

Development of Big Five Domains and Facets in Adulthood: Mean-Level Age Trends and Broadly Versus Narrowly Acting Mechanisms

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ABSTRACT Data from a cross-sectional sample ($N = 601$ men and women) and a longitudinal sample ($N = 125$ women) were used to test hypotheses about the development of Big Five domains and facets from early adulthood through middle age. Analyses of mean-level age trends indicated that overall Agreeableness and Conscientiousness increased with age and that several facets showed distinctive trends that replicated across the samples. Cross-sectional analyses of trait intercorrelations and covariances indicated that interrelations between the Big Five domains, and between their more specific facets, were quite similar at older versus younger ages. Finally, longitudinal analyses of individual-level changes indicated that (a) different people's personalities changed in markedly different ways; (b) these changes were predominantly independent, rather than correlated, across Big Five domains; and (c) the pattern of change correlations between Big Five facets could be explained by the facets' interrelations at the first assessment time. Taken together, these results suggest that a complete understanding of personality development requires consideration of facet-level traits and that adult personality development is predominantly influenced by narrowly acting mechanisms that each affect a single Big Five domain, or a small cluster of related facets, rather than by broadly acting mechanisms that simultaneously affect previously independent traits.

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How do people's personalities develop across adulthood? Much recent research has examined mean-level age differences in the Big Five trait domains: Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness to Experience (e.g., Donnellan & Lucas, 2008; McCrae et al., 1999, 2000; McCrae, Martin, & Costa, 2005; Roberts, Walton, & Viechtbauer, 2006; Soto, John, Gosling, & Potter, 2011; Srivastava, John, Gosling, & Potter, 2003; Terracciano, McCrae, Brant, & Costa, 2005). The available evidence suggests that, from young adulthood through middle age, mean levels of Conscientiousness and Agreeableness increase, whereas levels of Neuroticism, Extraversion, and Openness to Experience decline—although findings have varied somewhat across studies, especially for these last three domains.

These findings provide a rough sense of how older versus younger adults' personalities tend to differ from each other. However, they also raise new questions, and the present research was conducted to address two of these. One question concerns the specificity of mean-level age trends: Can the Big Five domains themselves capture all of the meaningful information about age differences in personality traits, or do the more specific facet traits within these broad domains sometimes show quite different age trends? The second question concerns causal processes: Is adult personality development predominantly influenced by broadly acting mechanisms that simultaneously affect multiple Big Five domains and their constituent facets, or by narrowly acting mechanisms that each affect only a single domain, or even a single facet?

Looking Beneath the Big Five: Age Trends for Facet-Level Traits

Each of the broad Big Five domains subsumes a number of more specific personality traits, often referred to as facets (Costa & McCrae, 1992; John, Naumann, & Soto, 2008). For example, the broad Extraversion domain includes the facet traits of assertiveness and gregariousness, among others. These facets covary with each other across individuals: Most highly assertive people are also gregarious. This covariation, however, is far from perfect, with correlations between same-domain facets typically averaging about .40 (Costa & McCrae, 1992). Moreover, previous research has demonstrated that individual facets uniquely predict a variety of important behaviors and outcomes—beyond the level of prediction afforded by

the five broad domains themselves (e.g., Herringer, 1998; O'Connor & Paunonen, 2007; Paunonen & Ashton, 2001; Ruiz, Pincus, & Dickinson, 2003; Samuel & Widiger, 2008).

Because specific facet traits capture unique personality information, it is important to ask whether the facets within each broad Big Five domain show similar or different patterns of development. If same-domain facets show very similar age trends, this would indicate that almost all meaningful information about the normative development of personality traits can be captured by the domains themselves. Conversely, if same-domain facets sometimes show quite different trends, this would indicate that a full understanding of personality development requires consideration of the more specific facet traits “beneath” the broad domains.

Although much recent research has investigated mean-level age differences in the Big Five domains, only a small handful of studies have examined such differences at the facet level. The little available evidence suggests that, within at least some of the domains, different facets show different age trends. For example, a meta-analysis of mean-level changes in personality traits distinguished between social dominance (assertiveness and social confidence) and social vitality (gregariousness and positive emotionality) facets of Extraversion (Roberts et al., 2006). Its results indicated that these two facets showed very different mean-level age trends across adulthood: levels of social dominance increased from early adulthood into middle age, whereas levels of social vitality declined gradually with age. Similarly, a recent cross-sectional study examined age differences in facets of Conscientiousness (Jackson et al., 2009). Results from two samples indicated that mean levels of industriousness, impulse control, and reliability increased substantially from early adulthood into middle age, whereas levels of orderliness did not.

And what of the other Big Five domains? An accelerated longitudinal study (Terracciano et al., 2005) examined mean-level age differences on the 30 facet traits assessed by the Revised NEO Personality Inventory (NEO PI-R; Costa & McCrae, 1992). Another study (Soto et al., 2011) examined age differences on the 10 facet scales of the Big Five Inventory (BFI; John, Donahue, & Kentle, 1991; Soto & John, 2009a), using data from a very large cross-sectional sample. Both studies found that, within most domains, different facets showed quite different age trends. Some of these facet-level trends were consistent with the results of Roberts et al.

(2006) and Jackson et al. (2009), but others were not. For example, within the Conscientiousness domain, Soto et al. (2011) found a positive age trend for BFI Self-Discipline—similar to the impulse control facet measured by Jackson et al., (2009)—but Terracciano et al. (2005) did not find a similar trend for NEO PI-R Self-Discipline. Consistent with Jackson et al. (2009), neither study found a positive trend for the two measures' Order facets. Within the Extraversion domain, Terracciano et al. (2005) found a significant, negative age trend for one of the two NEO PI-R facets most clearly related to social vitality (Positive Emotions), but not for the other (Gregariousness), and Soto et al. (2011) did not find a negative trend for BFI Gregariousness. Moreover, neither study found a positive trend for the two measures' Assertiveness facets.

In view of this scarce and inconsistent evidence, one major goal of the present research was to examine mean-level age trends for Big Five facets. We did this using the CPI-Big Five (Soto & John, 2009b), a recently developed method for measuring the Big Five domains, as well as 16 more specific facet traits, from the item pool of the California Psychological Inventory (CPI; Gough & Bradley, 1996). Table 1 presents the name, the number of items, and a short description for each CPI-Big Five facet scale. These facets overlap considerably with those assessed by other hierarchical Big Five measures. For example, the CPI-Big Five facets of Orderliness, Self-Discipline, Compassion, Gregariousness, Assertiveness, Idealism, Intellectualism, Anxiety, and Depression correspond closely with the NEO PI-R and BFI facets of Order, Self-Discipline, Altruism, Gregariousness, Assertiveness, Openness to Aesthetics, Openness to Ideas, Anxiety, and Depression, respectively (John et al., 2008). Therefore, age trends for many Big Five facets can be readily compared across these three instruments.

How might the facets assessed by the CPI-Big Five develop across adulthood? For many people, the central tasks of adult life include achieving in a job or career and forming satisfying and supportive close relationships (Erikson, 1968; Hogan & Roberts, 2004). At the level of the Big Five domains, investment in the corresponding social roles of worker, romantic partner, and parent—which frequently call for responsible and prosocial behavior—may underlie normative increases in Conscientiousness and Agreeableness (Hogan & Roberts, 2004; Roberts & Wood, 2006). At the facet level, because work ethic and task focus seem more important for career achieve-

Table 1
The CPI-Big Five Facet Scales: Names, Lengths,
and Descriptions

| Facet | Number of Items | Description |
|-------------------|--------------------|---|
| Conscientiousness | | |
| Industriousness | 21 | Work ethic and moral seriousness |
| Orderliness | 17 | Tendency to plan ahead and to be organized and neat |
| Self-Discipline | 11 | Ability to stay focused on tasks and on long-term goals |
| Agreeableness | | |
| Trustfulness | 22 | Tendency to be trusting and friendly with others |
| Compassion | 18 | Concern for the welfare of others |
| Humility | 18 | Tendency to be humble, rather than proud and bossy |
| Extraversion | | |
| Gregariousness | 14 | Enjoyment of social events and of others' company |
| Social Confidence | 13 | Comfort speaking with strangers and in front of groups |
| Assertiveness | 15 | Preference for exerting control in a group setting |
| Openness | | |
| Idealism | 24 | Valuing art and individual expression |
| Intellectualism | 22 | Intellectual curiosity and breadth of interest |
| Adventurousness | 20 | Preference for novel and intense experiences |
| Neuroticism | | |
| Anxiety | 27 | Tendency to feel nervous and fearful |
| Depression | 22 | Tendency to feel sad |
| Rumination | 11 | Susceptibility to intrusive thoughts, feelings, and behaviors |
| Irritability | 24 | Tendency to feel grouchy and annoyed |

ment than does a preference for neatness, we hypothesized that increases in the Industriousness and Self-Discipline facets of Conscientiousness might be more pronounced than increases in Orderliness (cf. Jackson et al., 2009; Soto et al., 2011). Within the Agreeableness

domain, willingness to trust others, prosocial concern, and respect for others all seem important for establishing and maintaining close relationships. We therefore expected positive age trends for all three facets of Agreeableness: Trust, Compassion, and Humility.

During early adulthood and middle age, many people also aim to maximize their social status, both inside and outside of their work role (Helson, Soto, & Cate, 2006), and most attain their highest level of status during middle age (Lachman, Lewkowicz, Marcus, & Peng, 1994; Roberts, 1997). We hypothesized that such pursuit and attainment of status would be accompanied by increases in both the Assertiveness and Social Confidence facets of Extraversion (cf. Roberts et al., 2006). In contrast, as adults settle into more stable relationships, the number of people they interact with on a regular basis typically decreases (Carstensen, 1992), and the focus of their social and personal goals often shifts from exploration to the maintenance of existing relationships (Carstensen, Isaacowitz, & Charles, 1999). In terms of personality traits, we hypothesized that these changes would be accompanied by declines in the Gregariousness facet of Extraversion and the Adventurousness facet of Openness to Experience.

Finally, as they age, people generally shift toward greater use of emotion regulation strategies that effectively reduce negative affect (Helson & Soto, 2005; John & Gross, 2004; Labouvie-Vief, Diehl, Jain, & Zhang, 2007). Moreover, most adults establish close relationships that become more satisfying and supportive over time (Carstensen, 1992; Gorchoff, John, & Helson, 2008; Lang & Carstensen, 2002) and potentially buffer them from life stressors. We therefore hypothesized that, within the Neuroticism domain, mean levels of Anxiety, Depression, Rumination, and Irritability would all decline with age.

Causes of Personality Development: Broadly Versus Narrowly Acting Mechanisms

Is adult personality development predominantly influenced by broadly acting mechanisms that simultaneously affect multiple Big Five domains and their constituent facets, or by narrowly acting mechanisms that each affect only a single domain? On the one hand, the Big Five are often conceptualized as orthogonal dimensions, suggesting that each domain might be influenced by an independent set of developmental mechanisms.

On the other hand, Digman (1997) noted that, when measured, the Big Five are seldom perfectly orthogonal to each other. Instead, measures of Agreeableness and Conscientiousness tend to intercorrelate positively with each other and negatively with Neuroticism, defining a higher order factor that he labeled α . Measures of Extraversion and Openness to Experience also tend to intercorrelate positively with each other, forming a second higher order factor, labeled β . Digman (1997) attributed the emergence of these higher order factors to the influence of two broadly acting developmental processes. Specifically, he proposed that Agreeableness, Conscientiousness, and Neuroticism are jointly influenced by the internalization of broad societal norms toward prosocial behavior, whereas Extraversion and Openness are influenced by exposure to a wide versus narrow range of personal experiences.

DeYoung, Peterson, and Higgins (2002) offered an alternative interpretation of these two higher order factors, proposing that their emergence reflects the influence of two basic neurobiological systems. Specifically, they argued that intercorrelations between Agreeableness, Conscientiousness, and Neuroticism reflect these domains' common dependence on the serotonergic system, which regulates behavioral and emotional impulses (Spoont, 1992), whereas the correlation between Extraversion and Openness to Experience reflects their dependence on the dopaminergic system, which promotes behavioral and cognitive exploration (Ashby, Isen, & Turken, 1999).

These experiential and neurobiological accounts both suggest that personality development might be influenced by two broadly acting mechanisms: one that affects Agreeableness, Conscientiousness, and Neuroticism and a second that affects Extraversion and Openness to Experience. Previous studies of adult age trends for the Big Five provide tentative support for this hypothesis. Consistent with the implications of the higher order α factor, most such studies have found that, from early adulthood through middle age, Agreeableness and Conscientiousness show positive age trends that are similar to each other and opposite the negative trend shown by Neuroticism. Consistent with the β factor, most studies have found that mean levels of Extraversion and Openness to Experience both decline somewhat with age.

However, some researchers have proposed that the intercorrelations typically observed between Big Five domains represent artifacts

of evaluative bias (McCrae et al., 2008) or blends of orthogonal factors (Ashton, Lee, Goldberg, & de Vries, 2009), rather than experiential or biological commonalities shared across domains. Moreover, although the mean-level age trends observed in previous studies have generally been consistent with the hypothesis of two broadly acting developmental mechanisms, they provide only weak tests of this hypothesis: Similar mean-level trends do not necessarily imply similar causal processes.

Longitudinal studies that estimate change at the individual level (rather than only at the mean level) can provide much stronger tests for broadly versus narrowly acting developmental mechanisms. Specifically, such studies can test whether changes in different personality traits correlate across individuals. For example, do individuals who show especially large increases in Agreeableness also tend to show large increases in Conscientiousness and decreases in Neuroticism? Or are individual-level changes in these domains independent of each other? Correlated changes would suggest the operation of broadly acting developmental mechanisms that simultaneously affect multiple domains, whereas independent changes would suggest the predominance of narrowly acting mechanisms that each affect only a single domain.

Two recent longitudinal studies tested for correlated changes in samples of middle-aged and older adults (Allemand, Zimprich, & Hertzog, 2007; Allemand, Zimprich, & Martin, 2008). One of these studies (Allemand et al., 2007) examined changes, across 4 years, in two samples: one in early middle age (ages 42 to 46 at initial assessment) and one in late middle age (ages 60 to 64 at initial assessment). It found substantial change correlations for almost all possible pairs of Big Five domains, with 17 of the 20 pairwise correlations attaining statistical significance and 13 exceeding .30 in magnitude. The second study examined changes in the older of these two samples across 12 years (Allemand et al., 2008). It found moderate or large change correlations between all of the Big Five except Neuroticism: All six of the pairwise correlations that did not involve Neuroticism were statistically significant and exceeded .40 in magnitude.

Taken together, these results do not support the hypothesis of two developmental mechanisms—one that influences Agreeableness, Conscientiousness, and Neuroticism, and one that influences Extraversion and Openness to Experience. Instead, they suggest an even broader, single mechanism that influences all of the Big Five

domains. However, it is important to note that, in both of the samples used in these studies, the initial domain intercorrelations (i.e., correlations at the first assessment time, before any observed personality change) were unusually strong. Across the two samples, their magnitudes averaged .31, and some exceeded .50. In contrast, across a variety of Big Five measures, the magnitudes of domain intercorrelations typically average less than .20 and only rarely reach .30 (John et al., 2008). Therefore, the widespread change correlations observed by Allemand et al. (2007, 2008) may reflect initial measurement overlaps between the domains, rather than previously independent traits changing in unison. In fact, when Allemand et al. (2008) tested for differences between change correlations and initial correlations, they found that only one of the six significant change correlations was also significantly different from the corresponding initial correlation. These results suggest that initial measurement overlaps may largely explain the pattern of change correlations observed in this study.

Thus, the second major goal of the present research was to test for broadly acting developmental mechanisms that simultaneously influenced previously independent personality traits. We did this in two ways. First, we examined longitudinal change correlations between the Big Five domains, and between their more specific facets. As explained above, mechanisms that simultaneously influenced two previously independent traits would lead to correlated changes between those traits. Second, we examined cross-sectional age differences in trait interrelations. If the adult development of two previously independent traits was influenced by the same mechanism, then those traits would covary more strongly at older ages than at younger ages (Hofer, Flaherty, & Hoffman, 2006).¹

Importantly, previous research has shown that intercorrelations between the CPI-Big Five domains average only about .10 in magnitude (Soto & John, 2009b). Therefore, any observed evidence of developmental mechanisms that simultaneously influenced multiple domains should not be attributable to initial measurement overlaps. Moreover, the CPI-Big Five's hierarchical structure allowed us to test for broadly acting mechanisms at the level of Big Five facets. To our knowledge, no previous research has examined this issue at the facet level.

1. We thank an anonymous reviewer for suggesting these cross-sectional analyses.

What should we expect to find? One possibility is that almost all domain and facet interrelations will be stronger at older ages, and that individual-level changes will correlate substantially between almost all pairs of traits (cf. Allemand et al., 2007, 2008). This pattern would suggest that adult personality development was influenced by a single, broadly acting mechanism. A second possibility is that the patterns of cross-sectional and longitudinal correlations will suggest two broadly acting mechanisms: one influencing Agreeableness, Conscientiousness, Neuroticism, and these domains' constituent facets and one influencing Extraversion, Openness to Experience, and their facets (cf. DeYoung et al., 2002; Digman, 1997). Finally, the cross-sectional trait interrelations may be very similar at older versus younger ages, and individual-level changes may be independent across Big Five domains. This pattern would suggest that personality development was predominantly influenced by narrowly acting mechanisms that each affected only a single domain and therefore only a small cluster (at most) of related facet traits. Due to the fact that almost no previous studies have tested for broadly acting developmental mechanisms, and the ambiguity of the little available evidence, we did not have a clear expectation regarding which of these three competing hypotheses would be best supported in the present research.

Overview of the Present Research

In short, the present research examined the development of Big Five domains and facets from early adulthood through middle age. Specifically, we tested hypotheses about mean-level age trends and about the influences of broadly versus narrowly acting developmental mechanisms, using data from two independent samples. One was a cross-sectional sample of men and women whose ages spanned early adulthood and middle age; the second was a long-term longitudinal sample of women assessed first in early adulthood and then several more times over the next 40 years. In both samples, we measured Big Five domains and facets using the CPI-Big Five (Soto & John, 2009b).

METHOD

Samples and Procedures

Longitudinal sample. These participants were 125 women who were born between 1934 and 1939 and graduated from Mills College, in Oakland,

California, in either 1958 or 1960. As part of the Mills Longitudinal Study (see Helson & Soto, 2005), the CPI was administered to them at the approximate ages of 21 (during their senior year at Mills College; range = 20–23), 27 (range = 25–29), 43 (range = 42–47), 52 (range = 50–55), and 61 (range = 60–64) years old. The number of participants who completed the CPI at each assessment time was 123 at age 21, 96 at age 27, 106 at age 43, 104 at age 52, and 110 at age 61. All 125 participants completed the CPI at least twice, 114 (91%) completed it at least three times, 102 (82%) completed it at least four times, and 73 (58%) completed it five times. Reflecting the demographics of Mills students at the time, the sample was predominantly White/Caucasian.

Cross-sectional sample. These participants were members of the Eugene-Springfield Community Sample, a sample of adult residents of the Eugene-Springfield, Oregon, area (see Goldberg, 1999). To maximize comparability with the longitudinal sample, the sample analyzed here included 601 individuals who completed the CPI when they were between the ages of 20 and 64 years old ($M = 47.68$, $SD = 9.15$). This sample was diverse in terms of gender (58% female) and level of education (16% no college, 29% some college, 33% graduated college, 22% advanced degree). Reflecting the local demographics, almost all (98%) were White/Caucasian.

Measure

The California Psychological Inventory and the CPI-Big Five. The California Psychological Inventory (CPI; Gough & Bradley, 1996) assesses a wide range of personal attributes using a pool of more than 400 true-false items. This pool contains much content relevant to the Big Five domains; however, the instrument's standard folk and vector scales do not include strong and unique measures of each domain (McCrae, Costa, & Piedmont, 1993). To address this issue, we recently developed the CPI-Big Five (Soto & John, 2009b), a method for scoring the Big Five domains, as well as 16 more specific facet traits, from the CPI items. Specifically, we first constructed 16 facet scales, ranging in length from 11 to 27 items (see Table 1), on the basis of those items' correlations with existing Big Five measures, as well as rational judgments of item content. We then derived scoring equations for the five superordinate domains from a principal components analysis of the 16 facet scales; this analysis rotated the five components to maximize their convergence with domain scores from the NEO PI-R. Finally, we transformed the domain and facet scoring equations so that they provide *T* scores—standard scores with an expected mean of 50 and a *SD* of 10. In

terms of Cohen's (1988) guidelines for interpreting effect sizes, differences of 2, 5, and 8 *T* score points represent small, moderate, and large effects, respectively.

After developing the CPI-Big Five, we examined its measurement properties in three independent samples and found that its domains and facets demonstrated strong reliability and validity (Soto & John, 2009b). Across these samples, alpha reliabilities averaged .84 for the five domains and .70 for the 16 facet scales. As for validity, at the domain level, convergent correlations with the NEO PI-R averaged .71, whereas discriminant correlations averaged only .06 in magnitude. Convergent correlations with BFI observer reports averaged .40, whereas discriminant correlations averaged only .10 in magnitude—values very similar to those for the NEO PI-R in the same samples. At the facet level, each CPI-Big Five facet scale showed a distinctive and conceptually meaningful pattern of correlates with scales and items from the NEO PI-R and the Adjective Check List (Gough & Heilbrun, 1983), such that four judges matched the facet scales to lists of their strongest correlates with 97% accuracy.

The CPI-Big Five also demonstrated strong reliability and discriminant validity in the present samples. The alpha reliabilities of the five domains averaged .84 in the cross-sectional sample and .79 in the longitudinal sample (across the five assessment times), and the alphas of the 16 shorter facet scales averaged .69 in the cross-sectional sample and .63 in the longitudinal sample. Regarding discriminant validity, the magnitudes of the domain intercorrelations averaged only .05 in the cross-sectional sample and .13 in the longitudinal sample; no discriminant correlation reached .30 in magnitude in either sample.

Cross-Sectional and Longitudinal Models

To examine age trends for Big Five domains and facets, we fit ordinary least squares regression models in the cross-sectional sample and multi-level models (sometimes referred to as hierarchical linear models) in the longitudinal sample. These models were designed to maximize comparability across traits and samples. Specifically, in the cross-sectional sample, we fit regression models of the following form:

$$TRAIT = b_0 + b_1(AGE) + b_2(GENDER) + b_3(AGE \times GENDER) + e.$$

In this model, *TRAIT* is the predicted value of the Big Five domain or facet, *AGE* is age in years (centered at 20), and *GENDER* is a contrast code for gender (−1 = male, 1 = female); b_0 is the trait's predicted mean at age 20 (controlling for gender), b_1 is the linear age effect (controlling for gender), b_2 is half the predicted gender difference at age 20 (with a positive coefficient indicating higher scores for women), b_3 is half the gender

difference in the linear age effect (with a positive coefficient indicating a more positive age effect for women), and e is random error.

In the longitudinal sample, we fit multilevel models with the five assessment times (Level 1) nested within individuals (Level 2). These models included fixed and random intercepts, as well as fixed and random linear age effects. The Level 1 models took the following form:

$$TRAIT_{it} = B_{0i} + B_{1i}(AGE_{it}) + R_{it},$$

and the Level 2 models took the following forms:

$$B_{0i} = G_{00} + U_{0i} \text{ and } B_{1i} = G_{10} + U_{1i}.$$

In these models, $TRAIT$ and AGE are as in the cross-sectional models, B_{0i} is the predicted value of the trait for a particular individual at age 20, G_{00} is the trait's predicted mean at age 20 (comparable to b_0 , above), U_{0i} is a particular individual's predicted deviation from the group mean at age 20, B_{1i} is the linear age effect for a particular individual, G_{10} is the mean linear age effect for the group (comparable to b_1 , above), U_{1i} is a particular individual's deviation from the mean linear age effect, and R_{it} is random error (comparable to e , above).²

These multilevel longitudinal models have important advantages over other approaches to analyzing group-level change (e.g., repeated-measures ANOVAs) and individual-level change (e.g., simple difference scores). At the group level, repeated-measures ANOVAs only use data from complete cases, whereas the present models used all of the available information. At the individual level, simple difference scores estimate change using only two time points, whereas the present models used all five of the available time points. These models' individual-level change estimates are therefore more robust and less susceptible to regression toward the mean.

RESULTS

Mean-Level Age Trends for Big Five Domains and Facets

How did adults' personalities differ by age? Tables 2 and 3 present mean-level age trends for the CPI-Big Five domains and facets in the cross-sectional (Table 2) and longitudinal (Table 3) samples, and Figures 1–5 illustrate these age trends. To test for overall

2. We conducted preliminary analyses to test for curvilinear age trends. The results of these analyses indicated that few traits showed significant curvilinear trends, and that these trends replicated poorly across the longitudinal and cross-sectional samples. We therefore included only linear age effects in the final models.

Table 2
Mean-Level Age Trends for Big Five Domains and Facets in the Cross-Sectional Sample

| Domain or Facet | Regression Coefficients | | |
|-------------------|-------------------------|---------------|---|
| | Intercept (b_0) | Age (b_1) | Gender (b_2) Age \times Gender (b_3) |
| Conscientiousness | 44.765 | 0.165* | 1.739 -0.031 |
| Industriousness | 42.850 | 0.226* | 2.745* -0.052 |
| Orderliness | 47.138 | 0.075 | 2.208 -0.043 |
| Self-Discipline | 48.244 | 0.064 | -0.647 0.013 |
| Agreeableness | 46.185 | 0.124* | 3.789* 0.000 |
| Trustfulness | 45.772 | 0.142* | 3.039* -0.035 |
| Compassion | 48.304 | 0.068 | 1.518 0.021 |
| Humility | 47.855 | 0.052 | 2.906* 0.013 |
| Extraversion | 48.987 | 0.038 | 3.183* -0.052 |
| Gregariousness | 51.227 | -0.044 | 1.153 -0.007 |
| Social Confidence | 47.868 | 0.062 | -0.783 -0.001 |
| Assertiveness | 50.366 | 0.005 | -0.394 -0.011 |
| Openness | 52.388 | -0.069 | -3.964* 0.124* |
| Idealism | 51.775 | -0.047 | -2.132 0.108* |
| Intellectualism | 49.481 | 0.010 | -3.958* 0.092* |
| Adventurousness | 56.936 | -0.220* | -5.229* 0.100* |
| Neuroticism | 51.223 | -0.038 | 3.816* -0.047 |
| Anxiety | 50.572 | -0.009 | 4.663* -0.056 |
| Depression | 52.109 | -0.068 | 3.383* -0.080 |
| Rumination | 52.621 | -0.097* | 0.043 -0.024 |
| Irritability | 51.268 | -0.042 | 1.897 -0.068 |

Note. $N = 601$. Intercept (b_0) = predicted mean at age 20 (controlling for gender). Age (b_1) = linear age effect (controlling for gender). Gender (b_2) = gender effect at age 20; positive coefficients indicate higher scores for women. Age \times Gender (b_3) = Linear Age \times Gender interaction effect; positive coefficients indicate more positive age effects for women.

* $p < .05$.

Table 3
Mean-Level and Individual-Level Changes on Big Five Domains and Facets in the Longitudinal Sample

| Domain or Facet | Mean-Level Change: Fixed-Effect Coefficients (Standard Errors) | | Individual Change: Random-Effect Variances (Standard Errors) | | Residual Variance (Standard Error) (R_{it}) |
|-------------------|--|------------------|--|------------------|--|
| | Intercept (G_{00}) | Age (G_{10}) | Intercept (U_{0i}) | Age (U_{1i}) | |
| Conscientiousness | 45.200 (0.788) | 0.143 (0.022)* | 55.356 (9.966) | 0.024 (0.008)* | 33.253 (2.727) |
| Industriousness | 44.080 (0.775) | 0.145 (0.021)* | 53.456 (9.622) | 0.022 (0.008)* | 32.457 (2.669) |
| Orderliness | 46.310 (0.806) | 0.038 (0.022) | 54.647 (10.477) | 0.021 (0.008)* | 40.017 (3.288) |
| Self-Discipline | 44.325 (0.942) | 0.128 (0.029)* | 78.911 (14.384) | 0.052 (0.013)* | 48.029 (3.933) |
| Agreeableness | 48.152 (0.749) | 0.104 (0.019)* | 49.918 (9.039) | 0.013 (0.006)* | 30.401 (2.506) |
| Trustfulness | 49.588 (0.673) | 0.053 (0.019)* | 35.731 (7.503) | 0.011 (0.006) | 31.551 (2.630) |
| Compassion | 44.064 (0.781) | 0.125 (0.024)* | 47.824 (9.885) | 0.025 (0.009)* | 42.935 (3.519) |
| Humility | 54.010 (0.562) | 0.085 (0.017)* | 17.137 (5.295) | 0.001 (0.005) | 34.092 (2.785) |
| Extraversion | 53.858 (0.795) | 0.007 (0.019) | 63.321 (10.114) | 0.019 (0.006)* | 23.377 (1.920) |
| Gregariousness | 55.338 (0.787) | -0.083 (0.020)* | 59.872 (9.859) | 0.024 (0.007)* | 26.097 (2.136) |
| Social Confidence | 51.795 (0.786) | 0.038 (0.020) | 60.848 (9.854) | 0.024 (0.006)* | 24.459 (2.002) |
| Assertiveness | 50.557 (0.810) | 0.064 (0.019)* | 63.762 (10.425) | 0.019 (0.006)* | 27.159 (2.215) |
| Openness | 56.737 (0.677) | 0.000 (0.016) | 45.327 (7.227) | 0.014 (0.004)* | 17.937 (1.466) |
| Idealism | 56.923 (0.632) | 0.006 (0.019) | 34.057 (6.456) | 0.021 (0.006)* | 23.898 (1.968) |
| Intellectualism | 54.303 (0.667) | 0.006 (0.019) | 37.972 (7.089) | 0.019 (0.006)* | 26.433 (2.178) |
| Adventurousness | 55.347 (0.819) | -0.116 (0.022)* | 58.181 (10.661) | 0.019 (0.008)* | 38.612 (3.162) |
| Neuroticism | 53.896 (0.853) | -0.003 (0.024) | 69.194 (11.568) | 0.035 (0.009)* | 32.563 (2.676) |
| Anxiety | 50.413 (0.916) | 0.043 (0.026) | 81.469 (13.402) | 0.048 (0.011)* | 34.721 (2.846) |
| Depression | 52.131 (0.715) | -0.064 (0.020)* | 39.309 (8.409) | 0.012 (0.007) | 37.026 (3.028) |
| Rumination | 53.325 (0.798) | -0.102 (0.026)* | 55.184 (10.162) | 0.045 (0.011)* | 36.592 (2.996) |
| Irritability | 49.023 (0.745) | 0.012 (0.024) | 45.265 (8.893) | 0.032 (0.009)* | 36.110 (2.962) |

Note. $N = 125$. Intercept (G_{00}) = predicted mean at age 20. Age (G_{10}) = mean linear age effect. Intercept (U_{0i}) = predicted variance of individual scores at age 20. Age (U_{1i}) = variance of individual linear age effects.
 * $p < .05$.

convergence between the two samples, we computed the correlation between the 21 cross-sectional age effects (5 domains and 16 facets) and the 21 longitudinal age effects; this correlation was very strong ($r = .86, p < .001$), indicating excellent replication between the samples.

Conscientiousness. We expected that overall Conscientiousness would show a positive age trend from early adulthood through middle age and hypothesized that this trend would be stronger for the Industriousness and Self-Discipline facets than for the Orderliness facet. The results supported these predictions (see Figure 1). Specifically, Industriousness ($b_1 = 0.226, G_{10} = 0.145$) and overall Conscientiousness ($b_1 = 0.165, G_{10} = 0.143$) showed significant, positive age trends in both samples, and Self-Discipline showed a significant, positive trend in the longitudinal sample ($G_{10} = 0.128$). In contrast, Orderliness did not show a significant age trend in either sample. Taken together, these results indicate that a typical late-middle-aged adult (i.e., an individual scoring at the 50th percentile of the age-64 distribution) was more dutiful and hardworking than approximately 80% of young adults (i.e., 20-year-olds), but was no more organized than a typical young adult.

Agreeableness. As expected, mean levels of Trustfulness, Compassion, Humility, and overall Agreeableness all related positively with age (see Figure 2). Specifically, Trustfulness ($b_1 = 0.142, G_{10} = 0.053$)

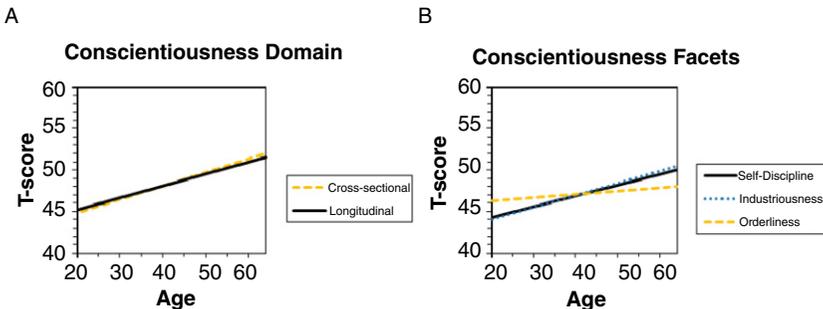


Figure 1
Cross-sectional and longitudinal age trends for overall Conscientiousness (A) and longitudinal age trends for facets of Conscientiousness (B).

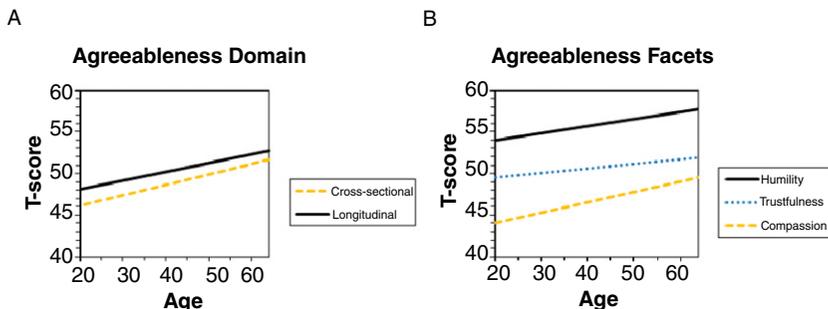


Figure 2

Cross-sectional and longitudinal age trends for overall Agreeableness (A) and longitudinal age trends for facets of Agreeableness (B).

and overall Agreeableness ($b_1 = 0.124$, $G_{10} = 0.104$) showed significant, positive age trends in both samples, and Compassion ($G_{10} = 0.125$) and Humility ($G_{10} = 0.085$) showed significant, positive trends in the longitudinal sample. These results indicate that a typical late-middle-aged adult was more trusting, empathic, and modest than approximately 70% of young adults.

Extraversion. We hypothesized that different facets of Extraversion would show different mean-level age trends, with Assertiveness and Social Confidence showing positive trends and Gregariousness showing a negative trend. These hypotheses were largely supported in the longitudinal sample (see Figure 3). Specifically, in this sample, Gregariousness showed a significant, negative trend ($G_{10} = -0.083$), and Assertiveness showed a significant, positive trend ($G_{10} = 0.064$). Reflecting this mixture of facet-level trends, overall Extraversion did not show a significant longitudinal trend in either direction. This pattern indicates that a typical late-middle-aged adult was more assertive than approximately 60%—but more gregarious than only about 35%—of young adults. In the cross-sectional sample, however, neither overall Extraversion nor any of its facets showed a statistically significant age trend.

Openness to Experience. As hypothesized, the Adventurousness facet of Openness to Experience showed substantial negative age trends in both samples ($b_1 = -0.220$, $G_{10} = -0.116$). In contrast, Ide-

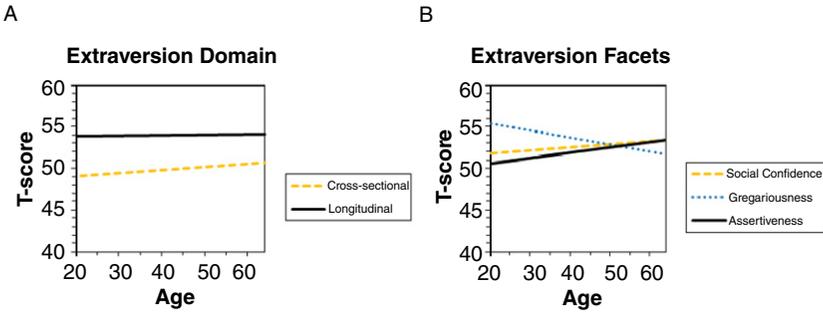


Figure 3
 Cross-sectional and longitudinal age trends for overall Extraversion (A) and longitudinal age trends for facets of Extraversion (B).

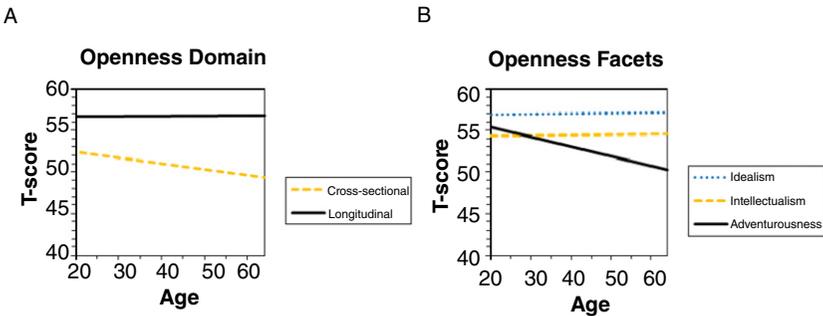


Figure 4
 Cross-sectional and longitudinal age trends for overall Openness to Experience (A) and longitudinal age trends for facets of Openness (B).

alism, Intellectualism, and overall Openness did not show significant trends in either sample (see Figure 4). These findings indicate that a typical late-middle-aged adult was less adventurous than approximately 75% of young adults but had intellectual and aesthetic interests just as broad as those of a typical young adult. Unexpectedly, the cross-sectional trends for overall Openness and all three of its facets were qualified by significant Age \times Gender interactions (see Table 2). In each case, the age trend was more positive for women than for men.

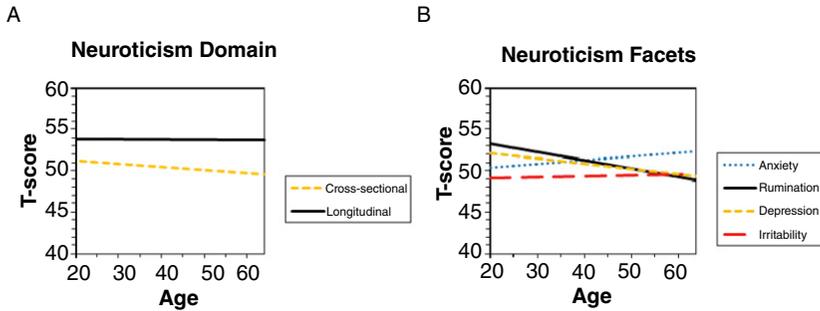


Figure 5
Cross-sectional and longitudinal age trends for overall Neuroticism (A) and longitudinal age trends for facets of Neuroticism (B).

Neuroticism. We expected that overall Neuroticism and its four facets would relate negatively with age, and these predictions were partially supported (see Figure 5). Specifically, Rumination showed significant, negative age trends in both samples ($b_1 = -0.097$, $G_{10} = -0.102$), and Depression showed a significant, negative trend in the longitudinal sample ($G_{10} = -0.064$). However, none of the remaining longitudinal or cross-sectional trends was statistically significant. These results indicate that a typical late-middle-aged adult was less prone to sad affect and compulsive rumination than approximately 65% of young adults but was no less prone to anxious or irritable affect than a typical young adult.

Cross-Sectional Age Differences in Trait Interrelations

Is the adult development of Big Five domains and facets predominantly influenced by broadly or narrowly acting mechanisms? To address this question in the cross-sectional sample, we examined age differences in the correlations and covariances between the Big Five domains and between facet traits. If the development of two previously independent traits was influenced by the same broadly acting mechanism, then those traits would covary more strongly at older ages than at younger ages (Hofer et al., 2006). In contrast, if each trait were influenced by an independent set of narrowly acting mechanisms, then the strength of the relation between the traits would not differ by age.

To compare these two possibilities, we divided the cross-sectional sample into younger (ages 20–43, $N = 197$), middle (ages 44–52,

$N = 217$), and older (ages 53–64, $N = 187$) age groups, using a three-way split. We then tested for age differences in trait interrelations in two ways. First, we conducted pairwise comparisons, between the three age groups, of both the domain-level and facet-level trait intercorrelations. Specifically, for each of the 10 correlations between two domains, and each of the 120 correlations between two facets, we tested whether that correlation differed between each pair of age groups, using the z test for the difference between independent correlations. Only 1 of the 30 domain-level tests (3%) and only 15 of the 360 facet-level tests (4%) were statistically significant at the .05 level. In other words, at both the domain and facet levels, the proportion of significant age differences in trait intercorrelations was no greater—and in fact slightly less—than would be expected by chance.

As a second method to test for age differences in trait interrelations, we fit two multiple-group covariance models—one at the domain level and one at the facet level—using maximum likelihood estimation in Mplus 6.11 (Muthén & Muthén, 2010). The domain-level model allowed all pairs of domains to covary but constrained each of these 10 covariances to be equal across the three age groups. Similarly, the facet-level model allowed all pairs of facets to covary but constrained each of these 120 covariances to be equal across the three groups. Despite these constraints, both the domain-level (CFI = .923, RMSEA = .017, 90% CI = .000–.064, SRMR = .050, $\chi^2(20) = 21.20$, $p = .39$) and facet-level models (CFI = .989, RMSEA = .030, 90% CI = .010–.043, SRMR = .083, $\chi^2(240) = 282.64$, $p = .03$) fit the data very well.

In sum, results from both the pairwise comparisons of correlations and the multiple-group covariance models indicate that the interrelations between the Big Five domains, and between their more specific facets, were very similar at older versus younger ages. They therefore do not suggest the influence of broadly acting mechanisms that affected the development of previously independent traits.

Longitudinal Change Correlations Between Traits

Examining cross-sectional age differences in trait interrelations is one approach to testing for the influence of broadly acting developmental mechanisms. The longitudinal sample provided a second, more direct approach: examining change correlations between the Big Five domains and between facet traits. If two traits were influ-

enced by the same developmental mechanism, then changes on those traits would correlate across individuals. For example, if increases in Conscientiousness and Agreeableness were caused by a single mechanism, then individuals who showed especially large increases in Conscientiousness would also tend to show especially large increases in Agreeableness.

Individual differences in change. Before examining correlated changes between traits, it is important to ask whether there were individual differences in change on each trait. For example, one can only ask whether especially large increases in Conscientiousness predicted especially large increases in Agreeableness if there were, in fact, individuals who showed larger and smaller increases on each of these two domains.

We tested for such individual differences in change using the variances of the longitudinal age effects, and the results of these tests are presented in the Age (U_{1i}) column of Table 3. As this column shows, there were significant individual differences in change for all of the Big Five domains and for 13 of the 16 facets. Moreover, there were marginally significant individual differences for two additional facets: Trustfulness and Depression ($ps < .10$). The only trait that did not show at least marginally significant variability in change was the Humility facet of Agreeableness, indicating that individuals tended to show similar changes on this trait.

How substantial were these individual differences in change? To address this question, we examined the distribution of 125 individual-level age effects (B_{1i}) for each Big Five domain and facet. Table 4 presents, for each trait, the percentages of participants whose individual-level age effects corresponded with large (more than 8 T score points), moderate (5–8 points), small (2–5 points), and trivial (fewer than 2 points) increases and decreases across the duration of the study. As this table shows, for all of the traits except Humility, the participants spanned at least four change categories, and for more than half of the traits (11 of 21), they spanned all seven categories.³ Taken together, these results indicate that there were

3. An alternative method for describing individual differences in change is the Reliable Change Index (RCI; Jacobson & Truax, 1991). Results of analyses using the RCI converged with those presented in Table 4. Specifically, for each trait, we used the RCI to count the proportions of participants who showed a reliable

Table 4
Percentages of Individuals in the Longitudinal Sample Showing Different Directions and Magnitudes of Change

| Trait | Large Decrease | Moderate Decrease | Small Decrease | Trivial Change | Small Increase | Moderate Increase | Large Increase |
|-------------------|----------------|-------------------|----------------|----------------|----------------|-------------------|----------------|
| Extraversion | 2% | 2% | 22% | 47% | 16% | 8% | 3% |
| Gregariousness | 10% | 26% | 29% | 26% | 7% | 2% | 1% |
| Social Confidence | 2% | 3% | 10% | 45% | 23% | 12% | 6% |
| Assertiveness | — | 2% | 8% | 31% | 38% | 13% | 8% |
| Agreeableness | — | — | 2% | 18% | 37% | 38% | 6% |
| Trustfulness | — | — | 3% | 49% | 38% | 10% | — |
| Compassion | — | — | 6% | 18% | 27% | 22% | 27% |
| Humility | — | — | — | 10% | 82% | 8% | — |
| Conscientiousness | — | — | — | 18% | 29% | 27% | 26% |
| Industriousness | — | — | 1% | 15% | 29% | 31% | 24% |
| Orderliness | — | 3% | 9% | 46% | 26% | 14% | 2% |
| Self-Discipline | — | 3% | 8% | 19% | 30% | 13% | 27% |
| Neuroticism | 10% | 6% | 19% | 33% | 18% | 10% | 3% |
| Anxiety | 6% | 6% | 20% | 24% | 13% | 15% | 16% |
| Depression | — | 12% | 57% | 28% | 3% | — | — |
| Rumination | 26% | 15% | 22% | 26% | 6% | 2% | 2% |
| Irritability | 6% | 6% | 17% | 34% | 22% | 8% | 7% |
| Openness | 2% | 4% | 22% | 46% | 23% | 3% | 1% |
| Idealism | 2% | 10% | 17% | 40% | 22% | 8% | 2% |
| Intellectualism | 1% | 8% | 21% | 38% | 23% | 9% | 1% |
| Adventurousness | 14% | 26% | 39% | 19% | 2% | — | — |

Note. $N = 125$. Large = individual-level age effect (B_{it}) corresponding with a total change of more than 8 T -score points across 40 years. Moderate = age effect corresponding with a change of 5–8 points. Small = age effect corresponding with a change of 2–5 points. Trivial = age effect corresponding with a change of fewer than 2 points.

considerable individual differences in change for each Big Five domain, and for almost all of the facets.

Change correlations. Did Big Five domains and facets show predominantly correlated or independent changes? To address this question, we examined correlations between the individual-level age effects ($B_{i,t}$) for all 10 pairs of Big Five domains and all 105 pairs of facets that did not include Humility.⁴ As described earlier (see Tables 3 and 4), all of the CPI-Big Five domains and facets except Humility showed considerable individual differences in change, making it reasonable to test for correlated changes between these traits.

For each pair of traits, a substantial change correlation would indicate that they tended to change in unison, whereas a zero or near-zero correlation would indicate that they tended to change independently. Table 5 presents the correlations between individual-level changes on the Big Five domains. The absolute magnitudes of these change correlations averaged only .09, all were smaller than .20, and none were statistically significant. These results indicate that personality changes were generally independent across the Big Five domains.

At the facet level, there were substantial change correlations between the facets within each Big Five domain. Specifically, the change correlations between pairs of same-domain facets averaged .46 among the Extraversion facets, .28 among the Agreeableness facets, .36 among the Conscientiousness facets, .42 among the Neuroticism

increase or decrease from the first time point to the last, then computed the difference between the proportions of increasers versus decreasers. Thus, a positive difference score for a particular trait would indicate that more individuals showed reliable increases than showed reliable decreases. Similarly, we computed difference scores between the proportions of nontrivial increasers versus decreasers, as estimated by the multilevel models and reported in Table 4. Across the 21 CPI-Big Five domains and facets, these two sets of difference scores correlated very strongly with each other ($r = .84, p < .001$).

4. Using the multilevel models described in the Method section, we first estimated the individual-level age effects separately for each trait; we then examined correlations between sets of age effects. An alternative approach would be to estimate individual-level age effects for all of the domains or facets—and correlations between those effects—simultaneously within a single latent change model (cf. Allemand et al., 2008). However, these more complex models were empirically underidentified in the present sample.

Table 5
Correlations Between Individual-Level Changes on the CPI-Big Five Domains in the Longitudinal Sample

| | Conscientiousness | Agreeableness | Neuroticism | Extraversion | Openness |
|-------------------|-------------------|---------------|-------------|--------------|----------|
| Conscientiousness | — | | | | |
| Agreeableness | -.01 | — | | | |
| Neuroticism | -.08 | -.15 | — | | |
| Extraversion | .12 | .03 | .07 | — | |
| Openness | -.11 | -.16 | .04 | -.10 | — |

Note. $N = 125$. None of the correlations is statistically significant.

facets, .19 among the Openness facets, and .36 overall; the strongest was .59, between changes on the Assertiveness and Social Confidence facets of Extraversion. Of these 16 correlations, 15 were statistically significant; the only exception was the correlation between changes on the Idealism and Adventurousness facets of Openness to Experience, which was marginally significant ($r = .15, p < .10$).

Change correlations between facet traits from different Big Five domains were generally weaker than those between same-domain facets—averaging only .17 in absolute magnitude—but some were substantial. Specifically, 38 of the 89 different-domain change correlations were statistically significant, and the strongest was $-.48$, between changes on the Self-Discipline facet of Conscientiousness and the Rumination facet of Neuroticism.

Do these substantial facet-level change correlations indicate that broadly acting mechanisms influenced the development of previously independent traits, or do they simply reflect the initial conceptual and measurement overlaps between the facets? Allemand et al. (2008) proposed one method for addressing this type of question. For each pair of traits, compute confidence intervals for (a) the change correlation (e.g., between changes in Self-Discipline and Rumination) and (b) the corresponding initial correlation (e.g., between Self-Discipline and Rumination at age 21). If the two intervals overlap, then the correlations are not significantly different, and therefore the initial correlation can explain the change correlation. However, if the two intervals do not overlap, then the correlations are significantly different and the initial correlation cannot explain the change correlation. Such a difference would suggest that two previously unrelated traits were subsequently influenced by a single developmental mechanism.

For each of the 105 pairs of facets, we therefore computed and compared 95% confidence intervals for the change correlation and the corresponding initial correlation. In all 105 cases, these two confidence intervals overlapped, indicating that all of the observed change correlations could be explained by the corresponding initial correlations. For example, although changes in Self-Discipline correlated $-.48$ with changes in Rumination, this was almost identical to the initial correlation of $-.43$ between these facets at age 21.

Taken together, these facet-level results indicate that some pairs of facets tended to increase and decrease together. However, they also indicate that these correlated changes could be explained by the

initial conceptual and measurement overlaps between facets. They therefore do not indicate the influence of broadly acting mechanisms that simultaneously affected the development of previously independent traits.

DISCUSSION

The present findings support several hypotheses about adult personality development. They also highlight some key issues in need of further investigation.

Mean-Level Age Trends for Big Five Domains and Facets

One major aim of the present research was to examine whether all of the meaningful information about mean-level age differences in personality traits can be captured by the Big Five domains themselves, or whether the more specific facets within each domain sometimes show quite different age trends. At the domain level, our cross-sectional and longitudinal results indicate that the most pronounced mean-level trends from early adulthood through middle age were increases in Conscientiousness and Agreeableness—findings consistent with most previous studies of age differences in the Big Five. At the facet level, we found that the related but distinguishable facets within each Big Five domain often showed quite different age trends, and that many of these differences replicated between the cross-sectional and longitudinal samples. For example, in each sample, (a) the Industriousness facet of Conscientiousness—but not the Orderliness facet—showed a significant positive age trend, (b) the Adventurousness facet of Openness to Experience—but not the Idealism and Intellectualism facets—showed a significant negative trend, and (c) the Rumination facet of Neuroticism—but not the Anxiety and Irritability facets—showed a significant negative trend.

Our general conclusion that different same-domain facets often show different age trends is further supported by the few previous studies that have examined such trends, and the evidence for some specific within-domain differences is growing. For example, our findings for the Industriousness and Orderliness facets of Conscientiousness are similar to results from two recent cross-sectional studies (Jackson et al., 2009; Soto et al., 2011). Converging with our findings for the Adventurousness, Idealism, and Intellectualism facets of

Openness to Experience, an accelerated longitudinal study found age-related declines in Openness to Actions, but not in Openness to Aesthetics or Ideas (Terracciano et al., 2005).

Such facet-level differences are important because they indicate that the broad Big Five domains themselves do not capture all of the meaningful information about how personality traits develop across adulthood. In some cases, mean-level increases or decreases at the domain level (e.g., increases in overall Conscientiousness) reflect the patterns shown by only some of the facets within that domain (e.g., Industriousness) and do not generalize to all of the facets (e.g., Orderliness). In other cases, flat domain-level trends (e.g., for overall Openness to Experience) conceal substantial increases or decreases for particular facets (e.g., Adventurousness).

Facet-level differences may also help explain some of the variability in domain-level age trends observed across previous studies. If two measures of a particular Big Five domain emphasize different facet traits, and these facets develop in different ways, then the measures' domain-level age trends will be pulled in different directions. For example, the Openness to Experience scale of the NEO Five-Factor Inventory (NEO-FFI; Costa & McCrae, 1992) emphasizes openness to new activities more so than does the BFI Openness scale (John et al., 2008). The present finding that mean levels of Adventurousness decline substantially with age, whereas levels of Intellectualism and Idealism do not, may therefore help explain why previous studies using the NEO-FFI have found negative age trends for overall Openness (e.g., McCrae et al., 2000) more consistently than have studies using the BFI (e.g., Soto et al., 2011).

Unfortunately, studies examining mean-level age trends for Big Five facets remain rare. Further specifying the trends for individual facets, and further understanding the relations between domain-level and facet-level trends, are important issues for future research.

Broadly Versus Narrowly Acting Developmental Mechanisms

The second major aim of the present research was to investigate whether adult personality development is predominantly influenced by broadly or narrowly acting mechanisms. We addressed this issue by examining cross-sectional age differences in trait intercorrelations and covariances, as well as longitudinal change correlations. In the cross-sectional sample, we found that trait interrelations were similar

at younger versus older ages. In the longitudinal sample, we found that individual-level changes in each Big Five domain were independent of changes in the other four domains. At the facet level, we found that almost all pairs of same-domain facets showed substantially correlated changes, as did some pairs of different-domain facets. However, we also found that these facet-level change correlations could be explained by initial conceptual and measurement overlaps. Thus, both our cross-sectional and longitudinal findings indicate that adult personality development was predominantly influenced by narrowly acting mechanisms, with each mechanism influencing only a single Big Five domain or a small cluster (at most) of conceptually related facet traits. They do not indicate that previously independent traits were subsequently influenced by broadly acting developmental mechanisms. For example, they do not suggest the influence of a single mechanism that affected all five domains, or of two mechanisms related to higher order factors above the Big Five.

At first glance, these findings contrast with results from the only two previous studies, to our knowledge, that have examined change correlations between Big Five domains (Allemand et al., 2007, 2008). Both of these previous studies reported substantial change correlations between most pairs of domains. However, both also reported unusually large discriminant correlations between the domains at the first assessment time. The present findings suggest that the widespread change correlations found in these two previous studies may largely reflect initial measurement overlaps, rather than conceptually independent traits changing in unison. However, additional research is needed to investigate the issue of broadly versus narrowly acting developmental mechanisms. In particular, research is needed to (a) replicate the present finding that the Big Five domains, when measured orthogonally, show independent rather than correlated changes; (b) develop new methods for disentangling change correlations from initial conceptual and measurement overlaps; and (c) further investigate change correlations between Big Five facets. To our knowledge, the present research is the first to test for broadly acting developmental mechanisms at the facet level.

Strengths and Limitations of the Present Research

The present research design had important strengths but also important limitations. One strength was our use of a hierarchical measure,

the CPI-Big Five, which allowed us to examine personality development not only at the level of the broad Big Five domains, but also at the level of more specific facet traits. This measure demonstrated strong measurement properties in the present samples, as in a previous study (Soto & John, 2009b). However, the CPI-Big Five is still relatively new, and replicating the present findings using more established measures, such as the NEO PI-R and the BFI, is an important task for future research.

An additional measurement limitation was that all of the present data were self-reports. Some previous studies have found that mean-level age differences in personality traits replicate between self-reports and observer reports (e.g., McCrae et al., 2005). However, the few studies that have compared individual-level changes in self-reports versus observer reports have found little convergence between these two methods (e.g., Watson & Humrichouse, 2006). Therefore, future research should test whether the present findings generalize to observer reports and behavioral data.

Another strength of the present design was that it included data from two independent samples, including a 40-year longitudinal sample. In a previous article (Soto & John, 2009b), we noted that the CPI-Big Five would allow researchers to address questions about the life span development of Big Five domains and facets by drawing on the rich archive of existing longitudinal CPI data, rather than having to wait years or decades for newly begun longitudinal studies to run their course. The present research represents the first such use of the CPI-Big Five, and this archival approach provided important benefits. For example, most previous studies of mean-level age differences in Big Five domains and facets have used entirely cross-sectional designs, which confound maturational changes with other sources of age differences, such as birth-cohort effects (i.e., the effects of younger vs. older participants being born and raised during different historical periods) and differential selection effects (i.e., the effects of recruiting younger vs. older participants who differ in unintended ways). The present longitudinal sample avoided these confounds. Moreover, the two previous studies that have examined change correlations between Big Five domains have used longitudinal data spanning only 4–12 years (Allemand et al., 2007, 2008). The present longitudinal sample allowed us to examine change correlations over a much longer developmental span.

However, this longitudinal sample was limited in terms of its diversity (female college graduates who were predominantly White/Caucasian) and size (125 participants). These limitations raise questions about generalizability and statistical power, especially power to detect change correlations. Regarding generalizability, we are encouraged by the fact that the present findings—regarding both mean-level age trends and broadly versus narrowly acting developmental mechanisms—converged strongly between the cross-sectional and longitudinal samples. However, additional research using other samples is needed to further test the generalizability of these findings.

Regarding statistical power, the present longitudinal sample provided excellent power to detect large and moderate change correlations. For example, two previous longitudinal studies reported widespread change correlations between the Big Five domains, with most exceeding .30 in magnitude and the strongest reaching .50 (Allemand et al., 2007, 2008). The present longitudinal sample size of 125 provided power greater than .99 to detect true correlations of .40 or .50 in magnitude, and power of .93 to detect a true correlation of .30 in magnitude (Faul, Erdfelder, Lang, & Buchner, 2007). We are therefore confident that the absence of large or moderate change correlations between the Big Five domains, and between previously independent facet traits, was not due to a lack of statistical power. However, this sample provided less power to detect small correlations. For example, it provided power of .61 to detect a true correlation of .20 in magnitude and power of only .20 to detect a true correlation of .10 in magnitude. Therefore, additional longitudinal studies, with larger samples, are needed to further test for small change correlations. These larger-sample studies could also fit more complex longitudinal models, such as factor-of-curves models (see Duncan et al., 2006), that were not possible in the present research.

Identifying Causes of Personality Development

A final key goal for future research will be to identify the specific causal processes that underlie adult personality development. The present findings, which indicate a predominance of narrowly acting developmental mechanisms, suggest that this task will be complex. Rather than searching for a few mechanisms that simultaneously affect many Big Five domains and facets, researchers will need to

identify many mechanisms, each of which uniquely affects an individual Big Five domain, a small cluster of related facet traits, or perhaps even an individual facet.

Hypotheses about particular developmental mechanisms can be tested most directly by longitudinal studies that repeatedly assess both personality traits and potential causes of change. Such studies can directly test whether and how social and biological factors predict subsequent personality changes. For example, one previous study found that greater career investment during middle age prospectively predicted greater declines in social dominance and conformence during the transition to retirement, perhaps because the relaxation of work demands was greatest for those who had been most invested in their careers (Helson & Soto, 2005). However, few such prospective studies have been conducted to date, and future research can greatly advance our understanding of the mechanisms that underlie adult personality development.

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