Most of the Girls Are Alright, but Some Aren't: Personality Trajectory Groups From Ages 14 to 24 and Some Associations With Outcomes

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Personality traits show normative patterns of development toward maturity during adolescence. Yet individuals follow these normative patterns to differing degrees. This study used growth mixture modeling to characterize personality development patterns and their associations with outcomes in a population-based sample of 1,537 girls aged 14 to 24. The authors used latent class analysis to identify 3 trajectory groups labeled *alright* (47%), *growing up* (42%), and *trouble* (11%). Alright group members were more likely at age 24 to have completed college, remained involved with their families, and obtained good jobs. Trouble group members were more likely to be involved with drugs and alcohol, to display interpersonal problems, and to behave antisocially. Growing up group members fell in between.

Keywords: personality development, trajectory classes, longitudinal study, adolescence, young adult outcomes

Personality traits are structurally cohesive and differentiable patterns of behavior, cognition, and affective reactivity that show consistency over time and across situations. Though sometimes conceptualized as inherent and immutable internal dispositions (McCrae et al., 2000), a more nuanced perspective is that personality traits are developmentally dynamic constructs that exhibit both change and stability throughout the life span (Roberts & Caspi, 2003). Consistent with this perspective, there has been a steady accumulation of research documenting systematic patterns of developmental change and stability in personality traits (Caspi, Roberts, & Shiner, 2005; Roberts & DelVecchio, 2000; Roberts, Walton, & Viechtbauer, 2006) across the life span. Two findings are of particular note. First, the period of greatest developmental change is the transition from late adolescence to young adulthood (Blonigen, Carlson, Hicks, Krueger, & Iacono, 2006; Roberts, Caspi, & Moffitt, 2001; Roberts et al., 2006). Second, this developmental transition is characterized by dramatic mean-level decreases in traits relating to negative emotionality (e.g., dispositional anxiety or neuroticism, aggression, antagonism) and behavioral disinhibition (e.g., impulsivity, irresponsibility, sensation seeking; Blonigen et al., 2007; Johnson, in press; McGue, Bacon, & Lykken, 1993; Roberts et al., 2001; R. W. Robins, Fraley, Roberts, & Trzesniewski, 2001). This normative trend toward greater self-control, risk avoidance, agreeableness, and emotional stability that marks the ascension into adulthood has been characterized as the *maturity principle* (Caspi et al., 2005); that is, individuals' personality structures tend to exhibit developmental adaptation to cope with the increasingly demanding and complex tasks of adulthood.

Although there is substantial evidence to support the maturity principle during the transition into adulthood, it is important to note that the principle refers to mean change for the population as a whole. In fact, many individuals exhibit either no change from adolescent levels or change in a direction opposing the overall population trend (Blonigen et al., 2006; Roberts et al., 2001; R. W. Robins et al., 2001). Therefore, it is necessary to make some distinctions among individuals in order to capture fully the heterogeneity of personality development.

Normative Developmental Change in Personality

Cross-sectional studies have accumulated an impressive body of results consistent with the maturity principle of personality development. For example, a recent Internet-based study of 132,515 participants found that Conscientiousness and Agreeableness (Srivastava, John, Gosling, & Potter, 2003) were higher in older than in younger participants on average. In addition, Neuroticism was lower in older than in younger women, though this was not the same for men. Other studies have collected data from several countries, with participants in

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each country exhibiting similar patterns of cross-sectional age differences, suggesting that the maturity principle of personality development is ubiquitous. For example, McCrae et al. (1999) and McCrae et al. (2000) examined cross-sectional age differences on scales of the NEO Personality Inventory–Revised (NEO-PI-R) in Germany, Italy, Portugal, Croatia, Korea, the United Kingdom, Spain, the Czech Republic, and Turkey. For all countries, there was a tendency for older age groups to exhibit lower mean scores on Neuroticism and Extraversion and higher mean scores on Agreeableness and Conscientiousness. Similar results were also found for both self-report and observer ratings in Czech and Russian samples (McCrae et al., 2004).

Longitudinal studies are consistent with cross-sectional studies. R. W. Robins et al. (2001) examined personality change over a 4-year period in a large sample of college students and detected mean-level increases in Agreeableness and Conscientiousness and decreases in Neuroticism. McGue et al. (1993) used the Multidimensional Personality Questionnaire (MPQ; Tellegen, 2006) to examine personality change roughly from ages 20 to 30 in a volunteer twin sample in Minnesota and detected significant decreases in negative emotionality (Stress Reaction, Alienation, and Aggression) and increases in behavioral constraint (Control and Harm Avoidance). These results have since been replicated with large epidemiological samples. Roberts et al. (2001) examined personality change in a total birth cohort in New Zealand and detected mean-level decreases in negative emotionality and increases in behavioral constraint from ages 18 to 26. Blonigen et al. (2006) also replicated these findings (though with notably greater effect sizes) when examining personality change from ages 17 to 24 in a large population-based sample of male and female twins living in Minnesota. Johnson (in press) further reported that for the female twins in this sample the greatest change occurred from ages 17 to 20, with continuing but moderated declines in traits of negative emotionality and behavioral disinhibition out to age 24. A recent meta-analysis of longitudinal studies of personality traits reached similar conclusions, showing age-related increases in traits of emotional stability, agreeableness, and conscientiousness in this age group (Roberts et al., 2006).

Although these studies demonstrate the robustness of the maturity principle at the population level, analyses of individual-level change reveal a more complex story. Both Blonigen et al. (2006) and Roberts et al. (2001) reported that for each MPQ scale the majority of individuals failed to exhibit any significant change from adolescence to adulthood. Additionally, for each scale a statistically significant (i.e., more than would be expected by chance alone) percentage of the sample exhibited change in the direction opposite from the overall sample. Moreover, both studies found that persons who exhibited the highest levels of negative emotionality and behavioral disinhibition in adolescence also experienced the greatest change, whereas persons who showed the reverse pattern (i.e., highest levels of emotional stability and behavioral control) in adolescence exhibited the greatest stability in personality. This suggests that different personality configurations are associated with different patterns of change. These results point to the necessity of analytic methods that explicitly model the heterogeneity of individual-level change.

Longitudinal Models of Developmental Change

Relatively new longitudinal methods like longitudinal hierarchical linear modeling and latent growth curves model change over multiple time points while incorporating individual-level variability. These methods have two important advantages. First, the presence of multiple (i.e., >3 or >2 in the presence of other constraints) measurement occasions allows for the modeling of nonlinear (e.g., quadratic) change. Second, the intercept (i.e., initial status) and the slope (i.e., direction of change) parameters that define the models can include random effects; that is, these parameters can differ across individuals. Typically, researchers have been most interested in estimating the mean intercept and slope parameters to describe the developmental trajectory of the population as a whole. Because the intercept and slope parameters the methods provide can include random effects, however, it is possible to model individual developmental trajectories that differ from the overall population trajectory. Additionally, these models can be expanded to incorporate predictors of initial status (i.e., the intercept) and change (i.e., slope) to better understand the factors that shape developmental trajectories.

Helson, Jones, and Kwan (2002) used longitudinal hierarchical linear modeling to examine normative personality change over 40 years in two longitudinal cohorts with scales of the California Psychological Inventory (CPI; Gough & Bradley, 1996). Scales measuring facets of norm adherence (e.g., Self-Control, Agreeableness) tended to exhibit increases with age, though with nonlinear or quadratic (i.e., accelerating) increases from middle to old age. On the other hand, scales measuring facets of social vitality tended to exhibit linear decreases. Additionally, all scales of the CPI exhibited significant variability in the intercept and slope parameters, indicating significant heterogeneity across individuals in terms of their initial status and rate of change or even the direction of that change. Finally, for some scales, both gender and cohort accounted for significant proportions of the variance in the intercept and slope parameters (e.g., women exhibited higher levels of Self-Control and lower levels of Dominance, particularly in older cohorts).

Longitudinal hierarchical linear modeling as employed by Helson et al. (2002) estimates a mean growth model under the assumption that all persons in the sample come from the same population. Individual variation around the mean curve is accounted for by variation in the intercept and slope parameters. Alternatively, another analytic technique called *latent class analysis* accounts for sample heterogeneity by identifying distinct subpopulations on the basis of similar patterns of responses on a number of measured variables. Extended to longitudinal data structures, latent class analysis can be used to identify developmental trajectories based on different patterns of responses to the same variable measured on multiple occasions. Unlike latent growth curves, however, latent class analysis does not allow for within-class variation.

Growth mixture modeling (GMM; B. O. Muthén & Muthén, 2000) is a relatively new longitudinal analytic technique that combines features of latent growth curves and latent class analysis. Briefly, GMM identifies classes or clusters of individuals on the basis of similar patterns of scores for an outcome variable that has been measured on multiple occasions, allowing for individual variation within each class. For each class or cluster, different

mean intercept and slope parameters are used to define separate growth curves for the same variable.

Because many behavioral phenotypes exhibit substantial variability in course, GMM has important advantages over latent growth curve analysis. This is because GMM can capture patterns of developmental change that differ considerably from the overall pattern in a way that latent growth curves cannot. GMM has been employed with increasing alacrity in longitudinal studies of delinquency, crime, and substance use (Broidy et al., 2003; Chassin, Flora, & King, 2004; Flory, Lynam, Milich, Leukefeld, & Clayton, 2004; Jackson, Sher, & Schulenberg, 2005; Schaeffer, Petras, Ialongo, Poduska, & Kellam, 2003). For example, several recent studies have used GMM to identify developmental classes of alcohol use, with the best replicated classes being a nonuser or a stable low user; a chronic or persistent high user, a "developmentally limited" course characterized by substantial increase in use during young adulthood followed by steady decline in use into later adulthood; and a late-onset course, characterized by increased use toward the end of young adulthood that persists into later adulthood (Chassin et al., 2004; Chassin, Pitts, & Prost, 2002; Colder, Campbell, Ruel, Richardson, & Flay, 2002; Jackson et al., 2005; B. O. Muthén & Muthén, 2000; Tucker, Orlando, & Ellickson, 2003). Identification of these different developmental patterns is important because they may have implications for etiology, comorbidity, treatment, and the links between alcohol use and important outcomes such as success in work and intimate relationships (Sher & Gotham, 1999; Sher, Gotham, & Watson, 2004).

At present, GMM is probably the most powerful method available to distinguish developmental patterns while incorporating recognition of individual-level heterogeneity. The method was conceptualized and has most generally been used, however, to identify qualitatively or categorically distinct subpopulations in which group membership is considered to be static and mutually exclusive. In the case of personality development, we do not presume that classes of this level of distinctiveness actually exist. Rather, it is more likely that developmental trajectories of personality are fairly continuous in nature, rendering the boundaries between them at best fuzzy. The use of GMM to detect developmental groupings in this case is thus not an attempt to "carve nature at its joints," but to use a systematic approach to explore the nature and extent of heterogeneity in developmental patterns experienced by the majority of people. The utility and importance of the resulting groupings can then be tested by examining the relationships between group membership and relevant life outcomes such as mental health and educational and occupational attainment.

In this study, we used GMM to describe distinct developmental patterns in a large sample of female twins from ages 14 to 24 on six personality traits measured by scales of the MPQ: Well-Being, Stress Reaction, Alienation, Aggression, Control, and Harm Avoidance. The study design provides an excellent opportunity to examine personality development, as the transition from adolescence to young adulthood is the period associated with the greatest overall change in personality, with these particular traits (except for Well-Being) exhibiting the most change within that age range. The period from ages 14 to 24 is also of critical importance because during it most people move from a situation that would be described as including the material and emotional supports of childhood to one of relatively adult material and emotional independence and responsibility. Recognizing this, we examined whether there was a tendency for developmental trajectories in one trait to be associated with trajectories in other traits. Finally, we tested the validity of these developmental groups by examining their association with outcomes at age 24, including educational and occupational attainment; income; adult antisocial behavior; substance dependence, including alcohol, nicotine, and drug dependence; and measures of social adjustment.

Method

Sample

Participants were female twin pairs from the ongoing Minnesota Twin Family Study (MTFS). The MTFS is a population-based longitudinal study of same-sex twins and their parents. The sample consists of two cohorts. The older cohort was recruited at age 17 and was assessed at ages 17, 20, and 24. The younger cohort was recruited at age 11 and was assessed at ages 11, 14, and 17, and some have completed an age 20 assessment. Some members (145) of the younger cohort provided personality data at age 20 instead of at age 17, and a few (10) provided data at both ages. This study thus consisted of personality data from the younger cohort at ages 14, 17, and 20, and the older cohort at ages 17, 20, and 24. The age 17 data provided the strongest link between the two cohorts, but the age 20 data contained substantial representation from both cohorts as well.

The two cohorts were recruited in the same way. Starting from state birth records, we determined the current status and location of more than 90% of the same-sex twin pairs born in Minnesota in the targeted years by using various publicly available databases. The targeted years were 1975–1979 for the older cohort and 1981–1984 and 1988–1991 for the younger cohort. Located twins without any significant physical or mental handicap and living within a day's drive of Minneapolis with at least one biological parent were invited to complete a day-long, in-person assessment at our labs at the University of Minnesota. Fewer than 20% of located families declined participation. The MTFS samples include same-sex male twin pairs as well as female twin pairs. We restricted this study to females because, due to differences in assessment protocols caused by differences in funding availability, we did not have consistent personality data at four time points for males.

The twins and their parents were generally representative of the Minnesota population at the time of the twins' birth, which ranged from the early 1970s to the early 1990s. Fathers averaged slightly over 14.5 years of education; mothers averaged about 1 year less. The education levels were slightly higher in the parents of the younger cohort than in the parents of the older cohort. The average Hollingshead (1957) occupational level for the families was about 4, indicating possession of jobs that required some education just beyond the skilled "blue collar" level. Both cohorts included parents working in highly professional occupations, however, as well as parents unemployed or working in semi-skilled jobs (the standard deviation was just under 2 Hollingshead levels). Again, occupational levels were slightly higher in the parents of the younger cohort than in the parents of the older cohort. In addition to the demographic information provided by the participating families, more than 80% of the families who did not participate completed a brief mail or telephone survey. This made possible some comparison of participants and nonparticipants. Parents in

participating families were significantly, though only modestly, better educated than those in nonparticipating families, with a mean difference of less than .30 years of education. The two groups of families did not differ significantly in self-reported mental health. Iacono, Carlson, Taylor, Elkins, and McGue (1999) provided a complete description of the ascertainment and assessment procedures used in the MTFS as well as an analysis of nonparticipants.

Self-reported personality data were collected beginning at age 14 for the 11-year-old cohort. The intake data for the 11-year-old cohort members that had reached age 14 at the time we began this study included 452 pairs of female twins born in the years 1981–1984 and 1988–1990. Of these, 390 (86%) provided personality data at age 14. This group consisted of 241 monozygotic (MZ) pairs and 149 dizygotic (DZ) pairs. There were no differences in level of parental education, parental Hollingshead occupational level, or mental health at age 11 between the twins who returned to complete the personality assessment at age 14 and those who did not. At age 14, twins who provided personality data at age 17 scored slightly lower ($SD = .21$) on the Alienation scale than those who did not. There were no other significant personality differences between those who provided personality data at age 17 (73%) and those who did not, nor were there any significant personality differences at age 17 between those who were assessed at age 20 and those who were not.

The intake 17-year-old cohort included 335 pairs of female twins (220 MZ, 114 DZ) born in the years 1975–1979, of which 312 (93%) provided personality data. There were no significant personality differences between those who returned at age 20 (88% of the total at age 17) and those who did not, nor were there significant personality differences between those who returned at age 24 (88% of the total at age 17) and those who did not. Consistent with the demographics of Minnesota for the birth years sampled, over 98% of the twins in the two cohorts were Caucasian.

Measures

Personality. Participants completed variations of the MPQ at each assessment. The MPQ is a self-report personality instrument designed to assess a broad range of individual differences in personality. The full MPQ consists of 11 primary scales; a 198-item (18 items per scale), 4-option (*agree, somewhat agree, somewhat disagree, disagree*) version was administered at ages 17 and 24. At ages 14 and 20, only the 6 scales of Well-Being, Stress Reaction, Alienation, Aggression, Control, and Harm Avoidance were administered, with the same questions and options format for these scales.[1] For this study, we focus on these 6 scales for which consistent data were available across four time points. High scorers on Well-Being tend to be happy, cheerful, and active. High scorers on Stress Reaction tend to be nervous, easily upset, and troubled by guilt. High scorers on Alienation tend to believe they are victims of bad luck and maltreatment. High scorers on Aggression are physically aggressive and vindictive. High scorers on Control are reflective, cautious, and careful. High scorers on Harm Avoidance avoid the excitement of adventure and danger.[2] The various versions of the MPQ have excellent psychometric properties in general (Blonigen, Carlson, Krueger, & Patrick, 2003; Blonigen, Hicks, Krueger, Patrick, & Iacono, 2006; Hicks, Krueger, Iacono, McGue, & Patrick, 2004; Tellegen, 2006). This was also the case in this sample, in which coefficients alpha for all scales at all ages (including age 14) ranged from .83 to .92.

Outcome variables. The MTFS collects a variety of information about the lives of its participants through interview. We made use of information from two of the age 24 interviews to chart young adult outcomes. Of course, only participants from the 17-year-old cohort had such information because the younger cohort participants had not yet reached age 24. Still, this constituted a representational cross-section of about half the sample, so the results should be meaningful.

The young adults were interviewed to assess symptoms of psychopathology according to the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-IV*; American Psychiatric Association, 1994). Interviewers had either bachelor's or master's degrees in psychology and were trained extensively in the diagnostic interview process. For our outcome variables, we made use of symptom counts of adult antisocial behavior (AAB; the adult criteria for antisocial personality disorder), and we assessed alcohol, nicotine, and all other drug dependence with respect to the last 3 years at age 24. Other drugs assessed included amphetamines, cannabis, cocaine, hallucinogens, inhalants, opiates, PCP, and sedatives. Symptoms of substance use disorders were assessed with the Substance Abuse Module of the Composite Diagnostic Interview (L. N. Robins, Baber, & Cottler, 1987), and AAB symptoms were assessed with a structured interview designed by MTFS staff that is comparable to the Structured Clinical Interview for Axis II Personality Disorders (SCID–II; Spitzer, Williams, Gibbons, & First, 1987), updated to reflect the *DSM–IV*. The symptom assignments were made during a consensus process conducted by teams of at least two graduate students with advanced training in descriptive psychopathology and differential diagnosis.

The Social Adjustment Interview provided information about the participants' attained levels of education, current employment status and income, and social relationships. Of course, at age 24, employment status and income may be far from their ultimate levels and may not even be well correlated with later levels. Still,

[1] The MPQ is intended for administration to adults. The primary reason for the use of only six scales at age 14 was to shorten the inventory to make it more manageable by younger participants. In addition to using only these six scales, we judged five items to contain individual words for which the vocabulary might prove too difficult, and simpler synonyms were substituted. For example, the item dealing with others' perceptions of the participant's "methodicalness" was changed to "People say that I do things with care and good planning." Coefficient alphas for the age 14 scales were nearly identical to those for the older ages, and there were no differences between the coefficient alphas for the six scales that were administered as part of the full group of scales and those that were administered in the shortened format. The shortened format was also used at age 20 for expediency.

[2] Church (1994) compared the Tellegen and five-factor models of personality. He reported correlations of −.45 and .47 between Well-Being and Neuroticism and Extraversion, respectively. Stress Reaction was correlated at .76 with Neuroticism. Alienation was correlated at .38 with Neuroticism and at −.41 with Agreeableness; Aggression correlated at −.48 with Agreeableness. Control correlated .56 with Conscientiousness, whereas Harm Avoidance had no major correlates among the five factors. Markon, Krueger, and Watson (2005) provided a road map showing the links between the five factors and Tellegen's three, higher order factors.

we believe that they do provide some indication of emerging adult levels, and we wanted to consider outcomes from a range of areas important to early adult development. Employment was measured using the Hollingshead (1957) index, which results in the assignment of an occupational code ranging from 1 to 8 based on status of job held, education, and income. In this coding, 1 represents major professionals and higher executives in large business organizations, 7 represents unskilled employees, and 8 represents lack of employment. We assigned codes of 2 to participants who remained in graduate school at age 24 and codes of 3 or 4 to participants in the military, depending on whether they were college graduates. To assess social relationships, we constructed two scales. The first consisted of items involving relationships with the twins' mothers, fathers, co-twins, and closest other siblings. Participants rated the qualities and closeness of their relationships with these family members on 4-point scales. The relationship items involving closeness were correlated .52 overall with the items involving problems getting along in these relationships, so we termed this scale *Family Involvement*. The second scale consisted of items involving problems getting along with family members as well as similar items dealing with problems getting along with friends, co-workers, supervisors, and romantic partners. We termed it *Interpersonal Problems*.

Analytical Approach

Data adjustment. We made two adjustments to the data to establish consistency over time and across cohorts. First, we centered the data at age 14. Thus, age 14 data had a mean of 0, and the means for the other ages reflected their differences from the age 14 levels. Second, at intake for each cohort, the vast majority of participants were assessed during the year in which they were the targeted age. Follow-up assessments also had clearly targeted ages, but the actual ages at which the follow-up assessments were carried out were more variable. Thus, for the 17-year-old cohort, age at age 17 assessment was generally 17, but for the 11-year-old cohort, age at the age 17 assessment ranged from 16.5 to 19. To adjust for this, we regressed the effects of age and age (see Footnote 2) from the data at each age, leaving unstandardized residuals in order to preserve the original variances.

Because the data consisted of two birth cohorts and no participants had data at all time points, it was important to evaluate the extent to which the two birth cohorts were comparable. We started by comparing mean age-adjusted personality scale scores at the age 17 assessment, which served as the primary data link. Three scales, Stress Reaction, Aggression, and Alienation, showed significant mean differences. In each case, mean scores for the older cohort were higher, with standardized mean differences of .29, .20, and .25, respectively. There was, however, no trend in these mean differences by year of birth, and the mean differences in these scales did not persist to the age 20 assessment. Instead, at age 20, the Control scale showed a significant mean difference, with the older cohort showing higher scores, with a standardized mean difference of .36. Moreover, twin zygosity, which had no association with birth cohort and for which there is no reason to suspect personality differences (Johnson, Krueger, Bouchard, & McGue, 2002), showed significant mean differences in four scales, though the effect sizes were much smaller than those for birth cohort. The Kolmogorov–Smirnov test revealed no differences in trajectory membership by cohort for any scales, nor were there any differences in change in scale scores from assessment to assessment by cohort. We concluded that most of the differences we observed were not systematic. However, there may have been small differences in negative emotionality between the two cohorts, possibly as a result of participation attrition: at age 17, the younger cohort was being assessed for the third time, whereas the older cohort was being assessed for the first time. Whatever the reason, these small differences did not appear to be important to our analysis.

Because attrition was another factor that could have affected the trajectory groups we observed, we also carried out some analyses to evaluate this question. First, multinomial regression indicated that attrition did not predict trajectory group membership for any personality scale in either cohort. Second, there were no differences in change in personality scale scores from age 17 to age 20 among those who participated at age 24 and those who did not. Finally, because attrition between ages 14 and 17 was most likely to have affected our trajectory groups, we carried out all our trajectory group analyses both including and excluding those who participated at age 14 but at no other age. As these results were very similar to those we present, we do not discuss them further.

Latent trajectory groups. To model personality development patterns, we used Mplus (L. K. Muthén & Muthén, 2004) to extract latent groups with GMM. As described earlier, this approach models individual variation in trajectory shape within each trajectory group by allowing estimation of different groups of fixed trajectory shapes as well as individual random effects. The methodological allowance for variation in both fixed and random effects is important to our conceptualization of individual differences in personality development. Though GMM is usually applied to identify qualitatively and categorically distinct subgroups within a population, we do not presume that such qualitatively and categorically distinct subgroups actually exist. Rather, we suspect that individual differences in personality development patterns are continuous in nature and that any break points used to establish subgroups of those patterns are relatively arbitrary. Thus, like Nagin and Tremblay (2005), we applied the technique as a device to explore and characterize the diversity in developmental patterns in the population as a whole and to measure the associations between those patterns and life outcomes. B. O. Muthén (2003, p. 374) has also pointed out the advantages of the method in this context.

In particular, we explicitly reject the presumptions that individuals actually belong to latent trajectory taxons; that individuals within any trajectory subgroups follow the group pattern exactly; and that there is some specific, immutable, theoretically meaningful number of such trajectory subgroups in the population at large or even in our sample. Instead, we presume, as suggested by Muthén to Bauer and Curran (2003), that estimation of parameters describing trajectory subgroups within our data can contribute to accurate characterization of the overall population, particularly because we presume that there are individuals within the sample whose developmental patterns deviate considerably from the overall average. We further presume that accurate characterization of the overall population will improve our understanding of both the forces that shape individual differences within that population and their consequences for the people whose lives our trajectories describe.

This conceptualization confers two important technical advantages in our analysis. First, as noted by many researchers (e.g., Bauer & Curran, 2003; Bentler, 1990; Markon & Krueger, 2004), there are many indices that can be used to assess model fit, and these indices do not always clearly indicate a single best-fitting model. This is especially true in situations such as this one, in which we were interested in using a grouping technique to characterize a situation we believe to be continuous. In general, when data are continuous, the more groups into which they are divided, the better the fit. Obviously, there is some trade-off between parsimony and fit, but where their optimal balance lies is more often a matter of judgment than of objective observation. Here, we are clear that we are not seeking naturally occurring break points between pre-existing taxons, but rather we are seeking a practical descriptive tool. Thus, the absence of a clearly optimal number of groups as determined by examination of a single statistic or by the general consensus of several statistics to provide the best model fit does not present any conceptual difficulty as long as the number of groups chosen offers some descriptive advantage.

We evaluated model fit using the Akaike information criterion (AIC; Akaike, 1983), the Bayesian information criterion (BIC; Raftery, 1995), the adjusted BIC (adjBIC; Sclove, 1987), and entropy (ENT; Ramaswamy, DeSarbo, Reibstein, & Robinson, 1993). These are standard measures of model fit used in GMM, and they cover a good range of the types of fit statistics generally used. Others are available, but we believe there is little point in considering additional measures of fit given that it was not our goal to identify naturally occurring taxons. Smaller values of AIC, BIC, and adjBIC indicate better model fit. ENT ranges from 0 to 1 and indicates clearer classification when values are closer to 1. We also examined the sizes of the resulting groups, their distinctiveness from the other groups for the scale, and the prevalence of group membership for individuals. We avoided solutions that included groups comprising less than 5% of the total sample, unless the small groups were very distinctive from the other groups in the solution and estimated prevalence of membership in those groups was high. We also avoided solutions including groups that did not appear to differ from each other in any qualitative way, especially when one of the two groups was very small.

Second, and in a related vein, Bauer and Curran (2003) have noted that group mixture modeling relies on the assumption that data within each class are normally distributed. The data for the full sample do not have to be normally distributed, as violations from normality in the full sample data may indicate the combination of several groups of normal distributions with different means and standard deviations. When the assumption of normality within each group is not met, it is difficult or even impossible to distinguish population heterogeneity from the deviations from normality in the distribution of the data. This means that it is easy to end up identifying latent class trajectories that do not actually exist. One way to examine whether this is occurring is to test the full sample data for normality and to compare the results to tests for normality within each extracted group, and we took this approach. The groups should be more normally distributed than the full sample data. Moreover, because we explicitly acknowledge that the trajectory subgroups we identified using this technique do not actually exist as taxons in the population, our subgroupings have value to the extent that they offer descriptive power. The primary danger here is that overextraction of groups will reduce power to identify associations of latent personality trajectories with young adult outcomes (Bauer & Curran, 2003). This possibility makes the associations we do identify that much more meaningful. In certain circumstances, however, overextraction can also lead to identification of spurious associations.

Our data consisted of twin pairs. This causes no difficulty in accuracy of the parameter estimates, but it does result in underestimation of their standard errors (McGue, Wette, & Rao, 1984). We adjusted for this by using aggregated analysis under complex sampling as described by B. O. Muthén and Satorra (1995). This method makes use of the means of the values for the members of each pair, relying on the assumption that the pairs are independent. The variances, and thus the standard errors of the parameter estimates, can then be calculated by using stratified random sampling formulas.

We had missing data in our sample of two forms. First, there were small amounts of case-wise missing data due to very occasional participants who were assessed but who did not complete the personality scales for reasons such as lack of time during the assessment, failure to complete the optional mail back, and sample attrition. There was no evidence for selection on personality in this kind of sample attrition, however; thus, it was reasonable to assume that these data were missing at random. Second, there were sometimes large amounts of missing data because of planned missingness. For example, data for all members of the 17-year-old cohort were missing at age 14. Again, however, this form of missingness was not dependent on personality, so the assumption that data were missing at random was reasonable. We thus used maximum likelihood to estimate our models (Little & Rubin, 1987). Because latent class models such as this can converge to local rather than global maxima, we used 20 random starts in the initial stage, with 10 optimizations in the final stage, and examined the results for consistency (Hipp & Bauer, 2006).

For each scale, we specified linear growth models consisting of an intercept factor defined as personality at age 14 and a slope factor defining the degree of change from year to year. We limited consideration of higher order models to the Stress Reaction scale, for which we fit a quadratic term as well.[3] We limited consideration of quadratic terms in this way because the mean levels showed little evidence for quadratic change and because no one in the sample had data for all time points, making it difficult to estimate higher order terms with any accuracy. At the same time, the Stress Reaction data seemed to clearly show evidence of quadratic change over the period, as the mean increased from age 14 to age 17 and then dropped back to the age 14 level by age 24.

We constrained residual variances and covariances among the growth factors to be equal across groups. This had two effects. First, it limited distinctions among latent trajectories to differences in the mean intercept and slope parameters alone, which seemed appropriate given our focus on using the resulting subgroupings as descriptive tools. Second, Bauer and Curran (2003) noted that, when data are nonnormal, relaxation of the equality constraints resulted in proper solutions (those in which all values remained within bounds) more frequently, regardless of whether those solutions were descriptively accurate or reasonable. We restricted our analysis to proper solutions

[3] For Stress Reaction, for which we included a quadratic term, we fixed the variance in individual change to zero in order to identify the model.

with constrained models. This should increase the likelihood that the resulting solutions were descriptively accurate and reasonable because the presence of the constraints should cause lack of model convergence when generation of improper solutions is not allowed. When data are normal, the constrained solutions are more likely to be proper anyway, so maintaining the constraints allowed us to treat the personality scales consistently, regardless of whether the data were normally distributed.

Associations with outcomes. We assigned each participant her most likely trajectory group membership and used nominal logistic regression in Mplus (L. K. Muthén & Muthén, 2004) to predict that membership from each of our outcome variables. It was necessary to state the predictive association in this direction because our outcome variables were continuous, whereas our trajectory groups were categorical. Because we did this separately for each outcome variable, however, we are actually making no statement at all about the likely direction of causation involved in any significant association. We standardized our predictors by making the odds ratio metric equivalent to the change in odds for a one standard deviation increase in the predictor. Because our data consisted of twin pairs, we again used aggregated analysis under complex sampling (B. O. Muthén & Satorra, 1995). We used the ratio of the estimated change in odds ratio to its standard error at $p = .01$ to assess the significance of each association because of the large number of tests we were completing.

Results

Descriptive Statistics

Table 1 shows the means and standard deviations for each scale at each age, before and after the adjustments we made. As expected, most of the scales showed substantial changes between age 14 and age 24, and the direction of change could be described as manifestation of increasing maturity. That is, there were decreases in Alienation and Aggression and increases in Control and Harm Avoidance. In general, standard deviations decreased across the 10-year period for these four scales as well. Scale changes for these scales ranged from about 4.5 points to about 6 points. With the age 14 standard deviation as the base, Control showed the greatest increase of .56 standard deviation over the 10-year period. Aggression decreased by .67 standard deviation, which was the greatest decrease. Well-Being and Stress Reaction showed relatively little change from age 14 to age 24. For Stress Reaction, this was because it peaked at age 17 at .39 standard deviation higher than at age 14 and then basically returned to the age 14 level. Well-Being was much more stable, but its largest change (a de-

Table 1
Means and Standard Deviations of Personality Measures, Before and After Age Adjustment and Centering at Age 14 Mean Level, With Effect Sizes of Differences From Age 14 Level

	Age 14[a]		Age 17[b]		Age 20[c]		Age 24[d]	
Scale	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
				Before adjustment				
Well-Being	56.61	8.61	55.54	8.55	55.73	8.34	55.68	8.51
Stress Reaction	42.32	9.78	45.08	9.48	43.28	9.41	42.23	9.27
Alienation	34.74	8.95	34.87	8.81	32.37	8.24	30.26	8.04
Aggression	35.58	9.17	34.69	8.89	30.37	7.60	29.44	7.00
Control	47.88	8.14	47.99	7.84	51.53	7.55	52.41	7.29
Harm Avoidance	50.00	10.32	49.65	10.05	53.03	9.63	54.71	9.46
				After adjustment				
Well-Being	0.00	8.57	−1.07	8.52	−0.85	8.23	−0.88	8.40
Stress Reaction	0.00	9.73	3.81	9.44	0.96	9.40	−0.09	9.12
Alienation	0.00	8.89	0.89	8.71	−2.38	8.20	−4.52	7.88
Aggression	0.00	9.16	−0.43	8.81	−5.21	7.55	−6.17	6.89
Control	0.00	8.07	0.16	7.78	3.66	7.53	4.54	7.28
Harm Avoidance	0.00	10.30	−0.57	10.01	3.03	9.58	4.72	9.41
				Effect size of difference from age 14 level				
Well-Being			−0.12		−0.10		−0.10	
Stress Reaction			0.39		0.10		−0.01	
Alienation			0.10		−0.27		−0.51	
Aggression			−0.05		−0.57		−0.67	
Control			0.02		0.45		0.56	
Harm Avoidance			−0.06		0.29		0.46	

Note. Effect size is mean difference/standard deviation at age 14, so the effect sizes are stated in standard deviation units. The scale data before adjustment were raw scale scores; means and standard deviations were typical for the scales in question, so the difference in means between, for example, Well-Being and Aggression had no real significance.
[a] $n = 779$. [b] $n = 1{,}172$. [c] $n = 733$. [d] $n = 585$.

Table 2
Model Fit Statistics Used to Select Appropriate Numbers of Personality Trajectory Groups

Model and statistic	MPQ scale					
	Well-Being	Stress Reaction	Alienation	Aggression	Control	Harm Avoidance
2 latent classes						
−2*log likelihood	−11,159	−11,545			−10,952	
AIC	22,339	23,117			21,927	
BIC	22,392	23,186			21,991	
Adjusted BIC	22,360	23,145			21,953	
Entropy	.73	.40			.76	
Smallest class %	8	16			2	
3 latent classes						
−2*log likelihood	**−11,131**	**−11,537**	−11,247	−11,103	**−10,945**	−11,568
AIC	**22,287**	**23,109**	22,525	22,235	**21,920**	23,164
BIC	**22,357**	**23,200**	22,605	22,315	**22,000**	23,238
Adjusted BIC	**22,315**	**23,146**	22,557	22,268	**21,953**	23,194
Entropy	**.69**	**.59**	.73	.58	**.64**	.62
Smallest class %	**4**	**11**	3	5	**7**	1
4 latent classes						
−2*log likelihood	−11,117	−11,529	**−11,233**	**−11,086**	−10,940	**−11,558**
AIC	22,266	23,101	**22,502**	**22,204**	21,916	**23,149**
BIC	22,351	23,213	**22,598**	**22,290**	22,012	**23,240**
Adjusted BIC	22,300	23,146	**22,541**	**22,239**	21,955	**23,186**
Entropy	.75	.65	**.55**	**.60**	.67	**.54**
Smallest class %	0	1	**2**	**5**	1	**4**
5 latent classes						
−2*log likelihood			−11,224	−11,076		−11,550
AIC			22,491	22,191		23,140
BIC			22,603	22,292		23,247
Adjusted BIC			22,536	22,232		23,184
Entropy			.60	.60		.54
Smallest class %			1	3		0

Note. Values in bold indicate the number of trajectory classes selected for each scale. MPQ = Multidimensional Personality Questionnaire; AIC = Akaike information criterion; BIC = Bayesian information criterion.

crease of about .13 standard deviation) also took place between ages 14 and 17. Well-Being did not, however, return completely to its age 14 level by age 24.

Latent Trajectory Groups

Table 2 shows model fit statistics for the numbers of personality trajectory groups we considered for each MPQ scale. The fit statistics followed the pattern we anticipated: Different fit statistics pointed to different numbers of trajectory groups as optimal for each scale; thus, the selection of the optimal number of groups required balancing several criteria, including statistical fit and descriptive utility. We ran models with one, two, three, four, and five groups for each scale,[4] but actively considered only those numbers of groups whose fit statistics fell within an appropriate progression. For Well-Being, all of the fit statistics showed improved fit as we added groups, but once we reached four groups, one of them contained less than 1% of the sample, so we never really considered the five-group solution and selected the three-group solution in order to avoid solutions with groups that were too small to be meaningful. We also selected three groups for Stress Reaction. Here AIC indicated four groups, BIC indicated two groups, and adjBIC indicated three groups. As the four-group solution included one group comprising only 1% of the sample, the three-group solution appeared to be the compromise. The situations were similar for the four-group solutions for Alienation and Aggression, though we could have easily justified selecting five groups for Aggression. The parameters for the additional group were not clearly distinguished from those of one of the other groups in the five-group solution, however, so the additional complexity did not appear to offer additional descriptive power. The situation for Control was very similar to that for Well-Being, and we selected three groups here as well. The fit statistics indicated either three or five groups for Harm Avoidance, but both of those solutions included very small groups, so the four-group solution seemed the appropriate compromise.

[4] Reduction in BIC on the order of 2–5% has been interpreted as evidence for multiple trajectory classes in GMM (e.g., Hill, White, Chung, Hawkins, & Catalano, 2000; B. O. Muthén & Muthén, 2000; Nagin & Tremblay, 1999). Bauer and Curran (2003), however, found similar reductions in BIC in their simulations with nonnormal data from a single class, thus demonstrating that even this level of reduction in BIC does not guarantee accurate identification of distinct classes. The reductions in BIC that we observed in moving from one to two or more classes were considerably smaller than this, which provides evidence for our assessment that the personality developmental situation we were modeling was continuous.

For most likely group membership, the probabilities ranged from .61 to .90 with a median of .76 for all groups and scales. The highest alternative probabilities of group membership ranged from .06 to .25 with a median of .18. This indicates that group membership was reasonably clear for most individuals in the sample. Moreover, Well-Being, Aggression, Alienation, and Harm Avoidance all revealed groups following trajectories that deviated very clearly from the overall pattern, exactly the kind of situation it would be very hard for latent growth curves to pick up. Even the groups for Stress Reactivity and Control showed very substantial variation across the scale range, and trajectory slopes were not parallel, though the differences in slope could not be distinguished statistically.

Given the level of judgment required to identify reasonable groups of personality development patterns in our data, it was also important for us to demonstrate that the results had some descriptive power. To accomplish this, we did two things. First, we examined the extent to which the full sample data for each scale could be considered to be normally distributed by tabulating skewness, kurtosis, and the p values from the Kolmogorov–Smirnov test for normality at each age and comparing these values to those from each of the groups derived for each scale. For all scales, there were significant departures from normality in the full sample data. Most of the group data, however, did not show significant departures from normality, and those few ages and scales that did continue to show significant departures from normality had substantial reductions in skewness and kurtosis. These results are available from Wendy Johnson upon request.

Second, we assigned each participant to the group to which she had the highest probability of belonging for each scale. We then used multilevel mixture modeling with expectation maximization to compare the actual means of the adjusted data for each group for each scale at each age by using $p = .01$ to assess statistical significance because of the number of tests required. Table 3 shows the results. There are two important points to make about this table. The first point is that we assigned descriptions for each group at the left of the table on the basis of the model parameter estimates. Thus, we described a group's level as *high* when the intercept was positive and significant at $p < .01$ and *very high* when there was already a group with a high intercept. We described a group's level as *moderate* when its intercept was in the middle of the range. We described a group's change as *increasing* or as *decreasing* when the slope parameter was positive or negative, respectively, and significant at $p < .01$. We described change as *steady* when the slope parameter was not significant. This meant that we were more likely to characterize small groups as steady, even when they appeared to be changing, because the group size was not large enough to generate sufficient power for the change

Table 3
Scale Means by Personality Trajectory Group and Effect Sizes of Average Changes

Personality scale	Age 14	Age 17	Age 20	Age 24	Effect size of average change	Proportion of sample in group
Well-Being						
Low, increasing	−18.78	-15.28_{a}	-10.40_{b}	−4.02	0.97	.06
Moderate, decreasing	−3.55	-12.18_{a}	-13.33_{b}	−20.38	−1.10	.04
Moderate, steady	1.66	0.43	0.63	0.75	−0.06	.90
Stress Reaction						
Moderate, bowed	2.97	5.50	2.06	0.69	−0.24	.62
Low, increasing	−10.86	−6.11	−8.93	−10.66	0.02	.27
High, steady	16.69	18.14	14.54	14.05	−0.29	.11
Alienation						
Low, decreasing	−5.46	−5.30	−8.14	-11.55_{d}	−0.38	.42
Very high, decreasing	24.12	19.34	7.59_{c}	−7.69	−1.99	.02
Moderate, decreasing	3.24	4.38	0.62	−0.24	−0.22	.50
High, steady	11.47	14.93	11.06_{c}	13.58_{d}	0.40	.06
Aggression						
High, decreasing	15.06	9.48	−3.27	-9.04_{e}	−3.27	.08
Very high, steady	18.09	17.99	11.00	9.61	−1.15	.05
Moderate, steady	4.31	4.19	0.50	0.05	−0.58	.28
Low, decreasing	−5.68	−5.46	−9.50	-10.32_{e}	−0.63	.59
Control						
Low, steady	−15.85	−14.05	−9.24	−6.58	0.77	.07
Moderate, increasing	−0.36	−0.48	2.91	3.70	0.34	.81
High, steady	11.96	11.28	14.84	14.01	0.17	.12
Harm Avoidance						
Very low, steady	−21.10	−21.74	−15.38	−13.99	0.52	.05
High, increasing	6.00_{f}	5.60	9.73	11.85	0.43	.55
Low, increasing	−8.94	−7.68	-3.00_{g}	0.12	0.66	.34
High, decreasing	7.75_{f}	2.25	-1.39_{g}	−6.38	−1.03	.06

Note. Means with the same subscript did not differ significantly at $p = .01$ or less. All others within ages (in columns, by scale) did differ at this level or more significantly. Trajectories were characterized as "steady" when the slope parameters were not significant. This means that we were more likely to have characterized smaller groups as "steady," all else being equal. We characterized trajectories as "increasing" or "decreasing" when the slope parameters were significantly positive and negative, respectively. "Low, "moderate," and "high" were relative terms. Effect sizes of average changes were (average change in group)/(group intercept standard deviation), so they are stated in those standard deviation units.

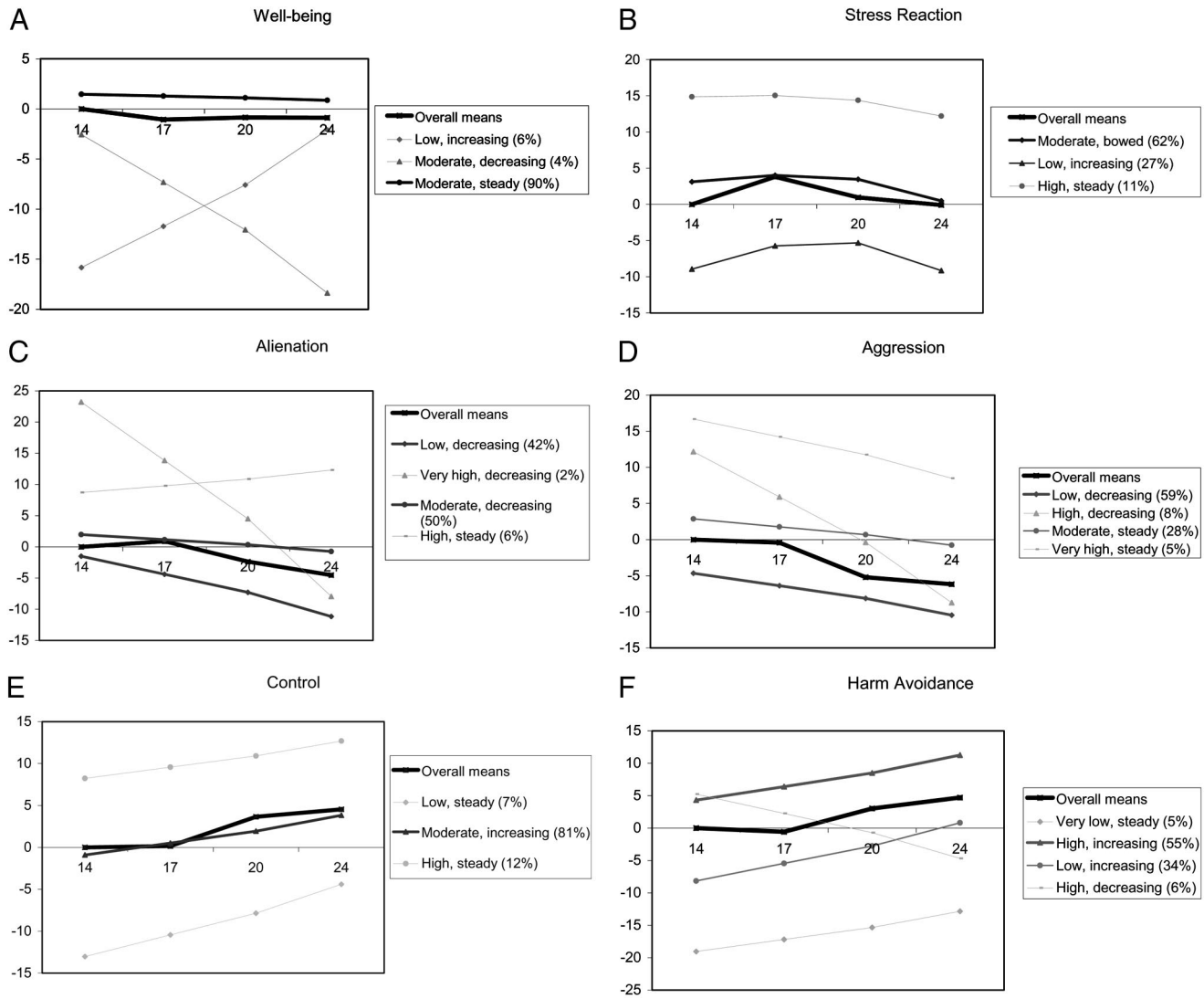

Figure 1. Overall mean levels and the underlying trajectory group estimates for Well-Being (A), Stress Reaction (B), Alienation (C), Aggression (D), Control (E), and Harm Avoidance (F). In all panels, heavier lines represent larger proportions of the total sample.

parameter to reach statistical significance. The means of the actual data showed that our descriptions based on the model parameter estimates were highly accurate within these constraints.

The second point about the table is that the descriptions defined groups with patterns that could be clearly distinguished from one another within scales. Thus, for all of the scales, the means for most of the groups could be distinguished from each other at $p = .01$ or less at most ages. Those means that were not significantly different at any particular age were similar because the trajectory paths followed by their groups intersected around those ages while moving in different directions or different rates. For example, Well-Being had one increasing group and one decreasing group, and their trajectories crossed somewhere around age 19. This meant that their means did not differ significantly from each other either at age 17 or at age 20, although they were very different at ages 14 and 24. Together, these points demonstrate both that our groups captured individual differences that really existed in the data and that these individual differences reflected patterns that could be described in meaningfully different qualitative terms.

Figure 1A–F shows the latent trajectory groups for each scale graphically. The graphs show the overall means and the trajectories indicated by the parameter estimates from the selected models. The relative sizes of the groups are indicated by the heaviness and the darkness of the trajectory lines, with the overall means shown with the heaviest black lines. Though some of the groups were small, the patterns were clearly distinct from each other.

Associations With Outcomes

Table 4 and Appendixes A–E present the results of the nominal regressions associating personality trajectory group with age 24 outcomes. These summaries show the prevalence of group mem-

Table 4
Prevalences of Well-Being Trajectory Group Membership for Different Outcomes

Outcome variable	Well-Being trajectory group		
	Low, increasing[a]	Moderate, decreasing[b]	Moderate steady[c]
Education			
High school			
Some college	Differences not significant		
College degree			
Hollingshead job code			
8: Unemployed	.07	.14	.79
4: Clerical, sales	.05	.06	.89
2: Managerial	.04	.04	.92
Income			
$14,000	.04	.11	.86
$26,000	.05	.05	.91
$40,000	.06	.02	.93
Adult antisocial behavior			
3 symptoms			
1 symptom	Differences not significant		
No symptoms			
Alcohol dependence			
3 symptoms	.07	.11	.82
1 symptom	.06	.08	.86
No symptoms	.05	.04	.91
Nicotine dependence			
3 symptoms	.08	.08	.84
1 symptom	.05	.06	.89
No symptoms	.03	.05	.93
Drug dependence			
3 symptoms	.09	.12	.80
1 symptom	.06	.08	.86
No symptoms	.05	.05	.90
Family involvement			
Low			
Medium	Differences not significant		
High			
Interpersonal problems			
High	.06	.12	.82
Medium	.05	.07	.89
Low	.03	.04	.93

Note. The three levels given for each outcome correspond very approximately to −1, 0, and 1 standard deviations from the mean.
[a] Overall membership = 6%. [b] Overall membership = 4%. [c] Overall membership = 90%.

bership for outcomes roughly representing the mean for the sample and one standard deviation above and below the mean for each outcome. Thus, for example, as shown in Table 4, overall, 4% of the sample was in the moderate, decreasing Well-Being trajectory group. But of those who were unemployed, or very roughly one standard deviation below the mean Hollingshead job code, 14% were in this trajectory group. This was because fewer of the unemployed were in the moderate, steady Well-Being trajectory group than overall (79% vs. 90%). In contrast, of those making $40,000 per year, or roughly one standard deviation above the mean, only 2% were in moderate, decreasing group, and this was because more of those making $40,000 per year were in the moderate, steady group (93% vs. 90%). Well-Being trajectory group was associated with the other outcomes in similar ways: The more adverse the outcome, the more likely was membership in the moderate, decreasing group. The more positive the outcome, the more likely was membership in the moderate, steady group.

For tables associated with the other personality scales, see Appendixes A–E. We present them despite the volume of information because they are the only way to show clearly that trajectory group membership for each personality scale is associated with a range of outcomes. There were several patterns of note. Aggression had the most pervasive effects (see Appendix C). Higher overall levels of Aggression and failure to decline in Aggression over the 10-year period were associated with poorer outcomes for educational attainment, occupational status, AAB, each substance use disorder, and family and interpersonal problems. Only income was not associated with Aggression trajectory group. The association of Aggression trajectory group with symptoms of AAB was particularly dramatic, as might be expected. Alienation (see Appendix B) and Control (see Appendix D) also had pervasive effects across outcomes. Those for Alienation tended to parallel those for Aggression, whereas those for Control were in the reverse direction (i.e., low levels of Control and failure to increase in Control were associated with worse outcomes), again as would be expected. Harm Avoidance (see Appendix E) had the fewest effects and was associated only with AAB and alcohol and drug dependence. It seems likely that this reflects the extent to which these behaviors involve illegal activity, as there was no association between Harm Avoidance and nicotine dependence.

At some level, it would be reasonable to think of educational attainment, occupational status, and income as linked outcome variables, though the links are probably stronger at older ages than at age 24. The personality scales associated with education and income outcomes were, however, very different. All the negative emotionality scales (Stress Reaction, Alienation, Aggression) were associated with education, but Well-Being was not. Conversely, none of the negative emotionality scales was associated with income, but Well-Being was. Control was associated with both education and income. Hollingshead job code, which is a combination of education, income, and job status, was associated with all of the scales that were also associated with both education and income, so its associated personality scales reflected its conceptual components.

AAB and the three kinds of substance dependence symptoms could also be considered linked outcome variables characterizing externalizing behavior (Krueger, Hicks, Patrick, Carlson, Iacono, & McGue, 2002), and their patterns of association with the personality groups were in fact similar. All the externalizing disorder outcome variables were associated with each negative emotionality scale, Control and Harm Avoidance, with the exceptions that Harm Avoidance was not associated with nicotine dependence and Control was not associated with drug dependence. It is interesting that, as noted in many in other contexts, antisocial behavior did not appear to trouble the people who engaged in it, as AAB was not associated with Well-Being (Table 4). Well-Being was, however, associated with each substance use disorder. Also of note is that the traits associated with interpersonal problems were similar to those associated with externalizing disorder symptoms, suggesting a common diathesis for the two kinds of outcomes. In contrast, the Family Involvement scale was only associated with Stress Reaction and Aggression.

Personality Configurations

The patterns of associations with outcomes across the personality scales indicated by the multinomial regressions suggested that there were meaningful configurations of personality. For example, the groups within Alienation and Aggression ran roughly parallel to each other and had very similar associations with outcomes, hinting that many of the people in the Aggression groups might be found in the analogous Alienation groups. Similarly, for each scale, there was a relatively large group that could be considered the most mature and was associated with the most positive outcomes, hinting that maturity on one scale might be associated with maturity on others. To capture these higher order associations, we used the most likely latent trajectory group memberships for each MPQ scale to carry out a latent class analysis to identify patterns of latent trajectory groups across scales. Again, this was implemented in Mplus (L. K. Muthén & Muthén, 2004), with the appropriate aggregated analysis under complex sampling. Table 5 shows the results.

We used three classes of trajectory groups to describe the data. The first group included 47% of the sample, so we labeled it *alright*. Its participants tended to fall into the trajectory groups that would be considered most maturely stable for all the MPQ scales. The second group included 42% of the sample, so we labeled it *growing up*. Across the MPQ scales, its participants tended to fall into the trajectory groups that showed the most movement from scale levels that might be considered problematic (such as higher Stress Reaction, Alienation, and Aggression, and lower Control) toward scale levels that might be considered mature. The third group included 11% of the sample. Its participants were most likely to fall into the trajectory groups that suggested trouble and were associated with poorer outcomes, including the moderate and decreasing Well-Being group, the high and steady Stress Reaction group, the high Alienation and Aggression groups, and the low and steady Control and Harm Avoidance groups.

We also carried out a nominal regression associating the latent classes of trajectory groups with age 24 outcomes. The results are shown in Table 6. As would be expected from the results for each personality scale trajectory group, prevalence of membership in the trouble group increased from the overall level for adverse outcomes in most of the areas considered, primarily at the expense of membership in the alright group. Prevalence of membership in the alright group increased from the overall level for positive outcomes in most of the areas considered, primarily at the expense of membership in the growing up group. With respect to negative outcomes, AAB and drug dependence made the most difference in latent class membership. With respect to positive outcomes, family involvement and interpersonal problems made the most difference in latent class membership. Only income was not significantly associated with latent class membership.

Table 5
Latent Classes of Personality Trajectories

Class	Trajectory
1: Alright, 47%	
Well-Being	Moderate, steady
Stress Reaction	Low, increasing; moderate, bowed
Alienation	Low, decreasing
Aggression	Low, decreasing
Control	Moderate, increasing; high, steady
Harm Avoidance	High, increasing; low, increasing
2: Growing up, 42%	
Well-Being	Moderate, steady
Stress Reaction	Moderate, bowed
Alienation	Moderate, decreasing
Aggression	Moderate, steady; low, decreasing
Control	Moderate, increasing
Harm Avoidance	High, increasing; low, increasing
3: Trouble, 11%	
Well-Being	Low, increasing; moderate, decreasing
Stress Reaction	High, steady; moderate, bowed
Alienation	Moderate, decreasing; high, steady; very high, decreasing
Aggression	High, decreasing; very high, steady; moderate, steady
Control	Moderate, increasing; low, steady
Harm Avoidance	Very low, steady

Discussion

In this study, we extended our understanding of personality development by explicitly modeling the heterogeneity in developmental course during the transition from adolescence to adulthood, ages 14 to 24. Specifically, we used GMM to detect developmental trajectory groups within each of six personality traits. For each trait, the groups differed in terms of their initial statuses (i.e., intercept parameters) and rates and directions of change (i.e., slope parameters). We found that the best-fitting models included three or four distinct trajectory patterns for each trait; therefore, no single curve could adequately describe the developmental course of the sample for a given trait. At the same time, the results were very consistent in showing that, for each personality trait, portions of the population could be grouped on the basis of both commonality of initial status (e.g., high, low, or moderate) and commonality of rate and direction (e.g., increasing, decreasing, or steady) of change on that trait over the 10-year period. This emphasized that developmental diversity was characteristic of all the personality traits examined and made possible systematic assessment of the associations between group membership and life outcomes for each trait. At the same time, membership in a developmental trajectory on one trait was not independent of group membership in another trait. A latent class analysis of developmental pattern membership across the six traits identified three broad categories of personality developmental course that could be conceptualized as varying in maturational process and outcome.

Certain trajectory groups in each personality trait were associated with important outcomes in young adulthood. In particular, trajectory groups that included high initial status and failure to decline on Alienation and Aggression and low initial status and failure to increase on Control were associated with a number of poorer outcomes on several variables including education, income, occupational status, adult antisocial behavior, substance dependence, and interpersonal problems. These associations were, however, probabilistic. Even within a given trajectory group there was variability; individuals within any given group were simply more likely to experience similar outcomes than were individuals across trajectory groups. Again, the consistency of results across personality traits indicated that development of each trait had an important impact on life outcomes.

Table 6
Prevalences of Latent Classes of Trajectory Group Membership for Different Outcomes

Outcome variable	Latent trajectory class		
	Alright[a]	Growing up[b]	Trouble[c]
Education			
High school	.30	.46	.24
Some college	.47	.40	.13
College degree	.51	.38	.11
Hollingshead job code			
8: Unemployed	.35	.37	.28
4: Clerical, sales	.46	.41	.14
2: Managerial	.50	.41	.09
Income			
$14,000			
$26,000	Differences not significant		
$40,000			
Adult antisocial behavior			
3 symptoms	.25	.39	.37
1 symptom	.41	.41	.19
No symptoms	.56	.36	.08
Alcohol dependence			
3 symptoms	.34	.41	.26
1 symptom	.40	.41	.19
No symptoms	.50	.39	.11
Nicotine dependence			
3 symptoms	.37	.40	.23
1 symptom	.45	.41	.14
No symptoms	.52	.39	.09
Drug dependence			
3 symptoms	.28	.41	.31
1 symptom	.38	.41	.20
No symptoms	.49	.40	.11
Family involvement			
Low	.31	.47	.22
Medium	.45	.41	.15
High	.58	.33	.09
Interpersonal problems			
High	.28	.45	.28
Medium	.44	.42	.14
Low	.59	.35	.06

Note. The three levels given for each outcome correspond very approximately to −1, 0, and 1 standard deviations from the mean.
[a] Overall membership = 47%. [b] Overall membership = 42%. [c] Overall membership = 11%.

Limitations

The current study is subject to certain methodological limitations that should be taken into account when considering the significance and generalizability of the results. First, the sample included only female twins. Though men and women exhibit similar rank-order stability and mean-level changes during the transition from adolescence to adulthood for the personality traits measured by the MPQ scales used in this study, some gender differences have been detected as well (Blonigen et al., 2006; Roberts et al., 2001). It will be important to examine whether analogously distinct developmental trajectory groups are present and have similar relations to outcomes in male samples, including MTFS when four data points become available. Also, although this sample is representative of families living in the state of Minnesota during the years the twins were born, the sample is not representative of the demographics of the broader U.S. population, especially in terms of racial and ethnic composition.

Another limitation of this study was that our assessment of personality was primarily limited to trait facets of negative emotionality and behavioral constraint. As these traits exhibit the most change from adolescence to adulthood and are related to antisocial behaviors that have high social costs, they are naturally of great interest. However, other traits, in particular traits related to achievement motivation and social dominance, also exhibit reliable mean-level change during this time (Blonigen et al., 2006; Roberts et al., 2001, 2006) and so may have important effects on individuals' success in navigating the transition from adolescence to adulthood (e.g., Roberts, Caspi, & Moffitt, 2003). Further studies that address how developmental trajectory groups differ for the traits associated with positive emotionality and agentic action, and the extent of their relations with adult outcomes, would be welcome.

Interpretations from this study are also limited by the analytic technique we used, which is more commonly used to identify subpopulations that are intended to be considered taxonic and qualitatively distinct. As we explicitly reject the presumption that such taxonic and qualitatively distinct subpopulations exist for personality development, it is reasonable to question whether we used the best approach to model the data. *Best* is a strong word, but we believe that our use of GMM has been informative at this still exploratory stage of the field's understanding of the associations between the development of personality and life circumstances. GMM is currently the most powerful technique available to handle a continuous longitudinal situation in which the sum of variances around individual group means can be expected to be as large as the total variance around the overall mean because it allows for both differences in fixed effects and random effects within the identified groups. Moreover, our results make clear that the associations with outcomes we identified were potentially much more than associations with age 24 outcomes alone. For each personality scale except for Stress Reaction and Control, there were two trajectory groups that had very similar age 24 levels, yet the associations of these trajectory groups with outcomes differed substantively. For example, age 24 Well-Being levels did not differ for the low, increasing Well-Being group and the moderate, steady Well-Being group. But prevalence of membership in the low, increasing group generally decreased with improved life outcome, whereas prevalence of membership in the moderate steady group generally increased.

Finally, there were certain analytic limitations in our application of GMM. First, no individual in the sample was assessed at each time point. Because the cohorts overlapped at certain time points (all twins at age 17, and some members of each cohort at age 20), it was possible to "link" the cohorts and model developmental trajectories across the entire 10-year period, under the assumption that the data were missing at random. For example, no member of the 17-year-old cohort had data at age 14, but no attempt was made to assess these participants at that age; therefore, there was no bias associated with their missing data. Because no individuals could be used to define the entire curve, however, the accuracy of the estimation of the change was somewhat limited, and it was particularly difficult to estimate nonlinear change parameters (e.g., quadratic or cubic) with much accuracy. Also, four time points is the minimum number of observations to conduct GMM, which

limited the full utility of the technique. Specifically, with only four time points, there were not enough degrees of freedom to model nonlinear change parameters and within-class individual-level variability simultaneously (see Footnote 3). However, these analytic limitations will be ameliorated as the twins participate in future assessments. That is, members of the younger cohort will be assessed at each time point so that their data can be used to model the full growth curve over the 10-year period.

The Mature Personality

We have used the term *maturity* throughout this article to refer to greater self-control, risk avoidance, and agreeableness and to lower levels of negative affect, aggression, and alienation. For example, we noted that persons who exhibited the greatest maturity at age 14 also exhibited the most stability in personality over time. However, greater elaboration of the term *maturity* is necessary to frame the current results in the broader context of personality development. We are not implying that the participants who seemed the most well-adjusted at age 14 were mature at that age in the sense of being ready to take on adult roles and fulfill adult obligations at that time. Rather we mean that they were adapting more effectively to their environments as evaluated by relative success in performing salient developmental tasks within a given sociocultural context. Masten et al. (1995) termed this kind of adaptation *competence* and noted that it presaged successful passage from childhood into adult roles.

Our study suggested one of the mechanisms that makes this possible. Across the 10-year period we examined, persons who exhibited the lowest levels of negative emotionality and behavioral disinhibition also exhibited the least change in personality. One way to think of this is that their personalities exhibited the fewest "rough edges" that needed to be smoothed during adolescence in order to meet adult obligations. As noted by more recent developmental researchers, the majority of individuals do not experience adolescence as a period of "storm and stress" (Arnett, 1999). They manage the transition to adulthood with relative success and little turmoil. It would appear that one major reason for this is that their personalities show positive adaptive qualities in childhood that require little modification in order to move successfully into adulthood. For these individuals, the process of maturation must involve primarily cognitive changes associated with increasing acceptance of responsibility. These participants tended to fall into the group of personality trajectories we termed *alright*.

We found, however, varying degrees of this kind of adaptive competence at all four ages, and they were associated with varying degrees of personality change. Some of the participants could be thought of as moving into adaptive competence at a slower pace (the *growing up* group), and a significant minority appeared to have experienced consistent difficulty in successfully adapting to their environments (the *trouble* group). One way of interpreting this is that their childhood personalities were associated with adaptive difficulties in early adolescence, but whether those adaptive difficulties persisted into adulthood depended on whether their personalities changed enough during adolescence to reach normative levels by early adulthood. For most showing adjustment difficulties at age 14, this appeared to take place. For a substantial minority, however, it apparently did not, and this was reflected in poor and troubled young adult outcomes.

A potential theoretical framework for these patterns is the *coresponsivity principle*, which posits that the most likely effect of life experiences on personality development is to accentuate the personality characteristics that increase the likelihood that people will be exposed to those events in the first place (Roberts & Caspi, 2003). Due to differences in personal characteristics, individuals are more or less successful in finding a "place" in the world, that is, the appropriate context that can maintain a Person $\times$ Situation interaction that yields consistent success in achieving adaptive outcomes. Whether through active or passive processes, persons lowest in negative emotionality and behavioral disinhibition appear to be most successful in finding a "place" or environment that helps to maintain success in performing salient developmental tasks. In contrast, persons highest in negative emotionality and behavioral disinhibition are likely to experience the most conflicts with prevailing environmental behavioral expectations. The experiences of these conflicts along with the experiences of social ostracism and punishment that tend to follow them are often likely to accentuate the personal characteristics that brought on the conflicts in the first place, thereby ensuring consistent difficulty in achieving adaptive developmental outcomes. The trick then in this theoretical framework is to explain how substantial numbers are able to overcome poor competence in early adolescence and to grow up to display more normative adaptive patterns in young adulthood. One key here is the fluidity of the boundaries of both the individual trait trajectory groups and the groups of personality configurations.

Almost all of the developmental trajectories we identified were characterized by trends toward lower negative emotionality and greater behavioral constraint, though with varying magnitudes. These results provide further support for the hypothesis that the maturity principle describes a fundamental developmental process. That is, regardless of their initial status at age 14, the personality structures of virtually all persons trended toward greater maturity, in keeping with the increasingly complex and demanding tasks associated with adulthood. Notably, persons in the trajectory groups associated with highest levels of negative emotionality and behavioral disinhibition exhibited the greatest changes toward maturity, at least in relation to the group standard deviations. In absolute terms, however, these groups were far from the age norm level: For each trait scale, their means were still significantly different from the means of the overall sample at age 14, and the mean-level differences between the trajectory groups associated with the best and worst adult outcomes remained relatively consistent across time. It seems then that movement toward maturity is not sufficient; a certain absolute level of emotional stability and behavioral control must be attained in order to accomplish successful adaptation.

Future Directions

Despite limitations, the current study offers a novel approach to conceptualizing personality development. Additionally, the analytic technique of GMM provides the framework for several extensions to gain greater insights into the mechanisms of personality development. Specifically, GMM allows for the incorporation of predictor variables that can be used to understand the factors that contribute to trajectory group membership as well as the intercept (i.e., initial status) and slope (i.e., direction and rate of change)

parameters that define the different growth curves. For example, variables related to rearing environment (e.g., family income, neighborhood quality, transient residential circumstances) and experience (e.g., abuse, illness or injury, academic failure, peer rejection) and parental characteristics (e.g., mental health history, child rearing styles, parent absence or neglect) can be measured and might be related to initial status and group membership. Other variables associated with adolescence (e.g., type of peer affiliation, delinquent activity, substance experimentation and use, relative academic success) and young adulthood (e.g., educational attainment, work experiences, psychiatric disorder, legal problems, formation of intimate relationships) can also be measured and may effect the direction (increase or decrease) and rate of change in these personality traits.

Essentially, GMM provides an analytic framework to examine the person–situation transactions that are generally held to be the basic building blocks of personality development. It thus provides an important framework to test the co-responsive principle (Roberts & Caspi, 2003). The innovation of our results with GMM is that the heterogeneity of personality development is explicitly modeled. This provides a framework to make more precise hypotheses and predictions. For example, what variables help to maintain the very high and steady trajectory of aggression? Are these variables different from those that help to maintain the low and decreasing trajectory? What characteristics distinguish the very high and steady trajectory from the high and decreasing trajectory of aggression? Given the broad movement toward maturity present across traits, there is likely a cluster of predictors that affects the trajectories of multiple traits. However, given the level of specificity we observed between outcomes and traits, there are likely predictors that are of particular importance to the developmental course for some traits but not for others. Moreover, because the sample is composed of twins, it will be possible to examine the genetic and environmental contributions to within-group variability and to the association between predictors of group membership and change parameters. That is, the behavior genetic design allows for moving beyond person–situation transactions to gene–environment correlations and interactions.

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(*Appendixes follow*)

Appendix A

Prevalences of Stress Reaction Trajectory Group Membership for Different Outcomes

Outcome variable	Stress Reaction trajectory group: Moderate, bowed[a]	Low, increasing[b]	High, steady[c]
Education			
High school			
Some college	Differences not significant		
College degree			
Hollingshead job code			
8: Unemployed	.90	.03	.07
4: Clerical, sales	.73	.12	.15
2: Managerial	.59	.20	.21
Income			
$14,000			
$26,000	Differences not significant		
$40,000			
Adult antisocial behavior			
3 symptoms			
1 symptom	Differences not significant		
No symptoms			
Alcohol dependence			
3 symptoms	.91	.02	.08
1 symptom	.85	.04	.11
No symptoms	.68	.15	.17
Nicotine dependence			
3 symptoms	.87	.03	.10
1 symptom	.78	.08	.14
No symptoms	.62	.20	.17
Drug dependence			
3 symptoms	.93	.01	.06
1 symptom	.85	.05	.10
No symptoms	.68	.16	.16
Family involvement			
Low	.88	.03	.08
Medium	.76	.10	.14
High	.54	.28	.19
Interpersonal problems			
High	.93	.01	.06
Medium	.82	.05	.12
Low	.55	.27	.18

Note. The three levels given for each outcome correspond very approximately to −1, 0, and 1 standard deviations from the mean.
[a] Overall membership = 62%. [b] Overall membership = 27%. [c] Overall membership = 11%.

Appendix B

Prevalences of Alienation Trajectory Group Membership for Different Outcomes

Outcome variable	Alienation trajectory group: Low, decreasing[a]	Very high, decreasing[b]	Moderate, decreasing[c]	High, steady[d]
Education				
High school	.22	.06	.65	.07
Some college	.44	.02	.48	.06
College degree	.49	.02	.44	.06
Hollingshead job code				
8: Unemployed	.32	.06	.50	.12
4: Clerical, sales	.42	.03	.50	.06
2: Managerial	.47	.02	.48	.04
Income				
$14,000				
$26,000	Differences not significant			
$40,000				
Adult antisocial behavior				
3 symptoms	.32	.02	.66	.19
1 symptom	.42	.03	.56	.08
No symptoms	.52	.03	.45	.03
Alcohol dependence				
3 symptoms	.33	.04	.53	.10
1 symptom	.38	.04	.52	.07
No symptoms	.45	.03	.48	.04
Nicotine dependence				
3 symptoms	.35	.05	.53	.08
1 symptom	.41	.03	.51	.06
No symptoms	.47	.02	.47	.04
Drug dependence				
3 symptoms	.29	.05	.56	.10
1 symptom	.36	.04	.53	.07
No symptoms	.44	.03	.49	.05
Family involvement				
Low				
Medium	Differences not significant			
High				
Interpersonal problems				
High	.25	.02	.61	.12
Medium	.39	.02	.53	.05
Low	.54	.02	.42	.02

Note. The three levels given for each outcome correspond very approximately to −1, 0, and 1 standard deviations from the mean.
[a] Overall membership = 42%. [b] Overall membership = 2%. [c] Overall membership = 50%. [d] Overall membership = 6%.

Appendix C

Prevalences of Aggression Trajectory Group Membership for Different Outcomes

Outcome variable	Aggression trajectory group: High, decreasing[a]	Very high, steady[b]	Moderate, steady[c]	Low, decreasing[d]
Education				
High school	.12	.13	.36	.39
Some college	.07	.04	.29	.60
College degree	.06	.03	.27	.63
Hollingshead job code				
8: Unemployed	.09	.13	.27	.51
4: Clerical, sales	.08	.05	.30	.58
2: Managerial	.07	.03	.31	.60
Income				
$14,000				
$26,000	Differences not significant			
$40,000				
Adult antisocial behavior				
3 symptoms	.08	.32	.36	.24
1 symptom	.09	.06	.34	.51
No symptoms	.07	.01	.22	.71
Alcohol dependence				
3 symptoms	.09	.10	.31	.50
1 symptom	.09	.06	.30	.55
No symptoms	.07	.03	.28	.62
Nicotine dependence				
3 symptoms	.09	.08	.32	.51
1 symptom	.08	.04	.29	.58
No symptoms	.06	.03	.26	.65
Drug dependence				
3 symptoms	.04	.06	.68	.22
1 symptom	.04	.03	.66	.27
No symptoms	.04	.02	.63	.32
Family involvement				
Low	.09	.10	.37	.44
Medium	.08	.05	.32	.55
High	.07	.02	.26	.65
Interpersonal problems				
High	.09	.11	.42	.38
Medium	.09	.04	.32	.55
Low	.07	.02	.23	.68

Note. The three levels given for each outcome correspond very approximately to −1, 0, and 1 standard deviations from the mean.
[a] Overall membership = 8%. [b] Overall membership = 5%. [c] Overall membership = 28%. [d] Overall membership = 59%.

Appendix D

Prevalences of Control Trajectory Group Membership for Different Outcomes

Outcome variable	Control trajectory group: Low, steady[a]	Moderate, increasing[b]	High, steady[c]
Education			
High school	.09	.86	.05
Some college	.06	.79	.15
College degree	.06	.76	.18
Hollingshead job code			
8: Unemployed	.10	.82	.08
4: Clerical, sales	.07	.79	.14
2: Managerial	.05	.76	.19
Income			
$14,000	.08	.81	.12
$26,000	.06	.78	.16
$40,000	.05	.74	.21
Adult antisocial behavior			
3 symptoms	.78	.19	.03
1 symptom	.25	.58	.17
No symptoms	.03	.62	.35
Alcohol dependence			
3 symptoms	.11	.81	.07
1 symptom	.08	.82	.10
No symptoms	.05	.79	.16
Nicotine dependence			
3 symptoms	.12	.82	.07
1 symptom	.06	.83	.12
No symptoms	.03	.78	.19
Drug dependence			
3 symptoms			
1 symptom	Differences not significant		
No symptoms			
Family involvement			
Low			
Medium	Differences not significant		
High			
Interpersonal problems			
High	.11	.80	.09
Medium	.07	.81	.13
Low	.04	.78	.18

Note. The three levels given for each outcome correspond very approximately to −1, 0, and 1 standard deviations from the mean.
[a] Overall membership = 7%. [b] Overall membership = 81%. [c] Overall membership = 12%.

(*Appendixes continue*)

Appendix E

Prevalances of Harm Avoidance Trajectory Group Membership for Different Outcomes

Outcome variable	Harm Avoidance trajectory group			
	Very low, steady[a]	High, increasing[b]	Low, increasing[c]	High, decreasing[d]
Education				
High school				
Some college		Differences not significant		
College degree				
Hollingshead job code				
8: Unemployed				
4: Clerical, sales		Differences not significant		
2: Managerial				
Income				
$14,000				
$26,000		Differences not significant		
$40,000				
Adult antisocial behavior				
3 symptoms	.05	.32	.43	.20
1 symptom	.07	.46	.40	.07
No symptoms	.08	.57	.32	.02
Alcohol dependence				
3 symptoms	.06	.46	.39	.09
1 symptom	.07	.49	.37	.07
No symptoms	.08	.54	.33	.04
Nicotine dependence				
3 symptoms				
1 symptom		Differences not significant		
No symptoms				
Drug dependence				
3 symptoms	.09	.41	.39	.11
1 symptom	.08	.47	.37	.07
No symptoms	.07	.54	.34	.05
Family involvement				
Low				
Medium		Differences not significant		
High				
Interpersonal problems				
High				
Medium		Differences not significant		
Low				

Note. The three levels given for each outcome correspond very approximately to −1, 0, and 1 standard deviations from the mean.
[a] Overall membership = 5%. [b] Overall membership = 55%. [c] Overall membership = 34%. [d] Overall membership = 6%.

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