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Personality and HIV Disease Progression: Role of NEO-PI-R Openness, Extraversion, and Profiles of Engagement

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Abstract

Objective—To examine the role of the big five personality domains (Neuroticism, Extraversion, Openness, Agreeableness, Conscientiousness) and their respective facets and profiles on change in CD4 and log HIV-RNA copies/ml (VL) over 4 years. The examination of psychosocial predictors of disease progression in human immunodeficiency virus (HIV) has focused primarily on depression, coping, and stress, with little attention paid to stable individual differences.

Methods—A diverse sample of HIV-seropositive patients (n = 104) completed personality assessment (NEO-PI-R), underwent comprehensive psychological assessment and blood samples every 6 months for 4 years. Linear rates of change for CD4 cells and VL were modeled using Hierarchical Linear Modeling controlling for antiretrovirals (time dependent covariate), initial disease status, age, gender, ethnicity, and education.

Results—Domains that were significantly associated with slower disease progression over 4 years included Openness (CD4, VL), Extraversion (CD4, VL), and Conscientiousness (VL). Facets of the above domains that were significantly related to slower disease progression were assertiveness, positive emotions, and gregariousness (Extraversion); ideas, esthetics (Openness); achievement striving and order (Conscientiousness). In addition, profile analyses suggested personality styles which seem to underscore the importance of remaining engaged (e.g., Creative Interactors (E+O+), Upbeat Optimists (N−E+), Welcomers (E+A+), Go Getters (C+E+), and Directed (N−C+)) had slower disease progression, whereas the "homebody" profile (Low Extraversion-Low Openness) was significantly associated with faster disease progression.

Conclusions—These results provide good initial evidence of the relationship between personality and disease progression in HIV and suggest protective aspects of profiles of engagement. These finding may help identify those individuals at risk for poorer disease course and specify targets for psychosocial interventions.

Keywords

personality; HIV/AIDS; disease progression; Five-Factor Model; openness; conscientiousness

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INTRODUCTION

The examination of psychosocial predictors of disease progression in human immunodeficiency virus (HIV) has focused primarily on depression, coping, and stress with little attention paid to personality. However, personality traits such as conscientiousness and extraversion have been related to health outcomes in various patient populations as well as longevity in healthy aging populations. The relationship between conscientiousness and health-related behaviors (1) also suggests that personality should be examined as a possible predictor of disease progression in HIV.

Personality has been defined as those enduring characteristics of a person that account for consistent patterns of feeling, thinking, and behavior (2). Although there are many approaches to studying personality, one leading approach to measuring these personality traits is the Five-Factor Model of personality (FFM) advocated by Costa and McCrae (3). The FFM is a hierarchical model. At the highest level of the hierarchy are the five broad factors or domains: Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism; within each domain, there are six narrower lower-order traits or facet scales. The NEO-Personality Inventory—Revised (NEO-PI-R) was explicitly designed to operationalize the FFM, which is a comprehensive model of the trait approach to studying personality.

The literature relating personality to health outcomes shows that conscientiousness has had the most consistent support for a protective health relationship with high conscientiousness being related to positive health outcomes in patients with renal insufficiency (4), diabetes or end-stage renal disease (5), coronary heart disease (6), HIV during a 1-year period (7), Medicare patients (8), and longevity in a healthy aging sample (9,10), and longevity in Presidents who were not assassinated (11). Neuroticism has mixed findings. Some studies have shown high neuroticism being related to poorer health outcomes (in renal insufficiency (4), in mortality in religious orders (9) and healthy aging (12), and in cancer and coronary heart disease (13)), but one study showed a protective effect for midrange neuroticism (for kidney longevity in diabetics and those with end-stage renal disease (5)), and three studies showed a protective effect of high neuroticism against mortality (in Medicare patients (8), post myocardial infarction (MI) (14), and healthy aging (15)). Several studies showed no relationship between neuroticism and health outcomes (with longevity in Presidents (11), with mortality in the Western Electric study (16), with cancer survival (17),(18) or later onset of cancer (19)). Extraversion has some support as protective of health (better prognosis after MI (14); survival after stroke(20); decreased risk of death in clergy (9); reduced risk of mortality in healthy aging (12), protective against mortality by cancer and coronary heart disease (CHD) >15 years (13), but showed no association with longevity/mortality in studies of cancer (17-19) or in Medicare patients (8)). Only a few studies have examined the relationship between agreeableness and longevity and two studies have found no relationship with longevity of Presidents (11) or within clergy (9), although it was protective against mortality in a large sample of elderly Medicare patients (8). The same three studies (8,9,11) examined openness as a predictor of longevity but failed to find a relationship.

Alternative approaches to personality often adopt type categories in association with disease outcomes such as Type C in cancer and Type D in cardiovascular disease. According to Temoshok (21), Type C persons are seen as very pleasant, unassertive people who have difficulty expressing negative emotions and are overly concerned with pleasing others. Denollet and colleagues introduced the Type D personality, which encompasses depression and social isolation and has been found to predict cardiovascular outcomes in patients with cardiovascular disease (22). Constructs historically associated with Type A that may be related to low agreeableness, such as hostility (23,24) as well as cynicism (16) measured on the

Minnesota Multiphasic Personality Inventory, have predicted the development of CHD and mortality.

Our aims in the current study follow from a progression in our longitudinal research on the psychosocial predictors of HIV disease progression from depression, stress, and coping (25, 26) to optimism (27) and conscientiousness (7). The results of these studies together with the literature suggesting the importance of other domains of personality prompted us to examine the relationship between the five personality domains and their facets (lower-order traits) and HIV disease progression. We also examined circumplex combinations (profiles) of the five factors (taken two at a time), which hold the potential to reveal associations that would not be seen when considering the domains separately and have been associated with health behaviors above and beyond their component domains (28).

The purpose of the current study is to examine the association of the FFM personality domains (Neuroticism, Extraversion, Openness, Agreeableness, Conscientiousness) and their respective facets to developmental trajectories involving CD4 and log HIV-RNA copies/ml (VL) over 4 years. In addition, circumplex combinations of the five factors or profiles will be analyzed to assess their importance in predicting health outcomes.

We hypothesize that personality might be particularly salient for HIV both because of its relationship to health behaviors (1), because of particular issues that people with HIV face (such as stigmatization) (29), and the hypothesized importance of remaining engaged in life (30) in the face of multiple losses and a high rate of trauma (31).

METHODS

Subjects

The sample from the parent longitudinal study has been comprehensively described elsewhere (25). Participants were a paid volunteer sample. Subjects were included in this study if they were HIV positive and had CD4 cells between 150 and 500 at study entry, thus capturing people in the midrange of disease. Subjects were excluded if they had ever experienced an acquired immunodeficiency syndrome (AIDS) defining (Category C) symptom, were <18 years old, had other life-threatening illnesses (e.g., cancer), were actively psychotic or suicidal, had dementia or current alcohol or drug dependence. Medical exclusion criteria were assessed through self-report and verified through doctor records and our study labs. Dementia risk was assessed using the HIV Dementia Scale (32) and substance dependence was assessed using the Structured Clinical Interview for Diagnostic and Statistical Manual, 3rd Edition—Revised (DSM-III-R) (33).

Design

This study used an associational-longitudinal design where participants were assessed every 6 months for a 4-year period. The accrual period lasted 2.5 years, and the study period was from 1997 to 2006. Ninety percent of the NEO personality assessments were completed from 2001 to 2002. Thus, personality variables, assessed post baseline, were related to change in HIV disease progression markers over 4 years. Participants were included from the parent sample ($n = 177$) if they agreed to complete the NEO-PI-R assessment during the substudy recruitment period and completed at least one follow-up assessment time point.

Procedures

At baseline, subjects completed written informed consent, psychosocial questionnaires, a clinical assessment interview, and blood samples for CD4 and VL assay. Follow-up visits, repeated every 6 months, included the questionnaire battery, brief interview, and blood

samples. Study procedures, including informed consent, were approved by the Institutional Review Board.

Measures

Demographics and background medical information were assessed by self-report. Personality was assessed by the Revised NEO Personality Inventory, Form S (NEO-PI-R; 3) a 240-item questionnaire designed to measure the five major factors or domains of personality: Openness (O), Conscientiousness (C), Extraversion (E), Agreeableness (A), and Neuroticism (N). Each domain contains six facet scales which provide a comprehensive and detailed assessment of normal adult personality in terms of emotional (N), interpersonal (E), experiential (O), attitudinal (A), and motivational (C) styles. Evidence of convergent and discriminant validity is presented in the NEO-PI-R manua; (3).

Adherence—Prescribed medications and adherence were assessed through interviewer administered AIDS Clinical Trials Group Adherence Measure (34). At each assessment, participants were asked to recall the number of missed doses on each of the previous 3 days. Medication adherence was calculated as the percentage of missed doses averaged over each of the assessment time points for which the participant was taking medication.

Medication—Antiretroviral medication use was dummy coded at each time point reflecting three levels: no medication, combination therapy, or highly active antiretroviral therapy (HAART). Throughout the study period reported here, HAART was defined as multiple antiretroviral medications that included a Protease Inhibitor, or Efavirenz (Sustiva), Tenofovir (Viread), or Abacavir (Ziagen) with some exceptions (35). Combination therapy was multiple antiretroviral medications that did not include the medications above.

Disease Progression Markers—CD4 Lymphocyte Count (CD3+CD4+) was determined by whole blood four-color direct immunofluorescence using a flow cytometer (XL-MCL, Beckman Coulter, Fullerton, California). Viral Load utilized the RT/PCR assay (Amplicor, Roche, Basel, Switzerland) sensitive to 400 copies of plasma RNA.

Statistical Methods

The main analyses used Hierarchical Linear Modeling (36,37) to model CD4 and VL change. NEO-PI-R domains and facets were tested individually in separate linear models. All continuous variables in the model were centered and all categorical variables were coded with zero as the lowest level. Because VL was skewed, it was transformed using a $\log_{10}$ transformation. Missing data were not replaced and separate listwise deletion was used for each analysis.

Additional descriptive statistics were calculated for clinical relevance. For continuous variables (i.e., domains), increase (in VL) and decline (for CD4)ratios were calculated (25). These ratios compare CD4 or VL changes for those at the 75^{th} percentile on a personality domain with those at the 25^{th} percentile. For contrasting profile groups that could naturally be compared, odds ratios were calculated to estimate the comparative effects of the “protective” and “at-risk” personality profiles on disease progression. Dichotomous variables were generated that distinguished those with the “protective profile” (e.g., Creative Interactors (E+O+)) from those with the “at-risk profile” (Homebody (E−O−)). The CD4 and VL distributions were regressed on antiretroviral medications to generate residualized distributions accounting for the effects of medications. Linear curve estimation identified those who experienced significant ($p < .05$, one-tailed test) linear increase in CD4 (or decrease in VL) over time. Separate logistic regression analyses were conducted to identify the odds of significant positive change in

disease progression markers associated with the contrasting personality profiles (e.g., O+E +versus O−E−).

Covariate Selection—Level 1 covariates included prescribed antiretroviral medication (as a time dependent covariate), time after baseline (months), and the interactions of these terms. Level 2 slope covariates included initial disease status (CD4 or VL), race, gender, age, and education level. Full details on coding of covariates and the rationale for their selection are presented in the work of Ironson and colleagues (25).

RESULTS

Sample Description

The current study sample (n = 104) was a subset recruited from the parent sample (n = 177), which has been comprehensively described elsewhere (25). The mean ± standard deviation (SD) age of the participants at study entry was 38 ± 8.48 years. The sample was predominantly male (68%) and the main ethnic/racial groups (White (30%), Hispanic (28%), and African-American (37%)) were well represented. The sample was well educated with approximately 65% having educational experiences beyond high school, although 20% did not graduate high school. Just >60% of the sample reported an annual income of <$10,000 per year and only 15% of the sample reported an income of >$30,000. Only 38% of the sample were employed (18% full-time, 20% part-time), 41% received disability, and 10% were unemployed. Half of the sample identified themselves as heterosexual.

The mean ± SD CD4 cell count at study entry was 290.80 ± 99.30 and mean ± SD HIV viral load was 31,823.4 ± 85,638.8 copies/ml. Just <80% of the sample were taking antiretroviral medication at study entry with 51% receiving HAART.

NEO-PI-R Domains, Background, and Medical Characteristics

Within this sample, the education level was significantly related to greater Openness (r = .38, p < .001), Agreeableness (r = .37, p < .001), and Conscientiousness (r = .25, p <.05), and less Neuroticism (r = −.20, p < .05). In addition, women had significantly less Openness ($t(102)$ = 2.39, p =.02) and significantly higher Neuroticism ($t(102)$ = −1.98, p = .05) than men, and those identifying themselves as gay/bisexual had significantly higher Openness ($t(102)$ = 3.58, p = .001) and Agreeableness ($t(101)$ = 2.50, p = .01) than those identifying themselves as heterosexual. However, the observed personality differences between these groups is more accurately accounted for by differences in socioeconomic status (SES) (e.g., education level) as the differences between men and women, and between gay/bisexual and heterosexuals were no longer significant when education was controlled. There were no differences between racial/ethnic groups on any of the personality domains.

In comparison with the NEO-PI-R normative sample, our sample had significantly higher Neuroticism and Openness and significantly lower Agreeableness and Conscientiousness. The samples did not differ significantly on Extraversion (Table 1).

Personality Associations With VL Change Over Time

Basic Model—As shown in Table 2, VL significantly increased over time (test of γ_{10}) controlling for all other covariates in the model. Patients had an average of 4.52 VL log units at study entry and increased 0.011 units per month, which translates into 0.132 log units per year. In addition, individual variation around the slope of VL (change) was significant ($\chi^2(97)$ = 185.45, p =.001), indicating that individual variation could be reliably measured and this variation may be explained by personality characteristics. In addition, there was significant individual variation around the initial starting point ($\chi^2(102)$ = 526.14, p < .001).

Covariates—Antiretroviral medications were significantly associated with lower levels of VL (γ_{20}, γ_{30}). As seen in Table 2, none of the four a priori covariates were significantly uniquely related to VL slope. VL at baseline was included as a level 2 covariate but was not significantly related to change in VL_{log} over time ($\gamma_{11} = 0.058 \times 10^{-2}$, $t(98) = 0.302$, $p = .76$). Antiretroviral medication dummy codes (repeated-measures covariates) were significant indicating significantly decreased logVL at each time point attributable to being on combination therapy ($\gamma_{20} = -1.08$, $t(695) = -7.65$, $p < .001$) or HAART ($\gamma_{30} = -1.25$, $t(695) = -10.06$, $p < .001$).

NEO-PI-R Personality Domains and Facets—As seen in Table 3, significantly slower rates of increase in VL were associated with Extraversion ($t(97) = -3.07$, $p = .01$), Openness ($t(97) = -2.49$, $p = .02$), and Conscientiousness ($t(97) = -1.95$, $p = .05$). Increase ratios (IR) were calculated comparing the rate of increase in VL for those at the 75th percentile with those at the 25th percentile on these domains (25). Those low in Openness experienced an increase in VL >3 times greater than those high in Openness (IR = 3.11). Similarly, those low in Extraversion experienced an increase in VL two and a half times those high in Extraversion. Neither Neuroticism nor Agreeableness was significantly related to change in VL. Next, facets of the domains that were significantly associated with VL change over time were examined. Within the Extraversion domain, the facets of Assertiveness ($t(97) = -2.44$, $p = .02$) and Positive Emotions ($t(97) = -2.20$, $p = .03$) were significantly related to VL change. Within the Openness domain, the facets of Esthetics ($t(97) = -2.71$, $p < .01$) and Ideas ($t(97) = -1.97$, $p = .05$) were significantly related to VL change; and within the Conscientiousness domain, the facets of Order ($t(97) = -2.29$, $p = .02$) and Achievement Striving ($t(97) = -2.74$, $p < .01$) were significantly related to VL change.

Personality Associations With CD4 Change Over Time

Basic Model—The model used to depict CD4 change over time is identical to that used with VL with the exception that at Level 1, the interactions between antiretroviral medications and time after baseline were included to help account for the change in CD4 over time attributable to being on antiretroviral medications. This model indicates that average CD4 level at study entry is 262.47 accounting for the effects of antiretroviral medications and the other covariates in the model. In addition, there is significant individual variation in initial CD4 ($\chi^2(102) = 445.78$, $p < .001$) and significant individual variation in CD4 change over time ($\chi^2(97) = 363.65$, $p < .001$) across study participants, suggesting the existence of reliable individual variation in CD4 change/slope that may be accounted for by stable personality characteristics.

Covariates—At level 1, the coefficients for the antiretroviral medication dummy codes were significant, indicating significantly higher CD4 cell number at each time point attributable to being on combination therapy ($\gamma_{20} = 85.19$, $t(705) = 4.00$, $p < .001$) or HAART ($\gamma_{30} = 52.16$, $t(705) = 2.82$, $p < .01$). The coefficients associated with the interaction terms of antiretroviral medication and time after baseline were not significant. At level 2, none of the covariates (age, gender, ethnicity, SES (i.e., education level) or initial disease status) were significantly uniquely related to CD4 change.

NEO-PI-R Personality Domains and Facets—As seen in Table 3, significantly slower rates of decrease in CD4 cells were associated with Extraversion ($t(97) = 2.25$, $p = .03$) and Openness ($t(97) = 2.22$, $p = .03$). There was a trend for Neuroticism to be associated with a faster decrease in CD4 ($t(97) = -1.69$, $p = .09$). Neither Conscientiousness nor Agreeableness was significantly related to change in CD4 cells. Next, facets of the domains that were significantly associated with CD4 change over time were examined. Within the Extraversion domain, there was a trend for the facet of Gregariousness to be associated with a slower rate of decrease in CD4 cells ($t(97) = 1.89$, $p = .06$). None of the other E facets were significantly

related to CD4 change. Within the Openness domain, the facet of Esthetics ($t(97) = 2.15$, $p < .03$) was significantly related to CD4 change.

NEO-PI-R Profiles and HIV Disease Progression

Based on the combination of scores on the five NEO-PI-R domains, it is possible to generate personality profiles that identify those scoring high or low on each possible pairing of the domains. Thus, it is possible to compute 40 personality profiles (4 for each of the 10 combinations) (38). From these possible combinations, 12 profiles were selected a priori, six "positive profiles" that were hypothesized would confer an advantage in the management of HIV and six "negative profiles" that were hypothesized would confer disadvantage. These profiles are listed with their descriptors in Table 4. The profiles were calculated by converting the raw domain scores into T scores using the published normative mean and SD values (3) and identifying those above and below the mean on each of the resulting domain distributions. Within each combination, each of the six protective profiles and each of the at-risk profiles are compared with the remaining three profiles in the combination. For example, the Creative Interactors (E+O+) are compared on trajectory of VL and CD4 cell count against the three other profiles in the E/O combination (i.e., E+O−; E−O+; and E−O−). These comparisons reveal protective effects on VL and/or CD4 cell count for all protective profiles except Go-Getters (C+E+), and increased VL along with decreased CD4 count for those with the at-risk profile of Homebodies (E−O−).

Odds Ratios for "Protective" Versus "At-Risk" Profiles—To provide clinically useful comparisons, we next examined the effects of a protective profile when it was directly compared with its counterpart (i.e., at-risk profile) and not all other profiles in its combination. To calculate odds ratios, six dichotomous variables were created distinguishing those who met the criteria for the "protective profile" for that combination of personality domains (e.g., Creative Interactors E+O+) from those who met the criteria for the "at-risk profile" (e.g., Homebodies (E−O−). The odds of a positive change in disease progression markers (linear slope significantly different from 0) for the "protective profile" versus the "at-risk profile" was then made. Of the six comparisons, the following profiles were more likely to show significant VL decrease: Creative Interactors (11.8 times more likely than Homebodies, 95% confidence interval (CI): 1.43-97.95); Go-Getters (5.85 times more likely than Lethargic, 95% CI: 1.15-29.77); and Adaptive (5.78 times more likely than Maladaptive, 95% CI: 1.02-32.99). Those profiles more likely to show increases in CD4 count: Welcomers (7.29 times more likely than Competitors, 95% CI: 1.92-27.63); Upbeat Optimists (4.84 times more likely than Gloomy Pessimists, 95% CI: 1.31-17.90); Go-Getters (4.11 times more likely than Lethargic, 95% CI: 1.02-16.63); Directed (4.19 times more likely than Undercontrolled, 95% CI: 1.24-14.16); and Adaptive (4.37 times more likely than Maladaptive, 95% CI: 1.24-15.38). The Creative Interactors were 3.4 times more likely than Homebodies to have increasing CD4 cells although this effect was not significant (95% CI: 0.86-13.57). These results show a number of associations not observed in Table 4: The Go-Getters profile is now protective in both VL and CD4 count, and the Directed profile is now protective in CD4 count.

DISCUSSION

The most important and consistent findings of this study are that Openness, Extraversion, and Conscientiousness were all related to 4-year disease progression trajectories showing slower disease progression in HIV. Despite the observation that CD4 cell numbers are expected to decline over time, Openness and Extraversion were significantly related to an increase in CD4 over time. Extraversion and Openness are personality traits that one would expect to predispose people with HIV to remain actively engaged in their interpersonal (E) and experiential (O) lives. We believe this is the first study to identify the protective health effects of Openness

over time with objective measures of disease progression. People high in Openness are experience seekers who are interested in seeking new thoughts and new ideas and expanding their fund of knowledge (3). They are sensitive to their surroundings and the larger environment, they seek out beauty, and they value transcendental and mystical experiences. Consistent with the above description, two facets—openness to ideas and esthetics—were significantly related to slower disease progression. It is possible that when faced with HIV, these "experience seekers" might be more proactive and seek out information that might afford them some advantage in managing their disease. These results are broadly consistent with an earlier study that found high Openness is related to more realistic HIV risk estimates (39). In this sample, NEO-PI-R Openness is significantly correlated with the items: "I ask my doctor about new treatments and new research" (r = .20, p = .016) and with "I read up on my own about new medications and new treatments" (r = .25, p = .003). This raises the possibility that "openness" may influence one's approach to HIV treatments and disease management.

Extraversion was also associated with more favorable disease progression. Those high in Extraversion are sociable, assertive, active, talkative, upbeat, energetic, and optimistic. Although the literature on extraversion is mixed with respect to the prediction of health outcomes (8,9,12,14,17-20), Extraversion may be particularly important in HIV because those high in Extraversion are more likely to have and maintain social supports. The nexus between Extraversion and slower disease progression takes on added significance when we recall that HIV disproportionately affects individuals and groups that are marginalized and stigmatized by society. Facets of Extraversion that were of particular significance in this study are assertiveness, positive emotions, and gregariousness. Interestingly and consistent with these theoretical considerations, these facets tap into both interpersonal and temperamental aspects of Extraversion. In HIV, one might hypothesize that those high in extraversion are less likely to socially isolate themselves, but rather seek the support they need; and elsewhere social support has been related to HIV disease progression (40). Positive emotions have been related to slower disease progression in HIV (41) and were a more powerful predictor than negative emotions. Finally, in this sample, extraversion was significantly associated with optimism (r =.31, p < .001), and optimism has been shown to predict slower disease progression in HIV (27).

The third domain related to slower disease progression (better control of VL) is Conscientiousness. This is consistent with a larger literature showing people high in conscientiousness have lower mortality both in longitudinal studies of health (8-11) and patient populations (4-7). It extends our previous finding that high conscientiousness (using the short NEO-FFI version) predicted slower disease progression (CD4, VL) over 1 year (7). The facet analysis in the current study suggests that both proactive (achievement striving) and inhibitive (order) aspects of conscientiousness are important.

Hypothesized mediators of these personality-health relationships, which have been related to disease progression, might include health behaviors (1), and psychosocial variable (25,27, 40). With respect to health behaviours, significant relationships in this sample were found for personality and adherence/missed doses (O: r = −.24*; C: r = −.20*) and cocaine use (O: r = −.24*; C: r = −.26**). Similarly, relationships found between the E, O and C domains and psychosocial predictors of HIV disease progression such as depression (E: r = −.35**; O: r = −.27**; C: r = −.42**) avoidant coping (O: r = −.28**; C: r = −.20*), social support (E: r = .25**; C: r = .31**) and substance use (O: r = −.24*; C: r = −.26**) may suggest possible path ways by which these domains exert their effects on the markers of disease progression.

Personality profiles that related to slower disease progression included the Creative Interactors (E+O+), Upbeat Optimists (N−E+), Adaptive (N−O+), Directed (N−C+), and the Welcomers (E+A+). The Go-Getter (C+E+) profile was also related to slower disease progression, but only

in direct comparisons with its at-risk counterpart, Lethargic (C−E−). The Creative Interactor (E+O+) profile was the profile most strongly related to slower disease progression. Those with this profile like to have new and different experiences and like to share their discoveries with others (3). They enjoy social contact and have wide and sometimes unconventional interests. One might hypothesize then that these people would remain engaged and cultivate new interests even in the face of HIV and would find others in similar situations with whom to share and learn from both regarding HIV and other experiences. The Homebody (E−O−) profile was associated with faster disease progression. This group is unadventurous and prefers solitary pursuits. One might hypothesize that this group could have a tendency to withdraw and isolate, and be prone to depression.

Low N was found to be protective when in combination with high E, O, or C. Those with low N and high E (“upbeat optimists”) remain cheerful even in the face of setbacks, appreciate what they have, and move on quickly after experiencing anger or sadness. Consistent with this, those with low N and high O profile (“adaptive style”) are keenly aware of conflict and stress, they are able to move toward creative adaptations and solutions. The N and C profile combinations refer to one's style of impulse control. The low N high C (“directed”) style is goal directed and persistent, having the ability to take setbacks and frustrations in stride without losing their plan of action. Finally, the high A and high E profile combination was also protective of the disease progression. These people, referred to as the “welcomers” (38), are described as enjoying the company of old friends and reaching out to new ones. They are good natured and sympathetic. Finally, the high C and high E profile combination was protective for VL and CD4 count when contrasted with the low C and low E profile combination. These “go-getters” are productive and efficient and work with a rapid tempo. They know exactly what needs to be done and are eager to pitch in.

The above profile findings are consistent with a literature in HIV demonstrating that those high in optimism (27) and social support (40) have slower disease progression, whereas those high in denial and depression (25,26,40) have faster disease progression. It is also consistent with the literature demonstrating that those high in social inhibition or low in disclosure (42) and low in emotional expression (43) do poorly with HIV. These findings are also consistent with our previously reported findings in this cohort (25,27) and lend support to the hypothesized construct of engagement as protective of disease progression (30), as this study shows personality profiles predisposing one to generate new interests, keep up with old friends and meet new people, and pursue goals were all protective of disease progression.

Although this study examined associational relationships over 4 years, a truly prospective study needs to be undertaken ideally with a larger sample size. This study did not account for psychiatric disorders in the sample nor were psychotropic medications included in the analysis. It is possible that acute psychiatric disturbances or their treatment may have biased the personality assessment. Similarly, the absence of neuro-psychological assessment or physician assessed hepatitis C allows for the possibility that unidentified cognitive impairments or co-occurring liver disease may have unduly influenced some of the relationships reported here. Although many studies have examined neuroticism and conscientiousness as predictors of mortality, fewer studies have examined agreeableness and very few have examined openness. More studies need to be undertaken to determine whether the strong showing of Extraversion and Openness in this study are unique to the HIV population or would generalize to other patient populations. Also, pathways for the personality-health relationships suggested by the current study could be examined in future studies, including a consideration of both behavioral and biological mediators. The present study has provided a glimpse of the possible pathways by which Openness, Extraversion, and Conscientiousness exert their effects, and the investigation of these pathways should be a high priority for future research because it could help guide future interventions.

In conclusion, this study found that Openness, Extraversion, and Conscientiousness were associated with slower disease progression over 4 years in a sample of people with HIV controlling for age, education, gender, race, initial disease status, and antiretroviral medications. In addition, profile analyses pointed to the empirical importance of particular styles that seem to underscore the importance of remaining engaged (e.g., Creative Interactors (E+O+), Upbeat Optimists (N−E+), Go Getters (C+E+)), and the findings are consistent with previously hypothesized protective factors (30). The relationship between the NEO-PI-R domains, facets, and profiles may have particular relevance for psychosocial and behavioral medicine interventions to improve disease management in people living with HIV in several important ways. First, the observed associations between personality and HIV disease progression may help to identify those at risk for a less favorable disease course. Second, the observed associations in the present study between personality and established risk factors for an accelerated disease course (i.e., depression, substance use, medication adherence) may also help to specify the targets for psychosocial interventions.

Perhaps most importantly, personality assessment may help to triage patients into the most appropriate treatment. For example, those low in C may benefit from increased environmental supports around medication and medical appointment adherence (44); those low in Extraversion may particularly benefit from social support utilization interventions; and those high in Openness may be particularly receptive to alternative or complimentary treatments. It is important to remember, however, that the purpose of personality assessment and the aim of any treatment intervention is not to change the individual's personality, but rather, with appropriate training, to enable the individual to change their attitudes and behavior given their basic tendencies or personality. Targeting specific treatment that best conforms to the individual's personality may help to ensure a more effective intervention and better health outcomes.

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Glossary

VL, log HIV-RNA copies/ml
HIV, human immunodeficiency virus
NEO-PI-R, NEO Personality Inventory—Revised
N, Neuroticism
E, Extraversion
O, Openness
A, Agreeableness
C, Conscientiousness
FFM, Five-Factor Model
NEO-FFI, NEO-Five Factor Inventory
DSM, Diagnostic and Statistical Manual
IRB, Institutional Review Board
HAART, highly active antiretroviral therapy
SES, socioeconomic status
SD, standard deviation
ANCOVA, analysis of covariance
IR, increase ratios
DR, decline ratios

CI, confidence interval

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TABLE 1

Mean and Standard Deviation (SD) Values of the Domains and *t* Scores of the NEO-PI-R and Comparison With the Normative Sample

NEO-PI-R Domain	HIV+ Sample Mean	HIV+ Sample SD	*t* Score	Normative Sample Mean	Normative Sample SD	*t*
Neuroticism	89.27	20.97	54.7	79.1	21.2	4.46**
Extraversion	111.67	18.98	51.2	109.4	18.4	1.14
Openness	115.94	19.37	53.1	110.6	17.3	2.81**
Agreeableness	116.31	15.52	44.9	124.3	15.8	−4.70**
Conscientiousness	116.91	20.66	46.5	123.1	17.6	−3.16**

* $p < .05$

** $p < .01$

TABLE 2

Basic Model Including Coefficients and Significance Tests for Level 1 and Level 2 Covariates in the Modeling of Viral $Load_{log\ 10}$ Slope Over 4 Years

Fixed Effect		Coefficient	*t* Ratio	*df*	*p*
VLlog intercept, β_0					
Intercept, γ_{00}		4.521	42.80	103	<.001
VLlog slope (per month), β_1					
Average slope, γ_{10}		0.01067	2.51	98	.01
Baseline VLlog, γ_{11}		0.00058	0.30	98	.76
Age, γ_{12}		0.00028	1.02	98	.31
Gender, γ_{13}		−0.00266	−0.50	98	.62
Ethnicity, γ_{14}		−0.00441	−0.99	98	.33
Education, γ_{15}		−0.00274	−1.34	98	.19
Antiretroviral 1 increment, β_2					
Average increment, γ_{20}		−1.082	−7.65	695	<.001
Antiretroviral 1 increment, β_3					
Average increment, γ_{30}		−1.249	−10.06	695	<.001
Random Effects	SD	Variance	*df*	X^2	*p*
Intercept, U_o	0.8687	0.755	102	526.14	<.001
Slope, U_1	0.0161	0.0003	97	185.45	<.001
Error, R	0.6369	0.406			

TABLE 3

Association of NEO-PI-R Domains (Neuroticism, Extraversion, Openness, Conscientiousness, and Agreeableness) With Viral Load and CD4 Cell Slope Across 4 Years of Follow-Up (n = 104)

Fixed Effects NEO-PI-R Domain	Gamma Coefficient × 10^{-2}	Viral Load$_{log\ 10}$ *t* Ratio	*p*	Increase Ratio
Neuroticism	0.001	1.27	.21	N/A
Extraversion	−0.030	−3.07	.01	2.56
Openness	−0.025	−2.49	.02	3.11
Agreeableness	−0.009	−0.82	.42	N/A
Conscientiousness	−0.015	−1.95	.05	1.62
		CD4 Cell Number		
NEO-PI-R Domain	Gamma Coefficient	*t* Ratio	*p*	Decline Ratio
Neuroticism	−0.028	−1.69	.09	N/A
Extraversion	0.045	2.25	.03	1.45
Openness	0.053	2.22	.03	1.70
Agreeableness	−0.000	−0.001	.99	N/A
Conscientiousness	0.020	1.24	.22	N/A

TABLE 4

Association Between NEO-PI-R Personality Profiles and Change in HIV Disease Progression Markers (CD4 Cell and Viral Load) Over 4 Years

NEO Profiles	Viral Load			CD4 Cell		
	γ Coefficient × 10^{-2}	*t* Ratio	*p*	γ Coefficient	*t* Ratio	*p*
"Protective profiles"						
Creative Interactors (E+O+)	−0.98	−2.49	.02	2.00	2.41	.02
Welcomers (E+A+)	−0.76	−1.81	.07	1.99	2.09	.04
Upbeat Optimists (N−E+)	−0.82	−1.96	.05	1.90	2.08	.04
Go Getters (C+E+)	−0.67	−1.56	.12	0.99	1.21	.23
Directed (N−C+)	−0.81	−2.17	.03	0.92	0.86	.39
Adaptive (N−O+)	−0.79	−1.87	.06	2.32	2.46	.02
"At-risk profiles"						
Homebodies (E−O−)	1.09	2.04	.04	−2.18	−2.33	.02
Competitors (E−A−)	0.71	1.62	.11	0.35	0.39	.70
Gloomy Pessimists (N+E−)	−0.14	−0.30	.76	0.15	0.18	.86
Lethargic (C−E−)	0.77	1.69	.09	−0.67	−0.75	.46
Undercontrolled (N+C−)	0.23	0.57	.57	−0.29	−0.31	.76
Maladaptive (N+O−)	0.85	1.77	.08	−1.80	−1.73	.09