (i.e., Low NEM). Consistent with the literature, we expected a similar pattern of increasing maturity in personality from late adolescence to early adulthood as indicated by mean-level increases on facets of CON and PEM and decreases on facets of NEM.

Individual-Level Change

In addition to rank-order and mean-level change, a handful of studies (e.g., Donnellan et al., 2007; Roberts et al., 2001; Robins et al., 2001; Vaidya, Gray, Haig, & Watson, 2002), have also examined individual-level change in personality—the degree of change exhibited by each individual over time on a particular trait. This level of analysis is integral to obtaining a comprehensive picture of personality development as individual differences in change may be unrelated to population indices of change (i.e., rank-order and mean-level change). For example, there may be no mean-level change for a given trait; however, considerable individual-level change may exist if equal proportions of the population are increasing and decreasing on this trait over time. Thus, at the mean level, one might conclude that no meaningful change exists when, in fact, there are substantial individual-level changes that simply cancel each other out.

In general, individual-level changes conform largely to observed mean-level changes. In addition, Roberts et al. (2001) and Donnellan et al. (2007) note that patterns of individual change have implications for the concept of maturity. Specifically, these authors observed that individuals who were most “mature” in late adolescence (i.e., highest on CON, lowest on NEM) changed the least over time, whereas those exhibiting the inverse profile (i.e., highest on NEM, lowest on CON) changed the most in a direction towards growth and maturity. This suggests a systematic relationship between level of maturity in late adolescence and individual differences in change during the transition into adulthood. Accordingly, we sought to replicate the link between maturity and stability in the present investigation.

Gender Differences in Personality Development: Late Adolescence to Early Adulthood

Although mean-level gender differences in personality are well established (Feingold, 1994), few studies have investigated whether men and women differ in their patterns of stability and change in personality over time. Roberts et al. (2001) and Donnellan et al. (2007) explored this issue and found comparable rank-order stability for men and women during the transition into adulthood. At the mean level, however, both studies observed a larger decline for men than women on facets of NEM and a more significant increase for women on facets of CON. Additionally, Roberts et al. (2001) reported larger increases for men on Agentic-PEM. Despite these differences, the associated effect sizes were relatively small, suggesting more similarity than dissimilarity across men and women in their patterns of stability and change during this period. Following the lead of these authors, we examined whether gender moderated personality development in our sample.

Genetic and Environmental Contributions to Personality Development: Late Adolescence to Early Adulthood

A critical limitation to the aforementioned literature is that virtually no studies have assessed the relative genetic and environmental contributions to stability and change in personality during the transition into adulthood. One exception to this is a longitudinal twin study by McGue et al. (1993) on personality development in early adulthood (see also Dworkin, Burke, Maher, & Gottesman, 1976). Using the MPQ, the authors found rank-order stability to be largely genetic (on average, 83% of the stable variance was due to genes) with rank-order change primarily due to environmental influences and error. Notably, significant genetic influences on rank-order change were also observed for several MPQ scales although these contributions were modest relative to the environmental contributions to change. Conceptually, these findings as a whole have been interpreted with reference to a “set-point” model in which the environment may produce short-term variations in one's personality, but genetic factors primarily give rise to stable baselines to which individuals eventually return (Lykken & Tellegen, 1996).

The contributions of McGue et al. (1993) notwithstanding, it should be noted that this study was confined to early adulthood (participants’ average ages were 20 and 30 at Times 1 and 2, respectively) and, therefore, may not address how genes and environments contribute to stability and change during the transition from late adolescence *into* early adulthood. Given that individuals are continuing to develop psychologically and neurobiologically (Segalowitz & Davies, 2004) during this period, it is conceivable that genetic factors may also contribute to rank-order change during emerging adulthood. Such findings would suggest that personality, like other developmental processes, is partly regulated by the unfolding of genetic processes over time, which become expressed during key developmental periods.

THE PRESENT STUDY

There were two broad objectives in the present study. First, similar to Roberts et al. (2001) and Donnellan et al. (2007), we examined stability and change in personality from late adolescence to early adulthood using (a) an epidemiological sample of both men and women, (b) employing a varied set of analytic procedures, and (c) using a model of personality that can afford an assessment of stability and change at both broad and specific levels of the trait hierarchy. Congruent with the literature, we expected a pattern of normative change indicative of growth and maturity (i.e., mean-level declines in Aggression, Alienation, Stress Reaction; mean-level increases in Control, Harm Avoidance, Achievement, Social Potency). Second, as a means of extending prior research, we explored genetic and environmental contributions to rank-order stability and change in personality from late adolescence to early adulthood. Based on McGue et al. (1993), we expected stability to be more genetically mediated and change to be primarily environmental. However, given the ongoing psychological and neurobiological development during this period, it was hypothesized that both genetic and environmental contributions to rank-order change would be observed.

In a previous study, we used a subset of MPQ items to explore the development and etiology of two dimensions of psychopathic personality from late adolescence to early adulthood (Blonigen, Hicks, Krueger, Patrick, & Iacono, 2006). *Fearless Dominance* (composed of items primarily from Social Potency, Stress Reaction, and Harm Avoidance) remained stable at the mean level, whereas *Impulsive Antisociality* (composed of items primarily from Aggression, Alienation, and Control) exhibited mean-level declines. Using the same sample, the present study, in contrast, examined patterns of stability and change in the full range of normal personality using all MPQ primary scales and higher-order factors. Thus, the present study may reveal patterns of stability and change that were not the focus of our prior investigation.

METHOD

Participants

Participants included same-sex male and female twins from the Minnesota Twin-Family Study (MTFS). The MTFS is an ongoing population-based longitudinal study of reared-together twins and their parents (Iacono, Carlson, Taylor, Elkins, & McGue, 1999). The primary objective of the MTFS is to examine the etiology of substance use disorders and related syndromes from a developmental, behavior genetic perspective. The present study utilized data collected from a cohort of adolescent twins born between the years 1972 and 1978 (for males) and 1975 and 1979 (for females). All twins were identified via Minnesota public birth records and recruited for participation the year the twins turned 17 years old. The MTFS located over 90% of all twin pairs born during the above-mentioned target years; 83% of all eligible families agreed to participate. No significant differences were observed between parents of participating and nonparticipating families with regard to self-reported rates of psychopathology or SES (Iacono et al., 1999). Families were excluded from participation if they lived further than a 1-day drive to the University of Minnesota or if either twin had a serious physical or cognitive disability that would hinder their participation in the day-long, in-person assessment. The final sample is representative of the Minnesota population on key demographic variables including ethnicity and SES (Holdcraft & Iacono, 2004).

The sample size consisted of 626 complete pairs of monozygotic (MZ) and dizygotic (DZ) twins following completion of the age 17 intake assessment (Women: n_{MZ} = 223, n_{DZ} = 114; Men: n_{MZ} = 188, n_{DZ} = 101). This ratio of MZ to DZ twin participation reflects an overrepresentation of MZ compared to DZ twins in the population from which the sample was drawn (Hur, McGue, & Iacono, 1995), as well as a slightly greater likelihood of agreement to participate in MZ twins. Zygosity was determined by obtaining separate reports from parents and MTFS staff regarding the physical resemblance between twins and comparing this information to an algorithm using ponderal and cephalic indices and fingerprint ridge counts to assess twin similarity. In the event in which these estimates did not agree, a serological analysis was performed.

Measures

At ages 17 (Time 1) and 24 (Time 2), subjects completed a 198-item version of the MPQ. The MPQ is a self-report questionnaire comprising questions in which the chosen response provides insight into individual differences in affective and behavioral style. The present study used a four-factor model to organize 10 of the 11 primary scales (Tellegen & Waller, 1992). The four factors include Agentic-PEM, Communal-PEM, NEM, and CON. Agentic-PEM includes primary scales of Social Potency and Achievement. A person scoring high in this dimension is likely to be forceful and persuasive and tends to enjoy demanding projects. Communal-PEM encompasses primary scales of Social Closeness and Well-Being. An individual scoring high on this dimension tends to have a cheerful disposition and values close interpersonal ties. NEM contains primary scales of Aggression, Alienation, and Stress Reaction. People high on NEM tend to experience elevated levels of negative emotions (anger, stress, sadness) and tend to be antagonistic and sensitive to criticism. CON consists of primary scales of Control, Harm Avoidance, and Traditionalism. High scorers on this domain are likely planful and cautious, risk aversive, and value a conservative social order. Absorption is a primary scale of the MPQ that does not load principally onto any of the four factors. People high on Absorption tend to experience vivid and compelling images and become easily engrossed in sensory stimuli. Scale names and descriptions of a high scorer along with reliability estimates, as indexed via Cronbach's alpha, are provided in Table 1. Alphas ranged from .78 to .94 with a mean coefficient alpha of .88.

At age 17, complete MPQ data (scores on all 11 primary scales) were gathered for 1110 individuals with samples sizes across these scales ranging from 1114−1125 (N_{Women} = 616 −623, N_{Men} = 498−502). At age 24, complete data were gathered for 1004 individuals with samples sizes ranging from 1007−1014 across the scales (N_{Women} = 579−584, N_{Men} = 428 −430). Sample sizes for MPQ scale scores available at both 17 and 24 ranged from 910−931 (N_{Women} = 530−543, N_{Men} = 380−388).[1] Analyses examining for biases due to attrition found only small differences when comparing participants and nonparticipants from Time 2 on each of the MPQ primarily scales at Time 1 (mean Cohen's d = .06, range .01 − .17; Blonigen et al., 2006). Thus, in terms of personality, twins who returned at Time 2 appear to be representative of the original sample.

Data Analysis

Similar to Roberts et al. (2001) and Donnellan et al. (2007), we employed several analytic techniques to assess stability and change in personality from late adolescence to early adulthood. Rank-order stability (i.e., consistency in the relative ordering of individuals in a population over time) was measured via test-retest correlation coefficients. Analyses of mean-level change (i.e., change in the absolute amount of a trait in a population over time) were conducted using a two-factor, repeated-measures ANOVA (time as the within-subjects variable, sex as the between-subjects variable). For all scales, we report effect sizes (using a

[1]Although the phenotypic analyses (i.e., rank-order stability, mean- and individual-level change) were conducted using pairwise deletion, this did not appear to bias the results as the test-retest correlations using an “all data” analytic technique (i.e., Full Information Maximum Likelihood) to correct for potential biases due to missing data were essentially identical to the correlations using the pairwise approach.

partial eta-squared; η^2) for the main effects of time and gender and the Gender × Time interaction. The main effect of time is also presented using Cohen's *d* statistic (Cohen, 1988), which demonstrates the direction and magnitude of change in a trait over time using standard deviation units. The pooled standard deviation across Times 1 and 2 was used as the denominator in these calculations. For both the rank-order and mean-level analyses, significance levels were tested using a mixed model in SAS to account for the correlated twin data. Individual-level change was measured via the Reliable Change Index (RCI; Christensen & Mendoza, 1986). The RCI, which accounts for unreliability due to measurement error, provides an index of individual-level change that is not simply attributable to regression to the mean (Hsu, 1989). The RCI is equal to an individual's difference score from Time 1 to Time 2 ($X_2 - X_1$) divided by the standard error of the difference between the two scores (S_{diff}). The S_{diff}, calculated using the standard error of measurement (SEM) of a trait at Time 1 and 2 ($S_{diff} = \sqrt{\left[(\text{SEM}_{\text{T1}})^2 + (\text{SEM}_{\text{T2}})^2\right]}$), represents the distribution of change scores that would be expected if no actual change has occurred. In other words, it is intended to gauge whether an individual exhibits change on a given trait that is greater than chance levels. RCI scores larger than +1.96 or smaller than −1.96 are considered reliable, as an RCI above or below these respective points has a *p*-value of less than .05. Therefore, if change is due solely to chance, RCI scores ± 1.96 should only occur 5% of the time (2.5% less than −1.96, 2.5% greater than +1.96). Similar to Donnellan et al. (2007), we used the 30-day retest correlations reported by McGue et al. (1993) to compute the SEM for the RCI analyses.

An analysis of individual-level change also provides an opportunity to further explore the growth and maturity hypothesis such that individuals exhibiting a personality profile indicative of “maturity” (low NEM, high CON) are less likely to change over time, whereas individuals exhibiting an “immature” profile (high NEM, low CON) will evince the most change in a direction towards growth and maturity. To test this hypothesis, we compared the personality profiles of individuals at age 17, grouped according to the number of scales on which they exhibited reliable change.

Biometric Analyses—Twin methodology and structural equation modeling were employed to index the relative genetic and environmental contributions to rank-order stability and change from late adolescence to early adulthood. Our primary aims were to (a) estimate the heritability of personality at Time 1 (age 17) and Time 2 (age 24), and examine the extent to which this heritability is consistent over time, and (b) assess the extent to which genetic and environmental variance in personality at Time 2 is contributed from Time 1 (i.e., stability) or is unique to Time 2 (i.e., change). It should be emphasized that the biometric analyses specifically address stability and change in the etiologic contributions to the variance in personality traits and, therefore, can only attest to the biometry of the rank-order correlations and not mean- or individual-level changes.

The twin method utilizes the difference in genetic similarity between MZ and DZ twin pairs to index the relative genetic and environmental contributions to an observed phenotype. Typically, this method decomposes the variance of a phenotype into three components: additive genetic effects (a^2; the summation of genes across loci), shared (c^2), and nonshared (e^2) environmental effects. The shared and nonshared environments represent influences that are common and unique to each member of a twin pair, respectively. Nonshared environmental variance also includes measurement error and state fluctuations.

We used a Cholesky decomposition to estimate the variance of each phenotype (i.e., MPQ primary scales and higher-order factors) and the covariance among these phenotypes that is due to genetic and environmental factors. Figure 1 provides a path diagram of this model for one member of a twin pair using the trait of Well-being as an example. This model was able to address the primary aims of the present study in two key respects. First, it allowed us to parse the shared variance between each MPQ scale at Time 1 and Time 2 into their genetic and environmental effects. This indexes the degree to which genetic and environmental variance at Time 2 is contributed from Time 1 (i.e., genetic and environmental contributions to rank-order stability) and is represented in Figure 1 by the a_{21} and e_{21} paths from the Time 1 additive genetic (A_1) and nonshared environmental (E_1) factors to the Time 2 phenotype (WB_{T2}). Second, this model allowed us to partition the unique variance at Time 2 into genetic and environmental factors. This provides an estimation of the degree to which genetic and environmental influences are innovative at Time 2 (i.e., genetic and environmental contributions to rank-order change) and is represented in Figure 1 by the a_{22} and e_{22} paths from the Time 2 additive genetic (A_2) and nonshared environmental (E_2) factors to the Time 2 phenotype (WB_{T2}). The innovative genetic influences at Time 2 are independent of the genetic influences at Time 1 and, thus reflect the unfolding of genetic processes over time. The Time 2 nonshared environmental factor (E_2), per its measurement as a residual factor, includes measurement error.

Model fitting analyses were performed in *Mx*, a structural equation-modeling package (Neale, Boker, Xie, & Maes, 2003). Models were fit to the raw data using Full Information Maximum Likelihood, an "all data" estimation procedure, which corrects for potential statistical biases due to missing data. Several models were fit to the data for each of the MPQ primary scales and higher-order factors. The process began by fitting a full model that included an additive genetic (*A*), shared environmental (*C*), and nonshared environmental (*E*) parameter and subsequently dropping parameters to test more parsimonious models. The Akaike Information Criterion ($AIC = \chi^2 - 2df$; Akaike, 1987) was used to select and adjudicate among the models. As a measure of model fit relative to parsimony, the AIC allows for an assessment of the comparative fit among several competing biometric models.

RESULTS

Rank-Order Stability in Personality From Age 17 to Age 24

Pearson correlations were used to estimate the 7-year test-retest stability coefficients among the MPQ primary scales and higher-order factors (see Table 2). The stability coefficients were moderate to large, ranging from .49 (Control) to .66 (Harm Avoidance). The average correlation was .55 with the majority falling between .50 and .60 (all *ps* <.001). Thus, at a rank-order level, the MPQ primary scales and higher-order factors are fairly stable from late adolescence to early adulthood.

Mean-Level Change in Personality From Age 17 to Age 24

Repeated measures ANOVAs were used to assess mean-level change among the MPQ primary scales and higher-order factors. The means, standard deviations, *d* scores, and effect-size estimates are presented in Table 2. Among the more notable findings were large mean-level changes on primary scales comprising NEM and CON. With respect to NEM, all lower-order scales showed a substantial and significant decrease over time, the most prominent being Aggression, followed by Alienation and Stress Reaction. Accordingly, NEM also decreased considerably over time. In terms of CON, a review of the lower-order scales revealed significant increases in both Control and Harm Avoidance. Traditionalism increased significantly; however, the effect size was relatively small. At the higher-order level, CON showed a significant increase over time. In contrast to NEM and CON, Agentic- and Communal-PEM remained relatively stable with effect sizes ranging from −.05 (Social Potency) to .31 (Achievement) across the primary scales of these factors. However, with the exception of Social Potency, the main effect of time was significant for Agentic- (increasing) and Communal-PEM (decreasing) and their respective indicators. Scores on the Absorption scale decreased moderately over time.

Individual-Level Change in Personality From Age 17 to Age 24

Individual-level change measured via the RCI is presented in Table 3. If change were random for a given trait, we would expect roughly 2.5% of the sample to decrease over time, 2.5% to increase, and 95% to stay the same. Such a pattern was not observed for any of the MPQ scales. That is, when comparing the observed distribution of changers and nonchangers to the expected distribution if change were random, chi-square statistics (χ^2) were highly significant for all scales. Although the majority of individuals stayed the same over time for all scales (range of 55.8%–80.7%), a significant minority exhibited reliable change. Moreover, the percentage of individuals decreasing or increasing reliably was highly congruent with the pattern of mean-level change. Specifically, NEM evinced the largest number of decreasers with percentages for the primary scales ranging from 29.9% (Aggression) to 35.7% (Alienation). Conversely, a pattern of increase was observed at both the primary and factor levels of CON, with Control yielding the largest percentage of increasers among all primary scales (26.9%). Agentic- and Communal-PEM also showed moderate reliable change at both the primary and higher-order levels. Consistent with its moderate mean-level decline, 27.8% of the sample decreased reliably on Absorption.

In examining individual-level change across the MPQ primary scales, we observed that while no individual changed on all 11 scales, the vast majority of individuals (94.7%) demonstrated reliable change on at least one scale, with three or four being the modal number of scales on which individuals changed reliably. To examine whether certain personality traits or profiles were associated with stability or change, we divided the sample into five groups, ranging from those who exhibited no reliable change to those who showed reliable change on seven or more scales and examined their MPQ profiles at age 17. Figure 2 displays the mean *T*-scores at age 17 for each group across the MPQ primary scales. From this figure, it can be seen that those who exhibited minimal or no reliable change over time were lowest on all facets of NEM and highest on nearly all facets of CON at age 17. Conversely, the group who exhibited the most reliable change (i.e., 7 to 10 scales) was highest on all facets of NEM and lowest on all facets of CON at age 17. When directly comparing the magnitude of the difference between these two extreme groups, the effect sizes are large for several primary scales of NEM and CON. In essence, those whose personality profile connotes the most maturity in late adolescence (low NEM, high CON) changed the least, whereas those appearing the most immature in terms of their personality (high NEM, low CON) showed the most change in a direction towards growth and maturity.

Gender Differences in Personality and Personality Change

We tested for gender differences in three areas: mean-level personality, mean-level change in personality, and rank-order stability. These results are shown in Table 4. Regarding gender differences at the mean level, women scored higher than men at ages 17 and 24 on all facets of CON and on Social Closeness and Stress Reaction. Men scored higher than women at ages 17 and 24 on Social Potency, Achievement, Alienation, and Aggression. In terms of gender differences in mean-level change, we found significant Gender × Time interactions for Agentic-PEM and CON as well as for the primary scales of Social Potency, Control, Harm Avoidance, and Absorption. Agentic-PEM's significant interaction was due primarily to Social Potency as men increased on this trait over time, while women decreased. For Control and Harm Avoidance, although men and women both increased, women increased substantially more than men over the 7-year period. Conversely, for Absorption, both men and women decreased over time with women decreasing at a faster rate. We did not find a significant interaction for NEM or any of its constituent primary scales as men and women decreased over time at a comparable rate. With respect to rank-order stability, test-retest correlations were comparable for men and women with most coefficients falling between .5 − .6. After adjusting the sample sizes to account for the correlated twin observations, *z*-tests revealed no significant difference in the correlations between men and women ($p<.01$).

Genetic and Environmental Contributions to Personality Traits From Age 17 to Age 24

Table 5 contains parameter estimates from the best-fitting Cholesky models for each MPQ primary scale and higher-order factor. For nearly all scales an *AE* model (additive genetic, nonshared environment) provided the best fit to the data as evaluated by AIC.[2] The inclusion of a shared environmental parameter failed to provide a better fit than the *AE* model for any of the scales. Moreover, when *C* was included in the model, parameter estimates were not significantly different from zero.[3] For most scales, the variances could be constrained across men and women without a significant decrease in model fit. However, gender differences were evident for several primary scales (Well-being, Social Potency, Alienation, Aggression, Harm Avoidance). Nonetheless, parameter estimates were highly comparable across men and women and could be constrained across gender for all models without a significant decrement in fit as indicated by likelihood ratio tests. In other words, although there were significant gender differences for the total variance, there were no significant gender differences in the proportion of variance attributable to genetic or environmental effects. Thus, parameter estimates are provided for only the combined sample (estimates constrained across gender) in Table 5.[4]

Our first aim in conducting the biometric analyses was to estimate the heritability of personality in late adolescence and early adulthood and examine the degree to which the magnitude of this heritability is consistent across this period. At ages 17 and 24, and across all MPQ primary scales, heritability estimates were moderate in magnitude with roughly half of the variance due to additive genetic effects and the other half due to nonshared environmental effects (heritabilities ranged from .30 to .60; mean heritability for the total sample at both 17 and 24 was .46). To test for consistency in the magnitude of these estimates over time, we examined whether models in which the additive genetic parameter estimates were constrained to be equal at ages 17 and 24 differed significantly from models in which they were allowed to vary. Across all primary scales and higher-order factors, only Social Closeness [$\chi^2(1) = 4.35$, $p = .037$] was significantly different—a finding which would be expected by chance. Thus, the magnitude of the heritability of personality appears consistent from late adolescence to early adulthood.

The second objective of the biometric analyses was to assess the degree to which genetic and environmental influences on personality at age 24 are contributed from age 17 (i.e., etiologic contributions to rank-order stability) or are unique to age 24 (i.e., etiologic contributions to rank-order change). These effects, presented in Table 5, are listed under “Variance Partition at Age 24.” Under this heading, the genetic and nonshared environmental estimates at Time 2 (a^2 at Age 24, and e^2 at Age 24) are each parsed into their stable and innovative components [e.g., a^2 at Age 24 = a^2 from 17 (stable) + a^2 unique (innovative)].

In comparing genetic and environmental contributions from age 17 (a^2 from 17, and e^2 from 17, respectively), for most scales the genetic influences were significantly larger than the environmental influences. This difference, however, did not reach significance for the primary

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[2]We also explored the fit of models that included a nonadditive genetic parameter (i.e., dominance). Such models provided a better fit, based on AIC, for only the Achievement scale. Given that this may be a chance finding (1 out of 15 scales), the results presented in Table 5 are based on the *AE* model for all scales. The dominance parameter estimates (*D*) for the Achievement scale, when using an *ADE* model, were .44 and .47 at ages 17 and 24, respectively.

[3]For the Alienation scale, the best-fitting model, according to AIC, was an *AE* model for men (additive genetic, nonshared environment) and an *ACE* model for women (additive genetic, shared environment, nonshared environment). However, the parameter estimates for Alienation that are presented in Table 5 are based on an *AE* model for *both* men and women. For the sake of parsimony, the shared environmental parameter estimates for women were omitted from Table 5. The shared environmental parameter estimates for women were .29 and .16 at ages 17 and 24, respectively.

[4]MZ and DZ intraclass correlations are available upon request from the first author.

scales of Stress Reaction, Alienation, and Control. Conversely, when comparing genetic and environmental contributions unique to age 24 (a^2 unique, and e^2 unique, respectively), nonshared environmental contributions were more prominent than genetic effects. Thus, the stable variance over time appears to be genetically mediated, whereas the unique variance is due primarily to the nonshared environment. It is noteworthy, however, that for all scales there were significant genetic contributions to rank-order change in personality at age 24 (a^2 unique), which for most scales were similar in magnitude to the genetic contributions to rank-order stability (a^2 from 17). Furthermore, when considering that the unique nonshared environmental estimates at age 24 (e^2 unique) include measurement error, the genetic and environmental contributions to rank-order change may be quite comparable. Collectively, the biometric findings suggest that genetic effects are more prominent for rank-order stability, whereas both environmental and genetic factors contribute to rank-order change in personality during the transition into adulthood.

DISCUSSION

The present study used a longitudinal-biometric design to investigate personality development from late adolescence to early adulthood. Our objectives were two-fold: (1) examine patterns of stability and change in personality; (2) explore the genetic and environmental contributions to rank-order stability and change in personality. With a few exceptions, findings were consistent with predictions. Test-retest correlations suggested that, relative to one another, individuals remain stable on all dimensions of personality from late adolescence to early adulthood. Conversely, significant normative changes were observed for several traits over this period and connoted a pattern of growth and maturity. Furthermore, individuals exhibiting the most reliable change appeared the most “immature” at age 17 (highest on facets of NEM, lowest on facets of CON), whereas individuals evincing minimal or no reliable change appeared the most “mature” at age 17 (lowest on facets of NEM, highest on facets of CON). Biometric findings were consistent with predictions in that rank-order stability was primarily a function of genes, whereas rank-order change owed largely to environmental effects. However, for all scales, there were significant genetic contributions to rank-order change, suggesting that genetic innovation may work in concert with environmental influences to promote personality development during the transition into adulthood.

Developmental Trends in Personality From Late Adolescence to Early Adulthood: Further Evidence for the Maturity Principle

In addressing our first objective, we observed several noteworthy similarities and differences between the present findings and prior studies of personality development across this period. Given the similarities in sample, methodology, and measurement, we will focus on similarities and differences between the present study and that of Roberts et al. (2001) and Donnellan et al. (2007). Regarding their convergence, rank-order stabilities in the present study were comparable to Roberts et al. (2001) and Donnellan et al. (2007) as well as the literature as a whole (e.g., Roberts & DelVecchio, 2000). Of greater interest, however, are the congruent mean-level findings across all three studies. Specifically, parallel declines and increases on NEM and CON, respectively, suggest a normative pattern of psychological growth and maturity during the transition into adulthood. Interestingly, in comparison to Roberts et al. (2001), substantially larger mean-level changes were observed in both the present study and by Donnellan et al. (2007), with effect sizes from these studies more than twice as large as was found in the Dunedin sample. All told, the present findings appear to reaffirm the maturity principle of personality development (Caspi et al., 2005).

The present findings were also consistent with Roberts et al. (2001) and Donnellan et al. (2007) with respect to the effect of maturity on personality development as the most mature individuals changed the least during the transition into adulthood. This link between maturity and stability raises questions as to the precise mechanisms underlying this association. Roberts and Caspi (2003) posited that maintenance and commitment to an identity may facilitate personality stability. That is, individuals who have a clearer conception of “who they are” in adolescence may be less likely to seek out novel contexts that contrast with their personalities and press for a change in behavior, or they may simply choose social roles that align with their self-concept. Alternatively, if we assume all individuals aim for a high level of psychological maturity, the maturity-stability link may reflect the fact that early maturing individuals have already reached “adult” personality functioning and have less impetus for change, as well as face fewer external pressures to change (e.g., from romantic partners, demands of the workplace). Clearly, an examination of which perspective accounts for the robust link between early maturation and personality stability deserves further inquiry.

Despite their general accord, there were notable differences between our findings and Roberts et al.'s (2001). For example, Agentic-PEM remained stable over time in the present study but exhibited a large mean-level increase in the Dunedin sample. This difference appears to be attributable to Social Potency as the findings for Achievement were fairly comparable across the two studies. In addition, we observed significant mean-level changes for Stress Reaction and Harm Avoidance that were not observed by Roberts and colleagues (2001). With regard to these two scales, this “inconsistency” could be construed as consistent with the overarching conclusions of Roberts et al. (2001). That is, normative declines in one's propensity to be worried or anxious combined with a normative increase in one's avoidance of dangerous and risky ventures connotes a level of emotional stability that is essentially on par with previous descriptions of the maturity principle (Caspi et al., 2005). Moreover, similar declines in Stress Reaction were reported in Donnellan et al. (2007) as well as other longitudinal studies of young adulthood (McGue et al., 1993; Robins et al., 2001).

The lack of a mean-level increase for Social Potency is somewhat surprising as such changes have been observed in prior investigations (e.g., Helson & Kwan, 2000; Roberts et al., 2006). In contrast, McGue et al. (1993), utilizing a different sample of twins from Minnesota, found no mean-level change in Social Potency, and Donnellan et al. (2007), using a sample from Iowa, observed moderate mean-level decline for this scale. This suggests the possibility of national or cultural differences between the Midwestern and Dunedin samples. Alternatively, given that mean-level change may also reflect historical processes shared by a population, the discrepancies in question could represent cohort differences across these samples. Although further conjecture would be purely speculative, disentangling the nature of this difference is another intriguing area for future investigation.

Gender Differences in Personality Development From Late Adolescence to Early Adulthood

The inclusion of both male and female participants was valuable in allowing us to explore gender differences in personality and personality development during the transition into adulthood. Consistent with prior research, including the Roberts and DelVecchio (2000) meta-analysis, men and women exhibited comparable rank-order stability across all dimensions of personality. In terms of mean-level differences, women were higher in late adolescence and early adulthood on all facets of CON as well as Social Closeness and Stress Reaction, whereas men were higher at both time points on facets of Agentic-PEM as well as Alienation and Aggression. From the perspective of gender differences in personality change over time, women increased significantly more than men on facets of CON— a finding consistent with Roberts et al. (2001) and Donnellan et al. (2007) and indicative of a greater rate of maturity in women during the transition to early adulthood. Conversely, men increased at a greater rate than women on both facets of Agentic-PEM. However, this interaction was not significant for the Achievement scale. Men and women did not differ significantly in their rate of decline on any facets of NEM and thus appear to be maturing comparably with respect to their experience of negative affect (see Kirk et al., 2000). Of note, Roberts et al. (2006) in their meta-analysis of mean-level change found little support for gender differences in personality development over time. However, these authors examined gender as a moderator of personality change across the life course, which may have obscured relatively smaller and significant gender differences during specific periods of development.

Biometric Contributions to Personality Development During the Transition Into Adulthood: Genetic Influences on Change and Implications for Developmental Models of Personality

Among the more novel aspects of the present design was our use of the genetically informative twin sample to disentangle genetic and environmental contributions to rank-order stability and change in personality. Although a handful of behavioral genetic studies have examined personality development in adulthood (e.g., Johnson, McGue, & Krueger, 2005; McGue et al., 1993; Pedersen & Reynolds, 1998; Viken, Rose, & Koskenvuo, 1994), virtually no such studies have been conducted during the critical transition from adolescence into adulthood (but see Dworkin et al., 1976). In seeking to address this gap in the literature, the present study found rank-order stability to be primarily attributable to genetic influences, whereas rank-order change was largely mediated by the nonshared environment and error. In observing this same pattern in their sample, McGue et al. (1993) suggested that the influence of the environment on personality development may be short-lived relative to the enduring influence of genes. Although consistent with the aforementioned “set-point” model (Lykken & Tellegen, 1996; but see Lucas, 2007), this conclusion does not preclude the possibility that environmental factors influence personality stability via gene-environment correlations (i.e., individuals seeking out or eliciting experiences consistent with their genetic endowments; Scarr & McCartney, 1983).

Despite the predominance of the nonshared environment on rank-order change, significant genetic contributions to change were observed for all MPQ scales in the present sample—a finding also observed by McGue and colleagues (1993). Moreover, we should reiterate that these effects were measured as residual variance in the present study and are therefore confounded with measurement error. It is plausible that after correcting for this error variance, the impact of genetic factors on rank-order change may be comparable to the impact of the environment during this period. Notably, this finding does contradict past claims as to the limited significance of genetic contributions to change beyond childhood (e.g., Eaves & Eysenck, 1976; Eaves, Eysenck, & Martin, 1989; Loehlin, 1992). For example, Eaves and colleagues (1989) previously asserted that there is little evidence to support the notion of innovative genetic effects at different junctures in adulthood (see also Gillespie, Evans, Wright, & Martin, 2004). However, the transition into adulthood may represent an exception to this case, given the extensive psychological and neurobiological development that marks this period. Consequently, the dearth of behavioral genetic studies on this formative developmental period may have overstated the prominence of the environment to personality change. In conjunction with prior research (McGue et al., 1993), the current findings suggest that genetic factors may be a salient contributor to rank-order change in personality during the transition into adulthood. Fundamentally, such influences may represent the unfolding of genetic processes over time, which become expressed in response to transactions with the environment.

Beyond the implications for this particular developmental period, the current design represents an important first step in resolving discrepancies between various developmental theories of personality described in the literature (e.g., Baltes, Lindenberger, & Staudinger, 1998; Kogan, 1990). Among the more prominent theories are *trait* and *interactional* models. Trait models are noted for their conception of personality as “temperaments” that are underpinned by constitutional (genetic) factors and relatively uninfluenced by the environment beyond mere trait expression (McCrae et al., 2000). Conversely, other scholars (Roberts & Caspi, 2003) espouse interactional models, which stress the importance of transactions between traits and contexts throughout the lifespan. According to this model, both genetic and environmental factors contribute to stability and change in rank order on personality traits through a series of transactions between individuals and their social milieu.

The present findings of both genetic and environmental contributions to rank-order change ostensibly support a dynamic, interactional model of personality development. However, it is difficult to infer what developmental processes are operating, given that genetic contributions to change may reflect both the unfolding of genetic processes over time as well as gene-environment interactions and correlations (i.e., person-environment transactions). For example, social roles related to work, marriage, or parenting can exert a considerable influence on developmental trajectories in personality (Hogan, 1996) and psychological well-being (see Galambos, Barker, & Krahn, 2006). Such influences, however, may be interactional, such that individuals actively select and shape their environments, which serves to accentuate preexisting dispositions (Roberts, Caspi, & Moffitt, 2003). Conversely, an individual's personality may become modified as he or she responds to contingencies that accompany new social roles (Sarbin, 1964) or receive feedback from others about themselves (i.e., symbolic interactionism; Stryker & Statham, 1985). The present biometric analyses are somewhat limited in their ability to test the more nuanced hypotheses offered by these developmental theories. Accordingly, future studies must build upon the present findings and incorporate gene-environment interaction and correlational models (Purcell, 2002) so as to delineate the mechanisms underlying stability and change in personality. Nevertheless, the present study is an important first step in the incorporation of biometric evidence into studies of personality development during emerging adulthood and suggests that rank-order change in personality during this period is not simply a function of the environment.

Limitations and Future Directions

We conclude by addressing limitations and future directions for the present research. First, although the magnitude of the normative changes in the present study were for several scales nearly twice as large as was found by Roberts et al. (2001), the reasons for these differences are ambiguous. While this disparity could represent cohort or cultural differences between the Minnesota and Dunedin (New Zealand) samples, both studies also differ in the versions of the MPQ they employed. In the Dunedin study, participants completed a modified, 177-item version of the MPQ (Form NZ) consisting of a two-choice response format, whereas the Minnesota sample completed a 198-item version with a four-choice response format. Thus, the disparity in magnitude could conceivably reflect a measurement artifact rather than legitimate cohort or cultural differences. While this may not be a limitation per se, it still must be noted that the present investigation cannot definitively ascertain the nature of this difference. Nevertheless, the convergence in the pattern of mean-level change across the two samples is reassuring and suggests that maturity is the normative developmental trend during emerging adulthood.

A second limitation was our reliance on a single self-report measure of personality. Although the MPQ has considerable advantages in that its structure provides both bandwidth and fidelity in the assessment of the personality trait hierarchy, it is still subject to the same rater and method biases inherent in self-report measures. Furthermore, it is important to note that reliance on a single method of assessment in behavioral genetic studies of personality development limit the ability to disentangle true nonshared environmental effects on rank-order change from measurement error. Indeed, evidence from Riemann and colleagues (1997) using self- and peer reports suggest that nonshared environmental effects on personality may be overestimated relative to genetic influences when using self-report alone. On one hand, this lends credence to the significance of genetic contributions to rank-order change in the present study, given that we could not parse nonshared environmental effects from error. However, this issue remains as a serious limitation in contemporary biometric studies of personality development due to the potential bias in estimating genetic and environmental parameters. It is imperative that future studies use a multimethod approach to create latent factors free of measurement-specific variance in order to index stability and change in personality more precisely at both phenotypic and biometric levels of analysis.

Third, the current study, although comprehensive in many regards for a longitudinal design, was confined to two time points. Hence, the present analyses are limited in their ability to model nonlinear patterns of change as well as their ability to examine biometric contributions to individual differences in developmental trajectories. As a consequence of this latter point, it should be reiterated that the biometric results only pertain to stability and change in the etiologic contributions to the variance of these traits and cannot attest to the biometry of the mean- or individual-level changes. Future studies would be well served to utilize other methodological techniques (e.g., growth curve models) to decipher the relative contributions of genes and environments to individual-level changes in personality during the transition into adulthood (Neale & McArdle, 2000).

In sum, the present findings further validate the maturity principle as the normative trend in personality development during the formative transition into adulthood. From here, it will be interesting to explore the mechanisms that mediate and moderate these developmental patterns. Genetically informative designs may prove invaluable in this process by elucidating the genetic and environmental factors and their transactions over time that are most salient during this period. Moreover, the transition into adulthood is marked by several important developmental phenomena (e.g., identify formation, peaks in mental illness, desistance in criminal activity). The study of personality development and its etiologic underpinnings could potentially broaden our knowledge of these phenomena that highlight the transition from adolescence to adulthood.

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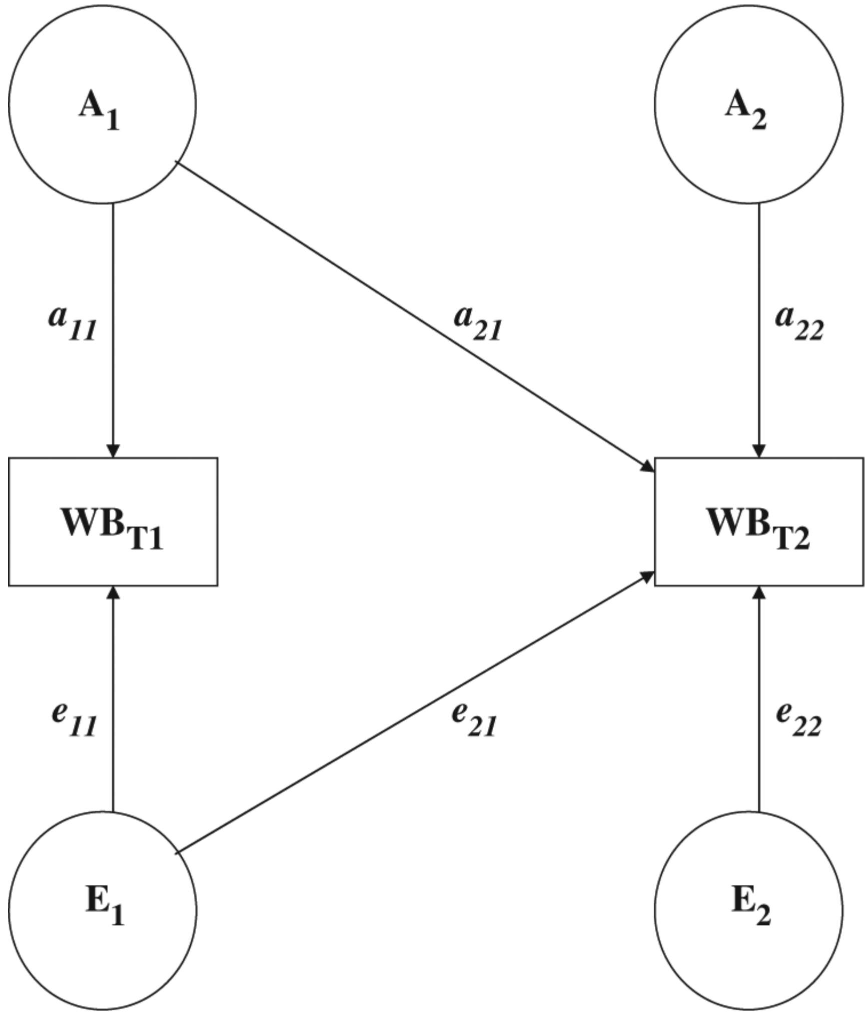

Figure 1.
A path diagram of an AE Cholesky model for Well-being (WB) at Time 1 (T1) and Time 2 (T2). For the sake of parsimony, shared environmental effects were omitted from this diagram, and the paths are only shown for one member of a twin pair. In this model the variance at each time point is decomposed into additive genetic (A_1, A_2,) and nonshared environmental effects (E_1, E_2). a_{11} & e_{11} = paths representing additive genetic and nonshared environmental contributions to the Time 1 phenotype, respectively; a_{21} & e_{21} = paths representing additive genetic and nonshared environmental contributions from Time 1 to the Time 2 phenotype, respectively; a_{22} & e_{22} = paths representing additive genetic and nonshared environmental contributions unique to the Time 2 phenotype, respectively. These paths are squared to estimate the proportion of variance accounted for by additive genetic and nonshared environmental influences.

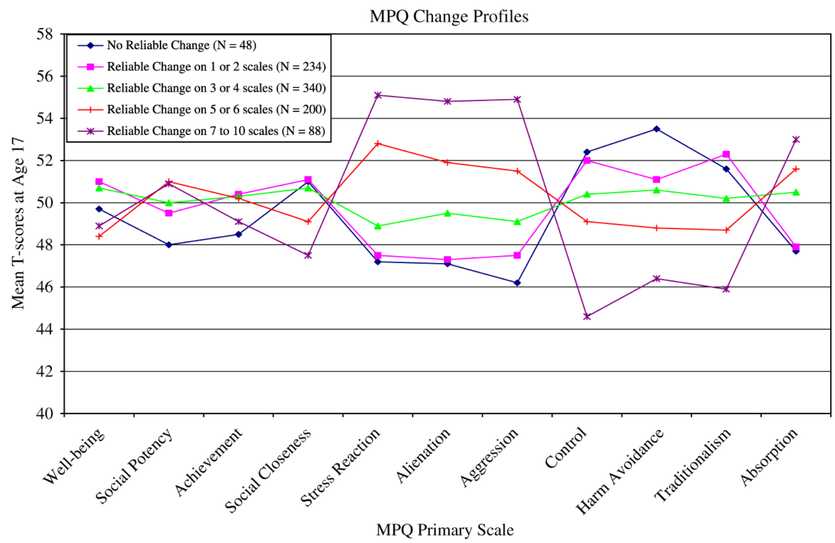

Figure 2.

MPQ personality profiles for groups exhibiting varying levels of reliable change over time. Mean T-scores at age 17 are depicted for all MPQ primary scales separated into five groups ranging from those exhibiting no reliable change from ages 17 to 24 to those exhibiting reliable change on seven or more scales. We conducted univariate ANOVAs to test for significant differences between the groups in mean levels of each trait. Well-being, $F(4, 905) = 2.57$, $p<.05$; Social Potency, $F(4, 905) = 1.34$, *ns*; Achievement, $F(4, 905) = 0.64$, *ns*; Social Closeness, $F(4, 905) = 3.18$, $p<.05$; Stress Reaction, $F(4, 905) = 16.48$, $p<.05$; Alienation, $F(4, 905) = 13.37$, $p<.05$; Aggression, $F(4, 905) = 13.68$, $p<.05$; Control, $F(4, 905) = 10.69$, $p<.05$; Harm Avoidance, $F(4, 905) = 6.15$, $p<.05$; Traditionalism, $F(4, 905) = 7.99$, $p<.05$; Absorption, $F(4, 905) = 6.71$, $p<.05$. *F*-tests remained significant after controlling for gender.

Table 1

Reliability Estimates and Scale Descriptions for MPQ Primary Scales and Higher-Order Factors

MPQ Scale	Age 17 Reliability	Age 24 Reliability	Description of a High Scorer
Well-being	.88	.90	Has a cheerful disposition; tends to be optimistic; lives an active and exciting life
Social potency	.87	.89	Prefers to take charge; is persuasive; enjoys influencing people; decisive
Achievement	.87	.87	Enjoys demanding projects; will put work ahead of other activities; diligent
Social closeness	.87	.88	Sociable; enjoys the company of others; values close interpersonal ties
Stress reaction	.87	.89	Prone to worry; sensitive; easily upset or irritable; guilt prone
Alienation	.87	.91	Suspicious of others' motives; feels they are often treated unfairly; sees self as victim
Aggression	.90	.89	Competitive; will intimidate others; may seek revenge for a perceived wrongdoing
Control	.84	.86	Reflective and rational; likes to plan ahead; cautious
Harm avoidance	.84	.88	Would prefer safe and tedious to potentially risky and exciting tasks
Traditionalism	.78	.81	Values high moral standards and a conservative social order; rarely challenges authority
Absorption	.86	.87	Easily engrossed in sensory experiences; may think in terms of images
Agentic positive emotionality	.89	.90	High on Social Potency and Achievement; enjoys challenging tasks and taking charge
Communal positive emotionality	.91	.92	High on Well-being and Social Closeness; derives pleasure from close social ties
Negative emotionality	.92	.94	Experiences negative emotions such as anger, sadness and anxiety more often than others
Constraint	.88	.89	Is cautious and planful; values order; tries to follow the rules

Note: Cronbach's alpha was used for reliability estimates of the 11 primary scales. Reliability estimates for the four higher-order factors were generated using a composite reliability. MPQ = Multidimensional Personality Questionnaire.

Table 2

Rank-Order Stability and Mean-Level Change in MPQ Personality Traits From Age 17 to Age 24

MPQ Scale	7-Year Stability Coefficient	Age 17		Age 24		*d* score	η^2
		M	*SD*	*M*	*SD*		
Well-being	.50*	50.0	10.0	51.0	10.1	.10	.01†
Social potency	.59*	50.0	10.0	49.7	10.7	−.05	.00
Achievement	.53*	50.0	10.0	53.1	9.5	.31	.09*
Social closeness	.53*	50.0	10.0	51.4	9.7	.13	.02*
Stress reaction	.55*	50.0	10.0	45.3	10.1	−.47	.20*
Alienation	.50*	50.0	10.0	42.5	10.0	−.77	.37*
Aggression	.56*	50.0	10.0	42.7	8.4	−.81	.42*
Control	.49*	50.0	10.0	55.3	10.1	.55	.23*
Harm avoidance	.66*	50.0	10.0	54.1	10.6	.40	.19*
Traditionalism	.56*	50.0	10.0	51.8	10.1	.17	.03*
Absorption	.52*	50.0	10.0	46.7	10.0	−.33	.10*
Agentic-PEM	.60*	50.0	10.0	50.8	9.6	.09	.01*
Communal-PEM	.55*	50.0	10.0	49.0	9.9	−.11	.01†
NEM	.53*	50.0	10.0	42.3	10.2	−.77	.39*
CON	.62*	50.0	10.0	55.0	9.6	.52	.26*

Note: N = 910−931. Means and standard deviations are presented in a *T*-score metric (raw scores available from first author). Mean *T*-scores at age 24 were generated after standardizing the Age 17 scores (M = 50, SD = 10). *d* score & η^2= Cohen's *d* statistic and partial eta-squared effect sizes, respectively. MPQ = Multidimensional Personality Questionnaire; PEM = Positive Emotionality; NEM = Negative Emotionality; CON = Constraint.

Significance levels were adjusted in a mixed model in SAS to account for the dependent nature of the twin observations.

† p<.01.

* p<.001.

Table 3

Individual-Level Change in MPQ Personality Traits From Age 17 to Age 24

MPQ Scale	Decreased (%)	Stayed the Same (%)	Increased (%)	χ^2 (2)
Well-being	15.3	63.1	21.6	2,066.6*
Social potency	10.9	80.7	8.4	416.1*
Achievement	9.8	67.0	23.2	1,857.3*
Social closeness	15.4	62.3	22.3	2,218.7*
Stress reaction	30.4	63.3	6.3	3,045.1*
Alienation	35.7	61.2	3.1	4,210.8*
Aggression	29.9	68.2	1.9	2,876.0*
Control	5.2	67.9	26.9	2,319.5*
Harm avoidance	4.5	72.6	22.9	1,634.7*
Traditionalism	12.6	67.5	19.9	1,540.2*
Absorption	27.8	60.9	11.3	2,778.9*
Agentic-PEM	8.6	77.9	13.5	594.4*
Communal-PEM	19.5	66.1	14.4	1,618.2*
NEM	41.0	55.8	3.2	5,475.0*
CON	4.1	65.9	30.0	2,807.1*

Note: N = 910−931. The reliable change index was used to determine the percentage of individuals increasing, decreasing, and staying the same. The chi-square test de-termines whether the observed distribution in the sample differed from the expected distribution (2.5% decrease, 95% same, 2.5% increase) if change were completely random. MPQ = Multidimensional Personality Questionnaire; PEM = Positive Emotionality; NEM = Negative Emotionality; CON = Constraint.

* p<.001.

Table 4

Gender Differences in Personality and Personality Change From Age 17 to Age 24

	Cross-Sectional Differences						Longitudinal Differences in Change		
	Age 17		Age 24		Gender *d* score		Change Over Time *d* score	Gender × Time η^2	Test-retest[a] Stability Coefficient
MPQ Scale	*M*	*SD*	*M*	*SD*	Age 17	Age 24			
Well-being					.04	−.07		.00	
Women	50.2	10.7	50.7	10.9			.07		.54*
Men	49.8	9.1	51.5	9.1			.16		.42*
Social Potency					−.15	−.43		.03*	
Women	49.3	10.3	47.8	10.6			−.17		.58*
Men	50.8	9.6	52.3	10.2			.12		.61*
Achievement					−.23	−.40		.01	
Women	49.0	9.9	51.5	9.2			.24		.55*
Men	51.3	10.0	55.2	9.4			.42		.47*
Social Closeness					.44	.43		.00	
Women	51.9	10.2	53.2	9.4			.13		.52*
Men	47.6	9.3	49.0	9.7			.13		.48*
Stress Reaction					.36	.31		.00	
Women	51.6	10.2	46.6	10.2			−.48		.56*
Men	48.0	9.4	43.5	9.7			−.47		.51*
Alienation					−.14	−.14		.00	
Women	49.4	10.6	41.9	9.7			−.76		.53*
Men	50.8	9.1	43.3	10.2			−.78		.46*
Aggression					−.83	−.85		.00	
Women	46.5	9.5	39.9	7.1			−.85		.53*
Men	54.3	9.0	46.5	8.5			−.90		.44*
Control					.15	.47		.02*	
Women	50.7	10.3	57.3	9.8			.67		.47*
Men	49.2	9.5	52.6	10.0			.38		.51*
Harm Avoidance					.65	1.00		.05*	
Women	52.8	9.8	58.1	8.9			.59		.61*
Men	46.6	9.2	48.6	10.1			.20		.65*
Traditionalism					.19	.00		.01	
Women	50.9	9.9	51.8	9.7			.11		.55*
Men	48.9	10.0	51.8	10.5			.25		.59*
Absorption					.19	−.09		.02*	
Women	50.8	10.2	46.4	9.8			−.45		.52*
Men	49.0	9.6	47.2	10.3			−.16		.53*
Agentic-PEM					−.22	−.52		.03*	
Women	49.0	10.4	48.7	9.4			−.04		.64*
Men	51.2	9.3	53.6	9.0			.29		.51*
Communal-PEM					.13	.06		.00	
Women	50.6	10.1	49.2	9.9			−.12		.55*
Men	49.3	9.8	48.6	10.0			−.10		.55*
NEM					−.15	−.24		.00	
Women	49.3	10.4	41.2	10.2			−.81		.54*
Men	50.8	9.5	43.7	10.1			−.72		.51*
CON								.01†	
Women	52.1	10.0	57.7	8.8	.48	.70	.63		.56*

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	Cross-Sectional Differences						Longitudinal Differences in Change		
	Age 17		Age 24		Gender *d* score		Change Over Time *d* score	Gender × Time η^2	Test-retest[a] Stability Coefficient
MPQ Scale	*M*	*SD*	*M*	*SD*	Age 17	Age 24			
Men	47.4	9.4	51.4	9.6			.41		.65*

Note. N = 910–931. (N_{Women} = 530–543, N_{Men} = 380–388). Mean *T*-scores at Age 17 and 24 were standardized within gender. (M = 50, SD = 10). MPQ = Multidimensional Personality Questionnaire; PEM = Positive Emotionality; NEM = Negative Emotionality; CON= Constraint. Gender d-scores = difference between women and men divided by the pooled standard deviation. Change over time *d*-scores = magnitude of the differences within gender over time divided by the pooled standard deviation. Gender × Time η^2 = magnitude of the effect size for the interaction between Gender and Time.

Significance levels were adjusted in a mixed model to account for the correlated twin observations.

† $p<.01$

* $p<.001$.

[a] There were no significant differences in correlations between men and women ($p<.01$).

Table 5

Parameter Estimates From Cholesky Models for MPQ Primary Scales and Higher-Order Factors (Age 17 to Age 24)

	Age 17		Age 24		Variance Partition at Age 24			
MPQ Scale	a^2	e^2	a^2	e^2	a^2 (from 17)	e^2 (from 17)	a^2 (unique)	e^2 (unique)
Well-being	.50 (.42, .57)	.50 (.43, .58)	.46 (.38, .54)	.54 (.46, .62)	.20 (.13, .29)	.05 (.02, .09)	.26 (.17, .34)	.48 (.41, .56)
Social Potency	.50 (.42, .56)	.50 (.44, .58)	.41 (.32, .49)	.59 (.51, .68)	.26 (.18, .34)	.11 (.07, .17)	.15 (.08, .22)	.48 (.41, .55)
Achievement	.42 (.34, .50)	.58 (.50, .66)	.43 (.33, .52)	.57 (.48, .67)	.22 (.14, .32)	.08 (.04, .13)	.21 (.12, .29)	.49 (.41, .57)
Social Closeness	.31 (.21, .40)	.69 (.60, .78)	.43 (.34, .52)	.57 (.48, .66)	.27 (.16, .40)	.07 (.03, .11)	.16 (.05, .26)	.50 (.42, .58)
Stress Reaction	.38 (.29, .46)	.62 (.54, .71)	.41 (.32, .50)	.59 (.50, .68)	.20 (.12, .29)	.11 (.07, .17)	.21 (.13, .29)	.48 (.41, .56)
Alienation	.40 (.32, .47)	.60 (.53, .68)	.44 (.35, .52)	.56 (.48, .65)	.20 (.12, .29)	.09 (.05, .14)	.25 (.16, .33)	.47 (.40, .55)
Aggression	.45 (.37, .52)	.55 (.48, .63)	.53 (.45, .60)	.47 (.40, .55)	.25 (.17, .35)	.05 (.02, .09)	.28 (.20, .36)	.42 (.36, .49)
Control	.37 (.29, .46)	.63 (.55, .71)	.30 (.19, .39)	.70 (.61, .81)	.15 (.07, .24)	.11 (.06, .17)	.15 (.07, .24)	.59 (.51, .68)
Harm Avoidance	.51 (.43, .57)	.49 (.43, .57)	.51 (.42, .58)	.49 (.42, .58)	.37 (.28, .46)	.08 (.04, .12)	.14 (.06, .21)	.42 (.36, .49)
Traditionalism	.60 (.54, .66)	.40 (.34, .46)	.57 (.50, .64)	.43 (.36, .50)	.33 (.25, .41)	.03 (.01, .05)	.24 (.16, .32)	.40 (.34, .47)
Absorption	.48 (.40, .55)	.52 (.45, .60)	.46 (.38, .54)	.54 (.46, .62)	.25 (.17, .33)	.06 (.03, .11)	.21 (.14, .29)	.47 (.41, .55)
Agentic-PEM	.50 (.43, .57)	.50 (.43, .57)	.49 (.41, .57)	.51 (.43, .59)	.35 (.26, .44)	.06 (.03, .11)	.15 (.07, .23)	.44 (.38, .52)
Communal-PEM	.48 (.40, .55)	.52 (.45, .60)	.51 (.43, .59)	.49 (.41, .57)	.26 (.18, .35)	.07 (.04, .12)	.25 (.17, .33)	.42 (.35, .49)
NEM	.40 (.31, .47)	.60 (.53, .69)	.45 (.36, .53)	.55 (.47, .64)	.23 (.15, .33)	.08 (.05, .13)	.22 (.13, .30)	.47 (.40, .54)
CON	.53 (.46, .60)	.47 (.40, .54)	.50 (.42, .58)	.50 (.42, .58)	.26 (.18, .34)	.11 (.06, .16)	.24 (.17, .31)	.39 (.33, .46)

Note. *N* = 1252 individuals from 626 twin pairs, some with missing data. a^2 = additive genetic variance; e^2 = nonshared environmental variance. Variance Partition at Age 24 = Partitioning of the total variance at age 24 into the genetic and environmental effects that are contributed from age 17 (from 17), and genetic and environmental effects which are unique to age 24 (unique). 95% Confidence Intervals are listed in parentheses underneath the respective parameter estimates. All estimates are from a combined model in which the parameter estimates were constrained across men and women. MPQ = Multidimensional Personality Questionnaire; PEM = Positive Emotionality; NEM 5 Negative Emotionality; CON = Constraint.