Longitudinally assessed biological correlates of personality and psychosocial dynamics in new university students

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Declaration

This thesis has been (a) composed by the candidate, (b) the work is the candidate's own, and (c) the work has not been submitted for any other degree or professional qualification except as specified.

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Abstract

Personality traits and psychosocial factors can be dynamic when measured longitudinally; the higher education setting may influence trait stability and change. Furthermore, biological processes may be linked to trait and psychosocial factor development; specifically, immune functioning may be indicative of higher levels of stress. This study examined longitudinal associations between personality traits and psychosocial factors in first year university students. In the first phase of the study, 68 undergraduate students (27 men and 41 women) completed personality and psychosocial measures at four times during their first year of university , and provided three saliva samples to measure salivary secretory immunoglobulin-A (sIgA) to determine immune functioning. A second cohort of first-year students (n = 187; 62 men and 125 women) only completed the personality and psychosocial measures. Across both samples, all of the Big Five traits (Neuroticism (N), Extraversion (E), Openness (O), Agreeableness (A), and Conscientiousness (C)) demonstrated at least moderate rank-order stability; A and C showed small mean-level increases between the beginning of the second semester and exam time; overall personality trends did not concur with previous findings. Data on academic performance was also gathered. Greater mean-level variability and less rank-order stability were observed with the psychosocial measures as the students' time at university increased. Salivary sIgA levels changed over the course of the year, with times of higher stress (beginning of the university semester and exam time) correlating with lower mucosal immunity. Linear growth curve modeling was used to represent the longitudinal data; end of first-year exam marks were significantly predicted by most of the trait and general psychosocial factors but not the university-specific factors; sIgA release rate models were not significant with the measures in the present study. These results demonstrate varying degrees of change and stability in personality traits and psychosocial factors during the first year of university that, taken together, does not impact academic outcomes when examined on a developmental scale through longitudinal measurements. Immune functioning was related to periods of stress independent of stress perception and changes in psychosocial factors related to changes in mucosal immunity. Modeling of traits and psychosocial factors with immune functioning provides new insights into biopsychosocial dynamics operating in university students. Future studies may benefit from this work which emphasizes how longitudinally assessed traits and psychosocial factors can be dynamic and are linked to immune functioning.

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Chapter 1 - Personality Trait Stability and Change

The study of personality examines the consistent component of how people behave. Funder (2001, p.2) defines personality as "An individual's characteristic pattern of thought, emotion, and behavior, together with the psychological mechanisms – hidden or not – behind those patterns." This definition fully considers how any behaviour is elicited. Behaviour can be thought of as a function of personality and environment; personality is the enduring constant factor operating in changing environments. Psychologists have described personality as being a person's "core of consistency which defines the individual's 'true nature' " (Matthews, Deary, & Whiteman, 2003, p.3). Inherent in this quote is that personality must demonstrate some sense of "consistency" over time and across situations; this consistent force operates in a given setting to elicit behaviour. This defining quote supplies another feature in constructing a definition of personality: traits lie at the "core". Whereas the environment and the resulting behaviour can be outwardly witnessed, personality is a latent variable, one that cannot be directly observed but can be determined by its manifested, observed behaviour in a particular setting (Matthews et al., 2003).

In understanding how personality operates in explaining behaviour across situations, one should acknowledge that personality examined on the scale of a lifespan does not always demonstrate consistency; although there exist potent and predictable links, adult personality does not always mirror childhood temperament (Roberts, Walton, & Viechtbauer, 2006a). Fully discussing personality traits includes consideration of personality trait dynamics over time.

What is meant by trait stability and change? How can stability and change be investigated? How does one know that a trait is enduring? This chapter will first discuss design considerations in personality trait change research (Section 1.1). Roberts and colleagues (2006) assert that, when not defined, use of terms like "stability," "consistency," and "change" elicit a misunderstanding in trait research because the terminology is broadly applied and incorrectly interchanged. Unqualified terms do not explicate multiple forms of stability and change, all of which can potentially occur simultaneously rather than in opposition to each other. To define types of trait consistency and change, the second section will discuss different meanings of stability from personality trait literature (Section 1.2). Five types of stability addressed include rank-order or differential stability, structural stability, mean-level stability, individual-level stability, and ipsative stability. The chapter concludes by summarizing findings and presenting implications for the research presented in this thesis (Section 1.3).

1.1 Lifelong Trait Dynamics Overview

Evidence exists for personality trait stability and change over the lifespan. Briefly, early childhood presents a short time of measurable stability from approximately age 5 until early adolescence near age 12. Ages 12 to 18 reflect another period of stability which can be subdivided into early (12-15) and late (16-18) adolescence in terms of periods reflecting trait stability. Early adulthood is the third period of stability, spanning from ages 18-21. Siegler and colleagues (1990) estimate half of personality trait variation is stable from late adolescence to middle adulthood. Early adulthood witnesses variability in trait stability around age 30 followed by a plateau of trait stability in the mid-30's (McCrae, Costa, Pedroso de Lima, Simoes, Ostendorf, et al., 1999; Helson & Kwan, 2000; reviews in Roberts, Robins, Caspi, & Trzesniewski, 2003; Roberts, Walton, & Viechtbauer, 2006a). Meta-analytic data from 152 longitudinal studies representing 3217 participants found trait consistency to increase from around age 30 until plateauing in the first half of middle age (40-49). The next period of trait consistency occurred in the second half of middle age (50-59) with a levelling off of trait consistency from 60-75. To summarize, Roberts and DelVecchio's meta-analysis (2000) found increases in trait stability coefficients in a linear, step-like pattern until around age 60. Taken together, each period in life has varying degrees and types of stability.

1.2 Measurement Designs and Considerations in Assessing Trait Consistency

Personality trait consistency is often assessed either cross-sectionally or longitudinally. Cross-sectional designs measure personality at a single time point in people of various ages; each participant provides one assessment point of information and age groups are compared to examine life-span changes. Longitudinal designs collect data from the same set of participants over multiple assessments. The difference lies between examining age differences (cross-sectional) and age changes (longitudinal) (Costa & McCrae, 1982). There is evidence for and against the equivalence of these techniques in assessing personality trait stability and change. McCrae and colleagues (2002) longitudinally and cross-sectionally administered the NEO PI-R to adolescents and found similar findings in both studies. Terracciano, McCrae, Brant, and Costa (2005) compared cross-sectional and longitudinal analyses on NEO-PI- R responses from 1944 participants providing 5027 assessments over a 15 year span as part of the Baltimore Longitudinal Study of Aging. Notably, rank-order correlation across the 30 facets' change slopes were significantly correlated between the two types of analyses ($r = .72$, $p < .001$) (McCrae et al., 2005). Although cross-sectional studies can estimate age change, longitudinal studies effectively rule out birth cohort effects and sampling biases since participants are their own controls. Synthesizing studies to obtain trends in personality stability and change must consider measurement designs to ensure that similar groups and trends are being compared.

1.2.1 Number of Assessments

Longitudinal designs incorporate multiple assessments; the number and frequency of assessments warrants consideration in dictating the generalizability of findings from a study. Longitudinal designs permit determination of individual variability in lifespan personality change and stability from calculations of individual-level trait variance. Single assessments would only allow analyses of individual differences in traits at one time point but not in personality trait change. Multiple time points inform of trait distribution at a particular time point and also reveal trait stability and change over time.

Enumerating the benefits of multiple assessments, one may ask if two assessments suffice. Two measurements cannot conclusively reveal if differences are due to change or due to measurement error. Caspi, Roberts, and Shiner (2003) comment on the persistence of longitudinal studies in estimating continuity and change over two assessments without employing new methodologies that can more adequately depict personality stability and change dynamics. Specifically, individuals display different levels of variance over time; two assessments generate a correlation, potentially overlooking key characteristics of individual change. This is due to the possible independence of the group's mean structure from the group's variance; in other words, a sample has a mean-level score at each assessment, but this mean does not reveal the individual variance at each time point (Biesanz, West, & Kwok, 2003). Applying individual variance to regression analysis, correlations may not account for independence of the intercept of the regression line (the trait's mean structure) from the slope of the regression line (variance of the trait's trajectory). Individual variance contributions to group means and variances permit investigation of personality trait change due to intraindividual development in the context of the sample's personality trajectory.

Three or more assessments provide insight into an individual differences perspective of trait change and stability. Individual differences examine traits common to some people rather than those common to all; the difference between personality characteristics of all people and characteristics of some people lies in how variance is explained: as error variance (characteristics of all people) or as being meaningful individual differences (characteristics of some people) (Biesanz, West, & Kwok, 2003). Rather than being considered as measurement error, examining personality on an individual differences level determines how individuals differ from the group's communal shared variance; an individual difference approach focuses on each individual's change rather than assuming all members of a group change in a similar manner (Cooper, 2002).

The number of assessments dictates the possible analyses for longitudinal designs. Correlations can be calculatedfrom two time points. Three assessments permit the calculation of linear change analyses across individuals (Biesanz, West, & Kwok, 2003). Four or more assessments are needed to model rates of change over time. Although outwith the scope of personality trait change, individual differences in behaviours that reflect a cyclical pattern can even be assessed with some researchers suggesting 50 or more measurements per individual (Biesanz, West, & Kwok, 2003; Anderson & Revelle, 1994).

1.2.2 Spacing of Assessments

Time between assessments may influence conclusions of personality trait consistency. Longer intervals detect greater long-term trends but can inherently miss within-person variability (Biesanz, West, & Kwok, 2003). Assessments spaced years apart generally reflect greater personality trait stability. Greater time between assessments may also be related to lower trait continuity if traits are observed at times encompassing many life events. Time and situations can be closely interlinked and interdependent, highlighting the need to consider situational factors (Biesanz, West, & Kwok, 2003). Methodologically, time and situation can be separated by using multiple cohorts or though time series analyses (Biesanz, West, & Kwok, 2003). In summary, the spacing of assessments can impact the conclusions one makes regarding personality trends over time.

1.3 Types of Stability – An Overview

Five types of personality trait change indices have emerged from the literature (De Fruyt, Bartels, Van Leeuwen, De Clercq, Decuyper, & Mervielde, 2006; Robins, Fraley, Roberts, & Trzesniewski, 2001). First, structural stability is the invariance of the covariance structure over time; this determination of homogeneity of variance across assessments and is needed to assess mean-level stability. Second, rank-order or differential continuity refers to the degree to which the relative differences among individuals remain stable over time. Third, mean-level stability is the extent to which personality trait scores change or remain the same for a group over time. Fourth, individual-level change is the magnitude of the change for one person on a particular trait. Fifth, ipsative stability deals with the continuity of the configuration of traits to each other within the individual and provides information on the patterning of traits within a person (De Fruyt et al., 2006). Each type of change and stability analysis will be developed and organize this chapter on personality trait stability.

1.3.1 Structural Stability

1.3.1.1 Definition

Structural stability tests for homogeneity of variance between time points; assessment of mean-level stability must follow the establishment of structural stability (Biesanz, West, & Kwok, 2003); mean-level stability is determined via a t-test or ANOVA (which assume equality of variances between time points) (Robins et al., 2001). Inventories can be considered valid when they reflect structural stability. If different phases of a study do not show homogeneity of variance, the results cannot be attributable to the greater population and are only reflective of that sample at that time point. Structural stability tests for factor invariance; dissimilarity between assessments may indicate differing constructs at each time. Factor structure invariance over time due to non-significant covariance matrix change indicates structural stability; structural continuity occurs if correlational patterns are stable over time (Caspi & Roberts, 2001; De Fruyt et al., 2006). Additionally, structural equation modeling can be used to determine consistency in the covariance structure over time (Robins, Fraley, Roberts, & Trzesniewski, 2001; Panter, Tanaka, & Hoyle, 1994, present structural equation modeling methodologies for assessing personality trait structure change). Additionally, targeted orthogonal Procrustes rotation has been shown to confirm structural stability in the NEO-PI-R East Baltimore Epidemiologic Catchment Area Study (Lockenhoff, Terracciano, Bienvenu, Patriciu, Nestadt, McCrae, Eaton, & Costa, 2008). Confirmation of homogeneity of trait variance over time permits further analyses and dictates the universality of findings.

1.3.1.2 Structural Stability Over the Lifespan

Research into personality over the lifespan has incorporated structural stability analyses. Structural stability calculated through structural equation modeling was used in a three year childhood to adolescence longitudinal study by

De Fruyt and colleagues (2006) with 682 participants who twice responded to the Hierarchical Personality Inventory for Children (HiPIC; Mervielde & De Fruyt, 1999) and Questionnaire Big Five (QBF; Gerris et al., 1998; Goldberg, 1992). Structural stability from trait intercorrelation invariance was found for all traits and age groups in that there were no significant differences in the models at the trait domain level for all ages assessed: age group 6-7, $\Delta\chi^2$ (df = 10) = 15.69, CFI = 0.98; age group 8-9, $\Delta\chi^2$ (df = 10) = 8.47, CFI = 1.00; age group 10-11, $\Delta\chi^2$ (df = 10) = 9.52, CFI = 1.00; age group 12-13, $\Delta\chi^2$ (df = 10) = 11.45, CFI = 1.00; all models were not significantly different from the unconstrained model (De Fruyt et al., 2006). This study demonstrates that the commonly assumed volatile transition from childhood into adolescence does, in fact, reflect structural stability on the HiPIC and QBF as evidenced by consistent trait intercorrelations which permits population-based inferences.

Lifespan structural stability was reported by Morizot and Le Blanc (2003) from the Montreal Two-Sample Longitudinal Study on Caucasian French-speaking men who were assessed between adolescence and midlife; participants consisted of a representative sample (n = 122) and a sample of individuals adjudicated at the Montreal Juvenile Court during adolescence (n = 269). Adjudicated males were assessed at ages 15, 17, 30, and 40 while the representative sample was measured at 17, 30, and 40. Participants were given the French version of the Jesness Personality Inventory (JPI; Jesness, 1983) and the EPQ (Eysenck & Eysenck, 1971). Confirmatory factor analyses assessed structural continuity. The data reflected structural stability in that regression coefficients set to be invariant across measurements produced a model that did not fit significantly worse than baseline. Both samples showed high levels of structural continuity in that model fit improved over baseline; trait measure invariance was found from ages 15 to 40 for the adjudicated men ($\Delta\chi^2$ (39) = 142.7, $p < .001$, CFI = .92, NNFI = .91, SRMSR = .10) and for the representative sample ($\Delta\chi^2$ (28) = 141.0, $p < .001$, CFI = .91, NNFI = .90, SRMSR = .07) (Morizot & Le Blanc, 2003). This study demonstrated that adolescence to middle adulthood reflects homogeneity of trait score variance and therefore structural stability.

Akse, Hale, Engles, Raaijmakers, and Meeus (2007) twice assessed 827 adolescents using the Dutch version of Goldberg's Big Five Questionnaire (Gerris et al., 1998; Goldberg, 1992) over a 2-year period and examined structural-level stability. General log-linear modeling (GLLM) was used to compare stability and change over time by assigning participants to defined personality groups (Resilient, Overcontrolling, or Undercontrolling) by implementing the k-means clustering procedure and then using the groupings as factors at both time points. Using GLLM and its fit statistic, the Bayesian Information Criterion (BIC) to account for sample size, models were compared differing on the inclusion of an interaction effect between assessments. Better model fit, indicated by lower BIC values, was achieved through incorporation of this interaction than over the null model that did not account for the influence of the first assessment on the second assessment (ΔL^2 (df = 1) = 176.98, ΔBIC = 170.27) (Akse et al., 2007). From these findings, Aske et al. (2007) concluded that more participants were structurally significantly stable (56.9%) than changing (43.1%) between assessments. Along with De Fruyt et al.'s (2006) work with adolescents, homogeneity of trait variance can be found in this age group.

Examining an older age group and providing a more detailed methodology of the strucutral equation modeling used in analyzing structural stability, Robins et al. (2001) assessed 270 students self-reported NEO-FFI scores during the first week and again in the fourth year of university as part of the Longitudinal Study of Personality and Self-Esteem Development at the University of California at Berkeley. Similar absolute levels and pattering of intercorrelations among the Big Five scales at the beginning and end of college were found; mean intercorrelations were .20 and .24 at week 1 and year 4, respectively. Structural equation modeling mathematically confirmed structural stability by comparing models that differed on intercorrelation or dependence of the first trait scores to the second trait scores. In other words, each assessment's factor loadings were compared through significance testing of correlation variance between the traits at each phase to chance variation alone. A significant change among the traits' structural relations, indicative of trait change rather than stability, would arise from a model with of best fit that did not constrain the intercorrelations between traits at each assessment to be equivalent. In that the model with unconstrained between-assessment intercorrelations did not significantly reduce model fit when compared to the constrained intercorrelations model ($\Delta\chi^2$ (df = 10) = 8.5, ns, CFI = 0.99), structural stability of the Big Five traits were found to be stable (Robins et al., 2001). This application of structural stability outlines the means to perform such an analysis and supports a nomothetic commonality of Big Five traits. Individuals progressing into young adulthood demonstrated structural stability on self-reported NEO-FFI scores, indicating that the NEO-FFI was assessing students reliably.

Vaidya and colleagues (2002) measured personality in 392 undergraduates at two time points 2.5 years apart using the Big Five Inventory (BFI; John, Donahue, & Kentle, 1991). Factor analysis ascertained factor replicability or structural stability. Vaidya et al. (2002) calculated a comparability coefficient (Finn, 1986) from factor regression scores; this procedure is considered a stringent test of factorial similarity (Everett & Entrekin, 1980). Principal components analysis (PCA) using varimax rotation derived five similar factors at each time point. The resulting two sets of regression-based factor scoring weights were multiplied by the participants' item responses to provide an overall score for each factor for each participant; structural stability would be attributed to high correlations between the resulting adjusted scores (Vaidya et al., 2002). Comparability coefficients between the first and second assessment's adjusted scores ranged from .957 to .995, which surpasses Everett's (1983) limit of .90 for factor comparability, providing evidence of structural stability in this population of undergraduates.

Rantanen and colleagues (2007) investigated structural stability in middle adulthood through longitudinally assessed Big Five traits in 192 participants over nine years at ages 33 and then 42 as part of the Jyväskylä Longitudinal Study of Personality and Social Development (JYLS) using the Big Five Personality Inventory, an authorized Finnish version of the NEO-PI (Pulver, Allik, Pulkkinen &

Hämäläinen, 1995). Unconstraining between-trait stability coefficients between time points did not significantly improve fit compared to a model with constrained intercorrelations (χ^2 (df = 312) 477.32, $p = 0.000$, CFI = 0.92, TLI = 0.91, RMSEA = 0.07) indicating structural trait stability with a consistent, common, and underlying trait structure present in middle adulthood (Rantanen et al., 2007).

Examining structural stability in later life, Allemand, Zimprich, and Hertzog (2007) twice administered the NEO-FFI to 455 middle-aged and 420 older participants with four years between assessments. Structural equation model comparisons of each assessment's trait covariance found high stability in both groups; a model with strict factorial invariance that constrained trait scores between assessments rather than unconstraining intercorrelations explained 57% and 54% of the variance in the middle-aged and older groups, respectively ($\Delta\chi^2$ (df = 45) = 99.43, CFI = 0.930, RMSEA = 0.052 (CI 90% = 0.049 to 0.056) (Allemand et al., 2007)).

Overall, there have not been many analyses on structural stability and change in longitudinal personality research despite evidence across the life span; this is one area of trait stability analysis that could be further investigated in that structural stability ensures factor invariance between assessments. However, the studies that have been conducted suggest that there is a high degree of structural stability in personality trait measures and that they can be used with confidence as valid measures of traits across time. Studies providing evidence for structural stability support a nomothetic view of personality traits and signify the existence of enduring ways of being over time and situations.

1.3.2 Rank-Order or Differential Stability

1.3.2.1 Definition

Differential or rank-order stability examines individuals' trait score ordering; order correlations or covariances at two time points are then statistically compared. Rank-order stability is an individual-level measurement; individuals can only be examined in the context of the group (Robins et al., 2001). It ascertains the extent that individuals stay in the same rank relative to others. That is, if a person's score rises, do they nonetheless stay in the same relative place of all scores over time? Rank-order stability can illuminate individual differences within group trends.

Correlations are typically employed to determine this type of stability (Biesanz, West, & Kwok, 2003). More specifically, test-retest correlations are often used to describe rank-order consistency that inherently reflect the degree to which the relative ordering of individuals on a given trait is maintained over time (Caspi, Roberts, & Shiner, 2005).

There are methodological considerations in rank-order analyses. Rank-order stability for the Five-Factor Model of personality has been meta-analyzed (Fraley & Roberts, 2005; Roberts & DelVecchio, 2000); importantly, rank-order stability was found to be time-sensitive and decreased as time between assessments increased. Additionally, little variance in rank-order stability was found across the Big Five Traits, by assessment method, or by gender (Fraley & Roberts, 2005; Roberts & DelVecchio, 2000; Caspi, Roberts, & Shiner, 2005). Table 2.1 presents population estimates of rank-order stability from Roberts and DelVecchio's (2000) meta-analysis of 152 longitudinal studies reflecting 3217 test-retest correlations. Taken together, rank-order stability has definitive trends over the lifespan which greater consistency as one gets older and appears to follow distinct patterns regardless of the trait; this underscores the nomothetic nature of trait theory whereby traits are seen as enduring ways of being.

Table 1.1 - Rank-order consistency estimates across age groups from 3217 test-retest correlations in 152 longitudinal studies (Roberts & DelVecchio, 2000)

Age (years)	ρ	K	CI	Q	N	ρ_t
0–2.9	.35	18	.31–.39	40.88*	2,085	.31
3–5.9	.52	12	.47–.57	67.14*	1,489	.49
6–11.9	.45	29	.42–.48	111.22*	4,053	.43
12–17.9	.47	32	.46–.48	153.85*	10,951	.43
18–21.9	.51	45	.50–.52	168.15*	11,340	.54
22–29	.57	10	.54–.60	59.91*	3,394	.60
30–39	.62	8	.56–.68	107.72*	1,055	.64
40–49	.59	11	.55–.63	55.42*	2,711	.60
50–59	.75	4	.69–.81	53.57*	948	.74
60–73	.72	6	.67–.77	78.20*	1,385	.71

Note. ρ = estimated population correlation; K = number of samples; CI = 95% confidence interval of estimated population correlation; Q = heterogeneity statistic; ρ_t = estimated population correlation controlling for time interval of longitudinal study.
* $p < .05$.

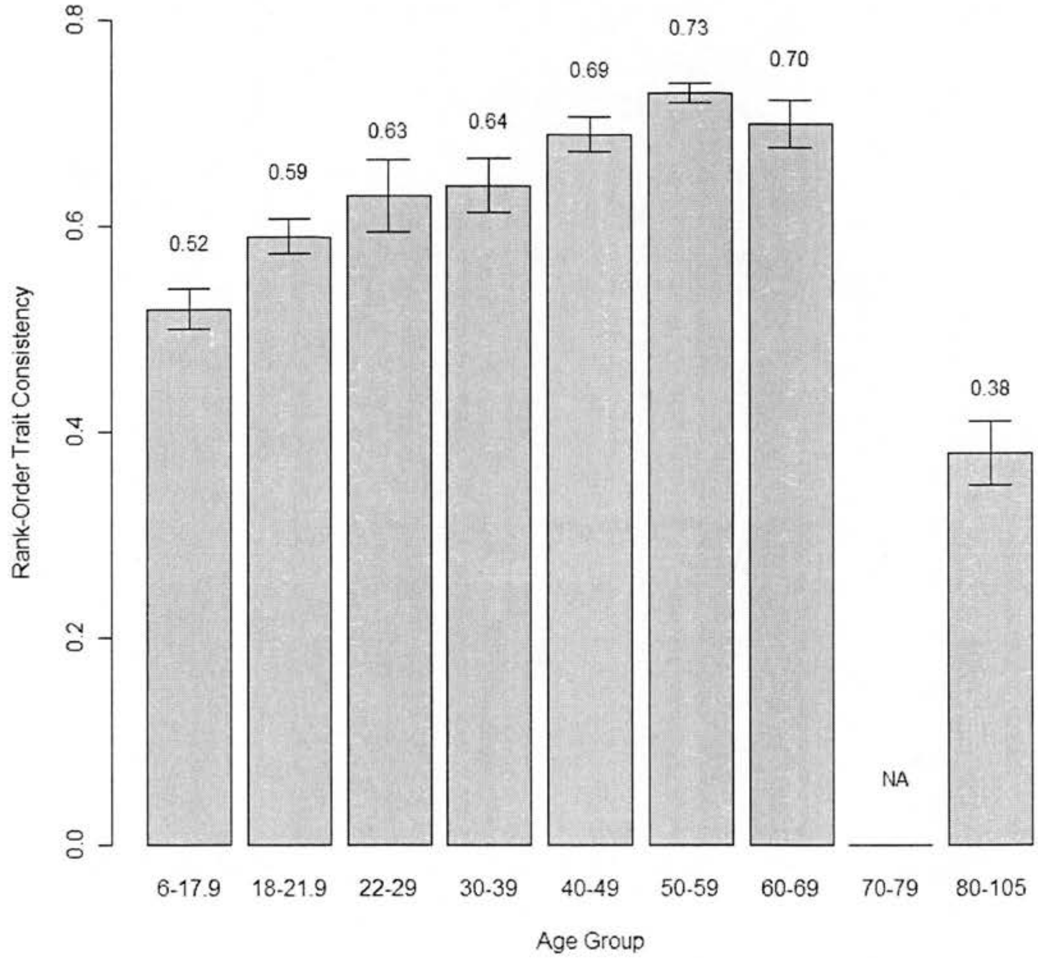
1.3.2.2 Rank-Order Consistency Throughout the Life Span

Rank-order trait stability research spans the life course. Beginning with general life trends before focusing on specific periods, a meta-analysis of Big Five traits reveal some variances in rank-order stability (Fraley & Roberts, 2005; Roberts & DelVecchio, 2000); stability coefficients have been found to have moderate effect sizes even when comparing childhood to early adulthood. Additionally, rank-order stability increases as age increases (Fraley & Roberts, 2005; Roberts & DelVecchio, 2000). Trait test-retest correlations increased from 0.41 in childhood to 0.55 at age 30, and then reached a plateau around 0.70 between ages 50 and 70, signifying a decrease in individual differences in trait variability over time. In terms of observed trends, rank-order stability increased linearly through adolescence and young adulthood (Caspi, Roberts, & Shiner, 2005). These findings present strong evidence for moderate rank-order stability that becomes more pronounced in later adulthood.

A summary of studies reporting rank-order consistency correlations used in a meta-analysis of rank-order stability is presented in Appendix A. Studies were included if they were longitudinally assessed, provided the age of the sample, the time between assessments, and implemented nomothetic measures; there were no language restrictions on the included studies.

It is worth discussing the table presented in Appendix A in relation to other meta-analytic findings on rank-order consistency over the lifespan (Fraley & Roberts, 2005; Roberts & DelVecchio, 2000). To condense and summarize the table, rank-order stability coefficients were averaged by age groups similar to Figure 1 in Roberts & DelVecchio's (2000) meta-analysis on 152 longitudinal studies reflecting 3217 test-retest correlations. Additionally, in line with Roberts and DelVecchio's (2000) work, it should be noted that some studies contributed to population estimates for several age periods which makes it inappropriate to perform statistical tests comparing different age categories. Finally, significant heterogeneity in the estimated population correlation coefficients indicated that these coefficients may vary significantly depending on numerous potential moderators of consistency.

Figure 1.1 – Rank-order consistency estimates across age groups with 95% confidence intervals



In comparing these results to those from the meta-analytic findings from Roberts and DelVecchio (2000), the present results' moderate effect sizes were in line with the published work. The life span in the first age grouping roughly matches the 2 composite age groupings in the published meta-analysis (.52 vs. .45 (6-11.9 years), 95% CI: 0.05 to 0.14, $p < .05$; .47 (12-17.9 years), 95% CI: 0.03 to 0.11, $p < .05$). The 18-21.9 age group in the present analysis has a slightly higher rank-order stability than from Roberts and DelVecchio's data (.59 vs. .51; 95% CI: 0.08 to 0.15, $p < .05$). Both the 22-29 and 30-39 age groupings were slightly higher (.63 vs. .57, 95% CI: 0.05 to 0.14, $p < .05$; .64 vs. .62, 95% CI: -0.03 to 0.10, $p > .05$) than in the published meta-analysis. The stability coefficient presented in Appendix A and Figure 1.1 (.73) is markedly higher than in the published work (.59) in the 40-49 age group (95% CI: 0.20 to 0.30, $p < .05$); the published data was then only slightly higher than the present data for the 50-59 and 60-69 age groupings (.73 vs. .75, 95% CI: -0.11 to 0.03, $p > .05$; .70 vs. .72, 95% CI: -0.10 to 0.02, $p > .05$). Overall, rank-order stability increased as age increases in line with previous work (Fraley & Roberts, 2005; Roberts & DelVecchio, 2000) but then demonstrated a decrease in later life past the age of 80. In the present analysis, trait test-retest correlations increased from 0.52 in childhood to 0.57 by age 30, and then plateaued around 0.71 between ages 40 and 70, signifying a decrease in individual differences in trait variability over time. Subsequently, but reflecting fewer stability coefficients, the 80-105 grouping demonstrated a decrease in rank-order stability (.38) which suggests an increase in individual differences in trait variability. In that moderate to high rank-order personality trait stability correlation coefficients are observed over the life span, there is considerable evidence for trait score permanence in relation to one's age.

In regards to specific traits, the Big Five demonstrated somewhat identical rank-order stability across traits in the meta-analytic data presented in Appendix A. Rank-order stability coefficients were found to be .63 for Neuroticism, .68 for Extraversion, Openness, and Agreeableness, and .67 for Conscientiousness across all studies; those traits reported in the meta-analysis that did not explicitly measure one of the Big Five traits were grouped with the trait that it was most correlated to (i.e.,. Friendliness was considered as Agreeableness). These personality trait categories all remained relatively consistent in terms of rank-order stability, indicating that individuals' trait score ordering stays consistent over time. In that these rank-order correlation coefficients were generated from tens of thousands of participants over the entire life span, it is not surprising that stability was found to be moderately high. For example, as seen in Figure 1.1, lower stabilities early in life (6 to 17.9 years of age) were lowered than in older age. However, in that much of adulthood experiences rank-order trait stability, the overall rank-order stabilities across the Big Five were found to be moderately high in that adulthood represented the greatest proportion of participants in this meta-analysis. In summary, rank-order trait stability varies by age and can be considered as moderately stable over the entire life span across the Big Five traits.

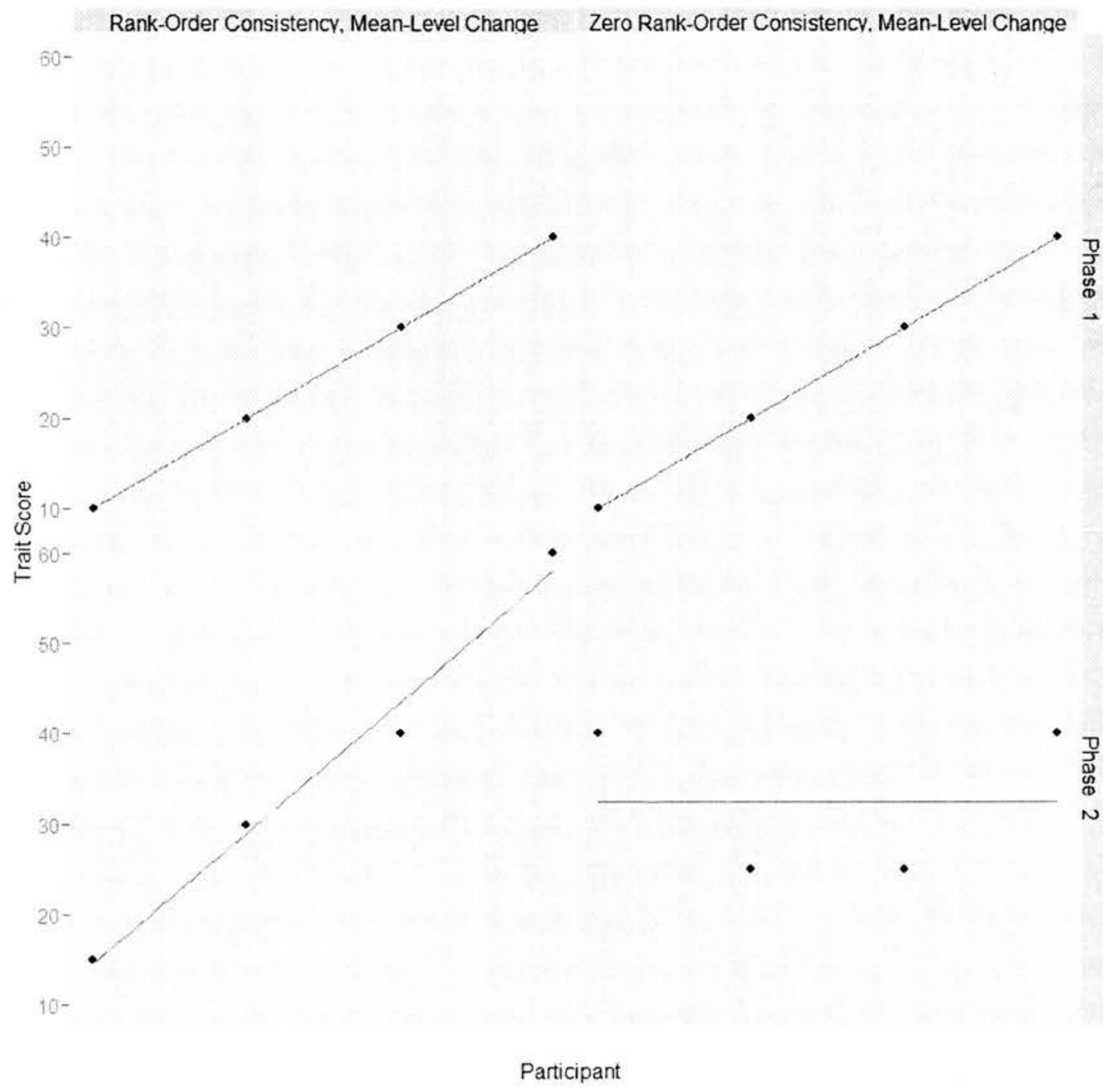
1.3.3 Mean Level Stability

1.3.3.1 Definition

Mean-level or normative stability refers to group trends of consistency over time or the "changes in the average trait level of a population" (Roberts, Caspi, & Moffitt, 2001; Caspi & Roberts, 2001; Robins, Fraley, Roberts, & Trzesniewski, 2001, p.619). Individual differences can be discussed in context of the group by comparing a single participant's change score to the group mean.

Longitudinal studies typically operationalize trait consistency as rank-order stability (Roberts et al., 2006) which was developed in the previous section. Roberts and colleagues (2006) point out that change is often examined as mean-level change that refers to increases or decreases on a trait over time. Analysing continuity or change over time permits the coexistence of rank-order stability and mean-level change; one type of change does not necessarily depend on the other and can be thought of as independent or orthogonal constructs (Roberts et al., 2006; Funder & Colvin, 1991). Roberts et al. (2006) provides a hypothetical example: "the numbers x = (1, 2, 3, 4) show perfect rank-order consistency (r = 1) with the numbers y = (2, 4, 6, 8) but yet a clear change in mean level. On the other hand, pairing the same x with y = (4, 6, 6, 4) yields zero rank-order consistency (r = 0) and still the same amount of mean-level change" (Roberts et al., 2006, p.2). Figure 1.2 graphically exemplifies this hypothetical data set and demonstrates how mean level change can be found with high and low rank-order consistency between two hypothetical assessments.

Figure 1.2 – Illustrative example of rank-order stability and mean level change



Longitudinal research has found rank-order consistency and mean-level change to coexist (Roberts et al., 2001; Roberts, Helson, & Klohnen, 2002; Robins et al., 2001); some of the aforementioned studies on rank-order stability will be reported in this section on mean-level stability with varying degrees of congruence between the two types of change.

Mean-level change is determined by statistically comparing mean trait scores

(Roberts et al., 2001; Caspi & Roberts, 2001). Measuring personality in the same participant at only two time points permits this level of analysis but does not permit higher-order analyses examining rates of change.

Some studies also report effect sizes for the mean-level change (e.g., Donnellan et al., 2007; Robins et al, 2001; Roberts et al., 2001). An illustrative example detailing how effect sizes for mean-level change can be calculated was reported by Donnellan and colleagues (2007). The study presents data from the Family Transitions Project that sought to better understand the psychological transition from late adolescence ($M = 17.60$ years) to young adulthood ($M = 27.24$ years) in 432 participants with a 10-year span between administrations of the MPQ-BF (Patrick, Curtain, & Tellegen, 2002). The mean difference between trait scores at each time point was divided by the standard deviation of the MPQ-BF scale in at the first assessment to generate a d-metric effect size (Kline, 2004). A positive d indicated a mean-level increase, whereas a negative d indicated a mean-level decrease. These effect sizes were interpreted using Cohen's rule of thumb whereby a d of $|.2|$ is considered small; a d of $|.5|$ is considered medium, and a d equal to or greater than $|.8|$ is considered large (Donnellan et al., 2007). Notably, each superfactor had significant mean-level changes with significant effect sizes between assessments; there were decreases in Positive Emotionality ($\Delta M = 0.02$, $d = -.13$), Negative Emotionality ($\Delta M = 0.19$, $d = -.95$), and Absorption ($\Delta M = 0.11$, $d = -.42$), while Constraint increased ($\Delta M = 0.09$, $d = .56$) (Donnellan et al., 2007). This indicates that the group as a whole demonstrated low to moderate effect sizes in change over time as Positive Emotionality, Negative Emotionality, and Absorption decreased while Constraint increased; taken together, these changes in mean trait levels indicates a trend toward greater maturity. And suggesting that "maturing"-type processes are the norm. This study exemplifies typical mean-level trait change analyses through comparisons of means and calculations of effect sizes; it provides the guidelines for discussing these mean-level trait change analyses in specific studies that will be detailed in the next section.

1.3.3.2 Mean-Level Stability Over the Life Span

Many studies have examined mean-level personality trait stability across the life span. Roberts, Walton, and Viechtbauer (2006) meta-analyzed FFM data from 92 longitudinal studies spanning the period from age 10 to 101; this reflected 113 samples representing 50,120 participants with 1682 estimates of change. By reporting standardized mean differences between age groups, the results were consistent with evidence from cross-sectional comparisons of different age groups (McCrae et al. 2000). Agreeableness increased (.17 standardized mean difference) in younger adulthood (22-30). Conscientiousness also increased in younger adulthood (22-30: .22) and middle adulthood (30-40: .26). Neuroticism decreased throughout adulthood (18-22: -.12; 22-30: -.23; 30-40: -.26). Finally, Openness increased in adolescence (10-18: .23) and young adulthood (18-22: .37) and then decreased in old age (60-70: -.19) (Roberts et al., 2006; Caspi, Roberts, Shiner, 2005).

This meta-analysis found three important features of mean-level personality trait stability and change. First, no gender differences in mean-level continuity patterning across the Big Five were found. Second, pooling change across the traits and plotting it over the life span reveals the greatest number of traits demonstrating significant mean-level change during younger adulthood (age 20 to 40) indicating personality development occurring into the early adult years. Consequently, certain traits, namely Agreeableness, Conscientiousness, and Openness, demonstrate less stability past young adulthood (Roberts et al., 2006a).

Cross-sectional mean-level stability analyses were performed by Srivastava and colleagues (2003) on an internet-based sample of 132,515 participants who completed the Big Five Inventory (John, Donahue, & Kentle, 1991). Mean-level trait stability or change was reported through a regression model of age to the Big Five traits and linear slopes of the change in trait scores per year. Table 1.2 shows the change per year for each trait.

Table 1.2- Linear slopes (and 95% CI) for trait score change per year – (Srivastava, John, Gosling, & Potter, 2003)

Big Five Factor		Age 21 - 30	Age 31 - 60
Conscientiousness			
	Women	.48 (+ .06)	.26 (+ .03)
	Men	.46 (± .06)	.31 (± .04)
Agreeablenes			
	Women	.10 (+ .06)	.28 (+ .03)
	Men	-.01 (± .07)	.20 (± .04)
Neuroticism			
	Women	-.25 (± .07)	-.25 (± .03)
	Men	-.06 (± .08)	-.03 (± .04)
Openness			
	Women	.04 (± .06)	-.04 (± .03)
	Men	.04 (± .05)	-.15 (± .03)
Extraversion			
	Women	.09 (± .08)	-.07 (± .04)
	Men	.14 (± .08)	.05 (± .04)
Sample size			
	Women	41840	30027
	Men	40831	19817

Regression analyses were then performed to determine the contribution of age towards the variance in trait change. The results of these regression analyses are presented in Table 1.3.

Table 1.3 – Regression analysis results in age predicting mean-level trait change (Srivastava, John, Gosling, & Potter, 2003, p. 1048)

Variable		B	SE B	β	p-value	% variance
Conscientiousness	constant	63.98	.066			**3.24**
	age	0.341	.008	.16	<.001	
Agreeableness	constant	65.74	0.76			**2.56**
	age	0.244	.009	.12	<.001	
Neuroticism	constant	50.69	.059			**5.29**
	age	-0.13	.007	-.05	<.001	
Openness	constant	74.63	.045			**1.21**
	age	-0.82	.005	-.04	<.001	
Extraversion	constant	54.44	.062			**ns**
	age	-0.01	.007	.00	> .05	

Conscientiousness and Agreeableness significantly increased with age while Neuroticism and Openness decreased with age. Extraversion did not significantly change when only age was used as a predictor; incorporating an age x gender interaction effect resulted in a model that explained 1.21% of the significant increase in Extraversion over time (constant: B = 54.442, SE B = .062; age x gender: B = 0.038, SE B = .007, $\beta = .02$, $p < .001$). Notably, these statistics describe relatively consistent yet small mean-level changes over the lifespan; longitudinal studies have presented mean-level changes in shorter age spans. The data from this study should be interpreted with caution; despite a large sample size, posting the survey on the internet warrant considerations of the characteristics of internet users. Although pre-retirement internet users are representative of the entire internet population in terms of how time is spent online (Fox, Rainie, Larsen, Horrigan, Lenhart, Spooner, & Carter, 2001), the entire internet population may not be as reflective of trends published from paper inventories.

The present study meta-analyzed mean-level trait scores in Appendix B. For this summary, studies employing nomothetic measures of personality traits and reporting longitudinally-assessed mean-level changes were included in this meta-analysis with no language restriction. The inclusion criteria differed from Roberts, Walton, and Viechtbauer (2006) and were more stringent in terms of the inclusion of validated measures and only incorporating longitudinal studies.

From Appendix B, Neuroticism had an average mean-level decrease of .42, Extraversion increased by .21, Openness increased by .90, Agreeableness increased by .64, and Conscientiousness increased by .72 in 8,466 participants. In combining all participants' mean-level changes, as with rank-order stability, there appears to be a tendency towards greater maturity with decreases in Neuroticism and increases in the remaining four traits which is typically associated with maturational processes. Overall, the table in Appendix B finds longitudinally-assessed mean-level change to move towards greater maturity.

Two studies from all of the studies reporting mean-level change will be discussed here in detail to demonstrate the use of higher-level statistics in analyzing trait dynamics over time when multiple assessments have occurred. In the study by Scollon and Diener (2006) (see Appendix B) on mean-level stability in Extraversion and Neuroticism over the life span in 1,130 participants every two years over an eight year span using the Eysenck Personality Inventory, structural equation models of latent growth curves were employed. First, a baseline model of no-growth with an intercept and a slope of zero was compared to models depicting growth for the entire sample (N = 1129), for an under-30 group (N = 400), and for those aged above 30 (N = 729). If longitudinal mean-level stability had occurred, the no-growth model should have the same degree of fit as the linear growth model. However, for all three comparisons, the linear growth model fit better than a no-growth model with just the intercept (all $\Delta\chi^2 > 11$, all $p < .05$). There was a significant decrease in Neuroticism (χ^2 (df = 25) = 41.9, RMSEA = .02) and Extraversion (χ^2 (df = 26) = 54.04, RMSEA = .03) (Scollon & Diener, 2006). This study provides evidence for continued mean-level change over the course of the entire lifespan when analyzed either cross-sectionally or longitudinally.

Mean-level trait change was reported in a study by Branje, van Lieshout, and van Aken (2004) (see Appendix B) examining personality in families. Three assessments at 12-month intervals of the Dutch adaptation of 30 adjective Big Five factors from the IPIP (Goldberg, 1992) were administered to 288 two-parent Dutch families with at least two adolescent children. The sample comprised 288 fathers (M_{age} = 43.9 years), 288 mothers (M_{age} = 41.7 years), 288 older adolescents (144 boys, 144 girls; M_{age} = 14.5 years), 288 younger adolescents (136 boys, 152 girls; M_{age} = 12.4 years). Rather than present mean level change as the difference between time points, Branje et al. (2004) used structural equation modeling to assess change over time. For this study, structural equation modeling was more advantageous than presenting means and significance testing between the means because modeling allows for multiple assessments and incorporates all collected data to more accurately describe change. Furthermore, structural equation modeling can simultaneously test for individual differences in initial trait scores and in mean level change; significantly different variances in the initial scores and in the average slope of mean change signifies individual differences in these two measures. Table 1.4 depicts the modeling results for the Big Five traits assessed in this study.

Table 1.4 – Big Five modeling results depicting mean-level change over three assessments and individual differences in initial scores and rates – (Branje, Van Lieshout, & Van Aken, 2004)

Univariate Latent Growth Curve Results for Big Five Personality Characteristics

Big Five factor	Slope loading at T3[a]	Intercept M	Intercept σ^2	Slope M	Slope σ^2
Extraversion					
F	2.3	4.95**	.52**	.00	.01
M	1.6	5.12**	.38**	.03	.02
O	1.9	4.90**	.48**	.03	.02
Y	1.5	5.03**	.55**	.00	.02
Agreeableness					
F	−0.4	5.64**	.16**	−.01	.00
M	0.1	5.84**	.10**	−.09**	.00
O	2.0	5.48**	.17**	.03	.01
Y	1.7	5.51**	.22**	.02	.02
Conscientiousness					
F	1.2	4.96**	.59**	.03	.04
M	1.0	4.92**	.43**	.32**	.07**
O	1.9	4.15**	.78**	.05	.05**
Y	1.5	4.03**	.84**	.04	.04
Emotional Stability					
F	2.3	4.85**	.34**	−.01	.01
M	1.2	4.42**	.39**	−.04	.02
O	1.3	4.63**	.32**	.00	.03
Y	−0.9	4.53**	.32**	−.04**	−.02
Openness					
F	2.2	4.63**	.46**	.03	.02
M	1.7	4.71**	.38**	.04	.04**
O	1.7	4.80**	.41**	.06**	.04**
Y	1.6	4.91**	.39**	.01	.01

Note. T = time; F = father's personality; M = mother's personality; O = older child's personality; Y = younger child's personality.
[a] T1 = 0, T2 = 1 for all factors.
** $p < .01$.

Table 1.4 indicates significant mean-level change for mother's Agreeableness (M_{slope} = -.09, $p < .01$), mother's Conscientiousness (M_{slope} = .32, $p < .01$), younger child's Emotional Stability (M_{slope} = -.04, $p < .01$), and older child's Openness (M_{slope} = .06, $p <$

.01). By reporting these change statistics over three assessments, this study provides a more representative picture of change compared to other studies comparing only two time points. Structural equation modeling also reveals mean-level individual differences; for example, the intercept variance in the fourth column informs of individual differences in initial trait scores. Furthermore, significant variances for the slope component indicates that there were systematic individual differences in mean-level change for mother's Conscientiousness ($\sigma^2 = .07$, $p < .01$), older child's Conscientiousness ($\sigma^2 = .05$, $p < .01$), mother's Openness ($\sigma^2 = .04$, $p < .01$), and older child's Openness ($\sigma^2 = .04$, $p < .01$). This study provides an excellent example of incorporating structural equation modeling to investigate mean-level trait change which uses all data points and provides information on individual differences.

In summarizing and critiquing these findings on mean-level change and their implications, overall, there is evidence for mean-level trait change over time. Time between assessments appears to be directly related to the degree of mean-level change. Age cohorts demonstrate different levels of mean-level stability with small to medium effect sizes in these changes. Specifically, adolescence to young adulthood is marked with higher degrees of mean-level change. In general, Neuroticism consistently decreases while Agreeableness and Conscientiousness increase; Openness and Extraversion also increase, but to varying degrees throughout adolescence. Through adulthood, significant mean-level change exists, but has been shown to occur to a smaller degree, with continued decreases in Neuroticism and increases in Agreeableness, Conscientiousness, Openness, and

Extraversion. In later life, much less, if any, mean-level trait change is seen. In discussing these generalizations, it is noteworthy to acknowledge that lifespan trends may mask the effect of a particular time in life on trait stability or change. Furthermore, these generalizations incorporate varying time between assessments. These two aspects of any longitudinal study introduce considerable variance; some findings may refer to one age group that another study may consider as two distinct age groupings. Furthermore, dependent upon the cohort's age, the timing of assessments may not be sufficient for mean-level changes to occur. Additionally, heterogeneity of the samples introduced differences in mean-level stability conclusions; there is an overall lack of multiple studies using a particular type of participants (American octogenarians or Finnish undergraduate students) that ultimately prevents consistent pooling of the data but does permit comparisons between different types of cohorts. These considerations should be warranted before conducting a longitudinal study and will be addressed in the design of the current research. Having examined mean-level personality trait dynamics, the next section focuses on trait assessment over time on an individual-level.

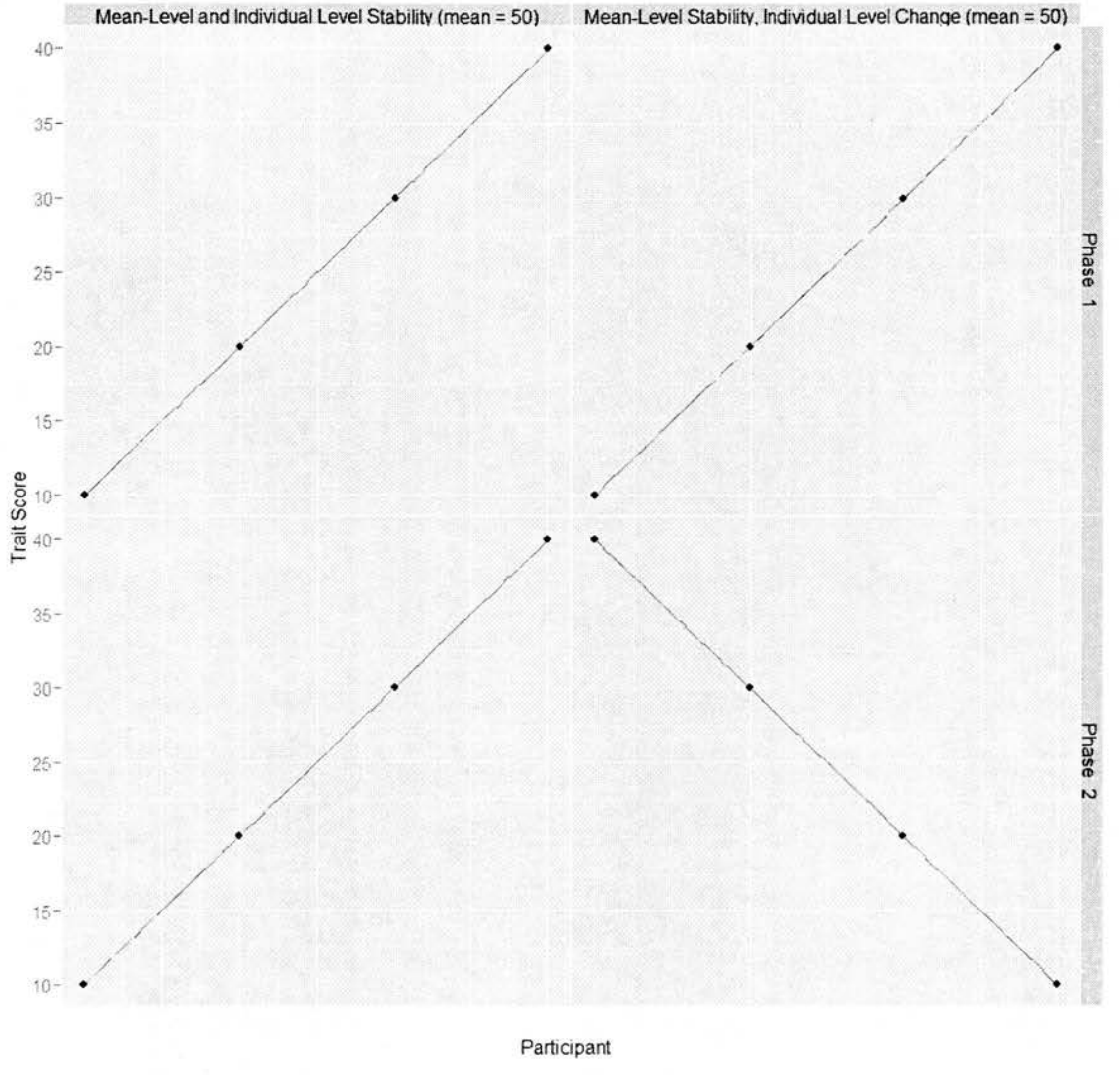
1.3.4 Individual-Level Stability

1.3.4.1 Definition

Individual-level stability describes individual differences in trait change by determining the magnitude of increase or decrease for an individual on a particular trait (Roberts, Caspi, & Moffitt, 2001). Individual-level stability and change analyses examine within-person variability in trait patterning over time (Biesanz et al., 2003). Mean-level analyses indirectly offer evidence for individual-level change by only accounting for between-person variance in growth rates. Examining stability and change over time both across and within individuals can thereby indicate personality trait change both nomothetically (relating to generalities of the sample) and idiographically (relating to particular processes of individual differences) (Biesanz, et al., 2003). Individual-level analyses focus on the individual.

Importantly, as with the other stability/change indices, individual-level stability can be unrelated to measures of population-level stability or change and may influence other types of change (Roberts et al., 2006). For example, subsets of individuals may be increasing and decreasing but ultimately offsetting each other's change, resulting in significant individual level change but the same mean-level score; mean-level trends do not imply that all participants change in the same direction. Figure 1.3 illustrates this potential coexistence of stability and change.

Figure 1.3 – Illustrative example of mean-level stability and individual level change



The concurrence of individual-level stability with mean-level change has been overlooked in personality research (Roberts, Walton, & Viechtbauer, 2006). Although trait means demonstrate group consistency, researchers can mistakenly believe there is no change.

The Reliable Change Index (RCI) is one statistical tool used to determine individual-level change and stability. Originally designed to detect meaningful change in therapy (Jacobson & Traux, 1991), it is considered a stringent measure of absolute individual stability (Donnellan et al., 2007). It is calculated by dividing the trait score difference between two time points by the standard error of the difference; incorporating the standard error in the calculation accounts for measurement error and can assess trait change independent of measure unreliability. The calculated value is then compared to the z-score generated by a normal distribution curve whereby scores greater than 1.96 indicate significant (i.e., "reliable" increases) and scores less than -1.96 are reliable decreases (Jacobson & Traux, 1991). The RCI "quantifies the probability of observing a difference score equal to or greater than the one observed, assuming that no change has occurred" (Robins et al., 2001, p. 625).

The RCI reveals individual variability in personality trait change trajectories. For example, the slopes of the line connecting two or more trait scores can easily vary between respondents over time (Biesanz, West, & Kwok, 2003). Greater overall individual level stability is attributed to less variance in slope for the entire sample. Examining personality trait change on an individual differences level can determine if consistent individual variability predicts variation in other types of trait or psychosocial change.

Latent variable modeling can also be used to determine individual-level change or stability; this technique separates the measurement error and the score variance of a construct (Biesanz et al., 2003; Bollen, 2002). Individual trait measurements can be modelled as a product of its associated measurement error and its true or latent (error-free) score. Individual variability is modelled as its own variable in a latent variable model. Life span patterns of individual level trait stability and change will now be presented.

1.3.4.2 Individual-Level Stability Over the Lifespan

Table 1.5 presents meta-analytic findings germane to the present research regarding individual-level stability over the lifespan. Studies that employed nomothetic measures of personality traits which were longitudinally assessed and reported mean-level changes were included in the analysis depicted in Table 1.5 with no restrictions on language.

Table 1.5 – Summary of individual-level trait change

Authors	Measure	N	Age at Baseline (range)	Time between Assessments (years)	Trait	□ (%)	No Change (%)	□ (%)
Branje, van Lieshout, & van Aken, 2004	IPIP	288 fathers	43.9 (34.0 - 56.1)	3	E	7.4	87.0	5.6
					A	4.2	85.6	10.2
					C	2.6	91.8	5.6
					ES	4.2	90.2	5.6
					O	6.7	89.8	3.5
		288 mothers	41.7 (34.0 - 51.2)		E	4.6	89.0	6.4
					A	9.2	82.3	8.5
					C	2.5	73.5	24.0
					ES	6.4	88.7	4.9
					O	2.5	89.0	8.5
		288 older adolescents	14.5 (11.4 - 16.0)		E	7.7	81.1	11.2
					A	6.3	84.6	9.1
					C	11.6	74.0	14.4
					ES	6.3	86.3	7.4
					O	5.3	88.0	6.7
		288 younger adolescents	12.4 (11.0 - 14.8)		E	7.7	84.9	7.4
					A	9.8	80.4	9.8
					C	9.1	78.6	12.3
					ES	4.2	90.5	5.3
					O	3.2	91.5	5.3
Roberts, Caspi, & Moffitt, 2001	MPQ	921 males & females	18	8	Constraint	6.8	84.4	9.8
					Neg. Emot.	20.7	72.2	7.1
					Ag. Pos. Emot.	2.5	72.2	25.3
					Com. Pos. Emot.	10.2	79.4	10.4
Robins, Fraley, Roberts, & Trzesniewski, 2001	NEO-FFI	270 male & female undergrads	18	4	N	23.0	73.0	4.0
					E	8.0	83.0	9.0
					O	2.0	91.0	7.0
					A	2.0	84.0	14.0
					C	6.0	81.0	14.0
Pullmann, Raudseppt, & Allik, 2006	NEO-FFI	380 adolescents	12-14	2	N	12.4	78.8	8.9
					E	6.1	79.7	14.2
					O	6.6	85.2	8.2
					A	11.6	82.6	5.8
					C	8.4	82.4	9.2
		206 adolescents	14-16	2	N	14.1	80.1	5.8
					E	6.8	80.6	12.6
					O	8.3	74.7	17

					A	8.3	81	10.7
					C	8.4	81.4	10.2
		290 adolescents	16-18	2	N	9.3	85.9	4.8
					E	9.7	82.8	7.5
					O	3.4	82.8	13.8
					A	6.6	87.5	5.9
					C	5.5	86.2	8.3
Donnellan, Conger, & Burzette, 2007	MPQ-BF	432 males & females	17.6 (16-19)	7	Pos. Emot.	19.2	67.6	13.2
					Neg. Emot.	46.5	50.2	3.2
					Constraint	5.8	60.6	33.6
					Absorption	36.6	51.6	11.8
Vaidya, Gray, Haig, & Watson, 2002	BFI	392 male & female undergrads	21.09 (20-32) at second assessment	2.5	N	9.9	83.0	7.1
					E	2.8	79.6	17.6
					O	3.1	79.3	17.6
					A	6.4	84.2	9.4
					C	1.3	85.7	13.0

BFI: Big Five Inventory; IPIP: International Personality Item Pool; MPQ: Multidimensional Personality Questionnaire; MPQ-BF: Multidimensional Personality Questionnaire - Brief Form; NEO FFI: NEO Five Factor Inventory; NEO PI: NEO Personality Inventory; NEO-PI-R: Revised Personality Inventory; QBF: Questionnaire Big Five; N: Neuroticism; E: Extraversion; O: Openness; A: Agreeableness; C: Conscientiousness; ES: Emotional Stability

Table 1.5 depicts those six studies that met the inclusion criteria for this meta-analysis; interestingly, all traits demonstrated significant ($p < .05$) individual-level change in all studies. Specifically, each trait differed from a normal distribution of change scores over time indicating individual-level change due to greater trait score variability between assessments than would be observed by chance alone. Despite some of these studies demonstrating other types of stability in previous sections (Section 1.2.2 on Rank-order stability and Section 1.2.3 on Mean-level stability), significant individual-level change occurred over time between assessments.

Averaging the change scores for all studies across 4043 participants, for Neuroticism, 10.2% increased, 84.1% stayed the same, and 5.7% decreased over time on an individual-level basis. These change statistics, along with the individual-level change statistics for all studies in Table 1.5, differ significantly from a normal distribution of changers versus non-changers due to chance alone. For Extraversion, 6.8% increased, 83.1% stayed the same, and 10.2% decreased over time. Openness witnessed an average of 6.8% participants increase, 85.7% exhibit no change, and 9.7% decrease. For Agreeableness, 7.2% increased, 83.6% stayed the same, and 9.3% decreased. Finally, for Conscientiousness, 7.2% increased, 83.6% remained the same over time, and 9.3% decreased.

Considering these overall individual-level change percentages, although the distribution of changers versus non-changers is significantly different than due to chance alone, most people remained the same across all five traits. Furthermore, one should consider the nature of the sample in the study when interpreting these findings; notably, for Neuroticism, 10.2% increased while only 5.7% decreased which was due to a greater percentage of university students who increased over time (23% increased in Neuroticism in the study by Robins et al., 2007; see Table 1.7). Generalizing overall individual-level change scores should be executed with caution in that the sample's characteristics may introduce confounds. As seen with Neuroticism, more participants increased while mean-level and rank-order change decreased as previously discussed. Having covered individual-level change, this chapter will now review how trait scores relate to each other over time through ipsative stability analyses.

1.3.5 Ipsative Stability

1.3.5.1 Definition

Ipsative continuity refers to the consistency of trait patterning over time within an individual. This can account for all traits simultaneously, a feature that the previous methods of change cannot accomplish. Furthermore, it can be applied to profile consistency for each trait between assessments. It is a "person-centered approach, which is concerned with the salience and configuration of variables within the person. An ipsative approach… seeks to discover continuities in personality functioning across development by identifying each person's salient attributes and their intraindividual organization" (Caspi & Roberts, 2001, p.53). Ipsative stability measures change on an individual level by comparing the relative ordering and configuration of a person's traits (Roberts, Caspi, & Moffitt, 2001). Löckenhoff and colleagues (2008) suggest the use of intraclass correlations to assess ipsative stability. Additionally, Robins et al. (2001) and Donnellan et al. (2007) determined ipsative stability by examining elevation, scatter, and shape of each individual's trait scores between assessments. More specifically, individuals' mean score (elevation), the variability of the scores (scatter) and the patterning of the scores (shape) are compared between assessments. Mathematically outlined by Cronbach and Gleser (1953), score difference variability is evaluated by creating three standardized indices that describe some combination of trait elevation, scatter, and shape. The first index, D^2, quantifies the summed squared differences across all traits between two assessments. D^2 describes the elevation, scatter, and shape of the trait scores. Second, D'^2 reflects differences in scatter and shape in that squared differences between profiles are centered around their mean; D'^2 is insensitive to mean differences between profiles. Finally D''^2 is the standardized score profile of squared differences between profiles and only represents differences in trait profile shape. These transformations account for measurement error and instrument unreliability and therefore indicate true change between time points (Robins et al., 2001).

1.3.5.2 Ipsative Stability Over the Lifespan

Table 1.6 depicts those studies employing nomothetic measures which reported ipsative stability statistics (D^2, D'^2, or D''^2); the studies had to be longitudinally assessed. Some of the studies also provided the percentage of participants with scores beyond those that would be realized by chance alone; there were no language restrictions for study inclusion.

Table 1.6 – Summary of ipsative stability statistics

Authors	Measures	N	Age at Baseline (range)	Time between Assessments (years)	Trait	D^2	D'^2	D''^2	% D^2 beyond chance	% D'^2 beyond chance	% D''^2 beyond chance
Robins, Fraley, Roberts, & Trzesniewski, 2001	NEO-FFI	270 male & female undergrads	18	4	all traits	1.63*	1.36*	3.12*	43	43	17
Donnellan, Conger, & Burzette, 2007	MPQ-BF	432 males & females	17.6 (16-19)	7	all traits	0.76*		0.51*			
De Fruyt, Bartels, Van Leeuwen, De Clercq, Decuyper & Mervielde, 2006	HPIC; QBF	682 males & females	(6-7)	3	all traits	98.65*	84.46*	1.31*	9.1	5.7	9.1
			(8-9)		all traits	89.62*	76.16*	1.19*	14.8	10.4	8.2
			(10-11)		all traits	93.24*	79.11*	1.20*	14.9	11.4	6.0
			(12-13)		all traits	108.60*	92.58*	1.39*	16.7	12.9	9.0

HPIC: Hierarchical Personality Inventory for Children; MPQ: Multidimensional Personality Questionnaire; MPQ-BF: Multidimensional Personality Questionnaire - Brief Form; NEO-FFI: NEO Five-Factor Inventory; QBF: Questionnaire Big Five

Table 1.6 indicates that over time, people tend to demonstrate significant ipsative change that reflects change in how trait scores are related to each other. All traits in Table 1.6 showed significant ipsative change along the elevation, scatter and shape (D^2) of trait scores; for the two studies that reported the percentage participants showing significant change over time compared to chance alone, the D^2 statistic was higher than the D'^2 statistic which only reflects differences in scatter and shape but not elevation. Furthermore, the D'^2 statistic was higher than the D''^2 statistic which reflects the profile shape. This indicates that change primarily occurred in the elevation and scatter of trait scores and less so in the shape. In other words, the relative patterning of scores over time remained consistent while the individuals' mean score (elevation) and score variability (scatter) demonstrated greater change over time.

Ipsative stability attempts to understand the interaction of traits in terms of how they relate to one another within an individual. This holistic consideration of personality traits separates it from other change analyses that can only consider one trait at a time. Furthermore, ipsative stability analyses provide information on an individual-level basis.

1.4 Conclusions

In presenting different methods to analyze personality trait dynamics over time, this chapter has emphasized that stability and change can coexist independently within the same sample over time. For example, many longitudinal studies operationally define stability as rank-order consistency whereas change is often defined as mean-level change. Since these two types of consistency share components in their definition but are not conditional upon each other, rank-order stability can be observed in the presence of mean-level change (Pullmann, Raudeppt, & Allik, 2006; Robins, Fraley, Roberts, & Trzesniewski, 2001; Roberts, Caspi, & Moffitt, 2001; Roberts, Walton, & Viechtbauer, 2006). It is therefore necessary to examine stability in light of how it is defined and how group and individual scores and patterns vary over time by themselves and in relation to each other. Notably, personality traits can be considered stable or mutable, but discussions of consistency rely heavily on numerous factors. Ultimately, the need to operationally define change or stability is paramount to beginning any discussion of the study of personality traits over time. In summary, interpretation of personality change and stability depends heavily on what is being measure, how often it is measured, and how it is analyzed.

The studies as a whole show that traits tend to show rank-order stability, but significant and meaningful change on a mean-level, individual-level, and ipsative basis. However, discussing trait stability and change needs to be operationally defined and should take into consideration both the nature of the sample assessed and the time between assessments. Furthermore, this chapter has demonstrated the benefits of multiple assessments in summarizing trait dynamics; this poses an additional question as to what trait dynamics would look like over time when repeatedly assessed in light of the five methods of analyzing trait stability.

One particularly interesting time period indicating change is young adulthood which has yet to be comprehensively examined through multiple trait assessments and subsequently analyzed on multiple levels to generate a complete picture of personality change and stability over time. The existing literature on young adulthood shows some variability over time. However, the dynamics of this period of trait change are not yet well understood. The next chapter will discuss personality dynamics in young adulthood to better understand how traits can both change and remain stable due to maturational forces at this point in the life span.

Chapter 2 - Personality Trait Stability and Change in New University Students

Having established the methods in which trait dynamics can be analyzed along with personality trends over the lifespan, the present chapter hinges upon the tenet that personality trait variability is dependent upon the nature of the time being examined. This chapter will specifically explore personality trait stability and change in new university students. The impact of academically-related influences and outcomes such as academic performance will be addressed. After detailing the literature search strategy (Section 2.1), personality trait dynamics in the university setting will be reviewed through summarizing studies examining personality in university students (Section 2.2). Third, the relationship between traits, achievement, and intelligence will be discussed (Section 2.3). Finally, implications for further research and unanswered questions will be discussed (Section 2.4).

2.1 Literature Search Strategy

To locate relevant studies for this chapter specific to trait stability and change over time specifically in university students, reference lists from previously published articles and books on personality in new university students were reviewed. Second, the PsycINFO database (http://www.apa.org/psycinfo) was searched from all available dates of publication using the following search strategy:

#1 Abstract, Title, or Keyword = colleg* or universit* or higher education

#2 Abstract, Title, or Keyword = student*

#3 Abstract, Title, or Keyword = personality and (change or stability)

#4 (#1 and #2) and #3

The above search strategy produced 980 references from peer-reviewed journals and books. Studies were included if they were longitudinal and employed a nomothetic, self-reported personality trait measure administered at least twice. For this review, only studies examining samples of undergraduates with mean ages between 17 and 23 years were considered even if personality trait measurement was not the primary purpose of the study but was reported in the article. References not specifying the composition of the sample, namely status (undergraduate, graduate, etc) or the age were not included in this literature review. Furthermore, studies not specifying trait scores at each time point or the change between time points according to one of the five means of personality trait change (structural, rank-order, mean-level, individual-level, ipsative) were not included.

Justification of the selection criteria can best be demonstrated by examining an excluded study. Simon and Thomas (1983) report mean-level and rank order consistencies for 1294 Further Education students (607 females; 687 males) and 644 College of Education students (480 females; 164 males) twice administered the Eysenck Personality Inventory (Eysenck & Eysenck, 1968) over one year. The study has a substantial sample size and results are categorized by gender, educational school classification, and assessment point. Furthermore, significant mean-level changes are reported between assessments for both Extraversion and Neuroticism. However, the exact significance levels of the findings were not given, nor were participants' ages reported. This prevents any generalizations of the effect size of the significant findings along with making it impossible to generate age-related generalizations or disambiguation. Previous chapters have established age-dependent differences in personality trait change and stability; omitting age characteristics introduces potential confounds in generalizing trends in trait change and stability patterns over time in university students.

2.2 Personality Change and Stability in University Students

Out of 980 studies, a total of six studies (0.6% included, 99.4% excluded) were finally included in this analysis that described self-reported, nomothetically-measured personality traits over time; the paucity of sources meeting the inclusion criteria was mostly due to the lack of studies measuring personality at more than one time point. Table 2.1 presents the change and stability statistics presented in these references.

Table 2.1 – Summary of studies repeatedly measuring personality in university students

Authors	Measures	N	Age at Baseline (range)	Time between Assessments (years)	Trait	Rank-order coefficient	Mean-level change	Decreased (%)	Remained the Same (%)	Increased (%)
Farnsworth, 1938	BPI	55 males	(18-21.9)	1	Neurotic Tendency	.76	-15.82			
					Self-Sufficiency	.76	3.64			
					Introversion	.70	-6.54			
					Dominance	.73	14.19			
					Confidence	.77	-20.44			
					Sociability	.74	6.25			
		53 males		2	Neurotic Tendency	.60	-12.68			
					Self-Sufficiency	.74	-5.85			
					Introversion	.62	-6.23			
					Dominance	.73	11.89			
					Confidence	.58	-2.08			
					Sociability	.56	-10.37			
		50 males		4	Neurotic Tendency	.69	-32.20			
					Self-Sufficiency	.57	7.80			
					Introversion	.69	-14.00			
					Dominance	.72	24.60			
					Confidence	.66	-27.60			
					Sociability	.44	-1.20			

Caputo, Psathas, & Plapp, 1966	EPPS	52 female nursing students	(18-20)	15 months	Achievemnt	.47	0.47
					Deference	.45	-1.25
					Order	.59	0.29
					Exhibition	.60	0.27
					Autonomy	.65	0.64
					Affiliation	.64	-1.02
					Intraception	.41	-0.01
					Succorance	.46	-0.98
					Dominance	.60	1.61
					Abasement	.59	-1.06
					Nurturance	.65	-2.47
					Change	.73	0.19
					Endurance	.61	-0.92
					Heterosexuality	.45	2.52
					Aggression	.50	1.08
Vollrath, 2000	NEO-FFI	119 1st year students	22.6	4	Neuroticism	.66**	-0.08
					Extraversion	.73**	0.02
					Openness	.73**	0.02
					Agreeableness	.67**	0.08*
					Conscientiousness	.76**	0.16***
Magnus, Diener, Fujita, & Pavot, 1993	HPIC; QBF	126 1st year students	20	4	Neuroticism	.54**	
					Extraversion	.73**	

Robins, Fraley, Roberts & Trzesniewski, 2001	NEO-FFI	270 1st year students	(18-19)	4	Neuroticism	.53*	-0.49*	23%	77%	4%
					Extraversion	.60*	0.03	8%	83%	9%
					Openness	.70*	0.22*	2%	91%	7%
					Agreeableness	.60*	0.44*	2%	84%	14%
					Conscientiousness	.59*	0.27*	6%	81%	13%
Vaidya, Gray, Haig, & Watson, 2002	BFI	392 male & female undergrads	21.09 (20-32) at second assessment	2.5	Neuroticism	.61**	-0.30	9.9%	83%	7.1%
					Extraversion	.72**	2.1*	2.8%	79.6%	17.6%
					Openness	.65**	2.2*	3.1%	79.3%	17.6%
					Agreeableness	.59**	0.5*	6.4%	84.2%	9.4%
					Conscientiousness	.64**	2.7*	1.3%	85.7%	13.0%

BFI: Big Five Inventory; BPI: Bernreuter Personality Inventory (Bernreuter, 1931); EPPS: Edwards Personal Preference Schedule (Edwards, 1959); HPIC: Hierarchical Personality Inventory for Children; NEO-FFI: NEO Five-Factor Inventory; QBF: Questionnaire Big Five

*: $p < .05$; **: $p < .01$; ***: $p < .001$

In addition to the data presented in Table 2.1 comprised mostly of mean-level and rank-order statistics in university students, the study by Robins et al (2001) also used higher-level modeling to ascertain structural stability as part of the Berkeley Longitudinal Study of Personality and Self-Esteem Development. Self-reported responses to the NEO-FFI during the first week and again in the fourth year of university were recorded. Structural equations mathematically determined structural stability by comparing models that differed on intercorrelation or dependence of the first trait scores to the second trait scores. In other words, each assessment's factor loadings were compared through testing of correlation variance between the traits at each phase to chance variation alone. A significant change among the traits' structural relations, indicative of trait change rather than stability, would arise from a best fit model not constraining the intercorrelations between traits at each assessment to be equivalent. The model with unconstrained between-assessment intercorrelations did not significantly reduce model fit when compared to the constrained intercorrelations model ($\Delta\chi^2$ (df = 10) = 8.5, ns, CFI = 0.99), thus demonstrating structural stability of the Big Five traits (Robins et al., 2001).

Additionally, Robins et al.'s study (2001) was the only study to report ipsative stability in personality traits measured repeatedly. D^2 had a mean of 1.63 (SD = 1.24; range: 0.04 - 8.24); 43% of the participants had D^2 scores greater than expected if change was due to measurement error alone. This indicates a change in the elevation or mean levels across all traits. D'^2 had an average value of 1.36 (SD = 1.06; range: 0.04 – 5.91); again, 43% of the scores were higher than those due to chance indicating change in the scatter or spread of all traits' scores. Finally, D''^2 had a mean of 3.12 (SD = 3.14; range: 0.03 – 15.59) with 17% of the sample's values greater than chance which is a somewhat smaller proportion showing significant change in the shape of the trait profile.

Overall, university students demonstrated a consistent mean-level decrease in Neuroticism over time. Additionally, there were consistent mean-level increases in Conscientiousness, Agreeableness, and Openness. Extraversion did not consistently follow any patterns in university students. Interestingly, rank-order stability coefficients reported in all studies ranged from .44 to .77 and overall displayed moderate stability in the ranking of individuals' scores over time. This is lower than rank-order stability coefficients seen in adults and in the general population of the same age (Roberts & DelVecchio, 2000). Furthermore, from the two studies reporting individual-level change, all traits significantly differed from a normal distribution of those changing and remaining the same; more students decreased rather than increased in Neuroticism and increased rather than decreased for the other four traits. Although there are relatively few studies repeatedly measuring self-reported personality using a nomothetic measure, there emerge consistent patterns of personality trait dynamics over time.

2.3 Traits, Academic Performance, and the University Setting

Personality trait dynamics are an important area of research in the higher education sector considering that traits have been linked to academic performance.

The link between personality traits and intelligence is directly examined in higher education research that seeks to determine which traits are associated with better academic performance. Some previous research has examined personality change in university students (Furnham & Mitchell, 1991; Robins et al., 2001; Chamorro-Premuzic & Furnham, 2003; Ridgell & Lounsbury, 2004; Noftle & Robins, 2007); they serve as a readily available population to study in the field of psychology. However, there are not an extensive number of personality trait change and stability studies focusing only on this population. Many studies incorporate university students, but may combine their data along with participants of similar ages who are not necessarily attending university; for example, the Dunedin Study that followed a cohort of 921 consecutive births in New Zealand assessed personality at 18 to 21 (Roberts, Caspi, & Moffitt, 2001). However, not all participants attended a higher education institution, so the stability or change in personality traits cannot necessarily be attributed to the university experience.

A recent meta-analysis by Poropat (2009) examined the Five-Factor model of Personality and academic performance in a total of 70,926 participants. Academic performance correlated significantly with Agreeableness ($r = .07$, $d = .14$), Conscientiousness ($r = .19$, $d = .46$), and Openness ($r = .10$, $d = .24$; all $p < .001$); Conscientiousness and academic performance were related independent of intelligence (Poropat, 2009). This meta-analysis provides an overview of the relationship between traits and academic performance; the remainder of this section will examine individual studies and discuss longitudinally assessed personality on academic performance.

Personality has been shown to be a predictor of academic success. For example, Noftle and Robins (2007) recently examined four samples using the BFI (John & Srivastava, 1999; n = 10, 497, 63% female, 37% male, $\text{median}_{\text{age}}$ = 19 years), the NEO-FFI (Costa & McCrae, 1992; n = 475, 56% female, 44% male, $\text{median}_{\text{age}}$ = 18 years), the HEXACO-PI (Lee & Ashton, 2004, 2006; n = 470, 78% female, 22% male, $\text{median}_{\text{age}}$ = 19 years), and the NEO-PI-R (Costa & McCrae, 1992; n = 425, 61% female, 39% male, $\text{median}_{\text{age}}$ = 19 years). Across all four samples and measures, Conscientiousness consistently predicted GPA (BFI_{C}: $r = .22$, $\beta = .25$; $\text{NEO-FFI}_{\text{C}}$: $r = .19$, $\beta = .19$; HEXACO_{C}: $r = .20$, $\beta = .22$; $\text{NEO-PI-R}_{\text{C}}$: $r = .18$, $\beta = .17$; all $p < .01$) (Noftle & Robins, 2007). These findings are in line with the 20 studies that are also meta-analyzed in that reference (Noftle & Robins, 2007); all but five found a significant positive correlation between self-reported Conscientiousness and either GPA or a specific course grade in pooling results from 5292 participants. From all studies, a mean effect size of .26 was found. This study further underscores the necessity to understand how personality is linked to performance and can improve academic success.

Table 2.2 summarizes the meta-analytic findings on personality and academic outcomes in college as presented in Noftle and Robins (2007) study.

Table 2.2 – Previous findings on personality and academic outcomes in college

(adapted from Noftle & Robins, 2007, Table 1, p. 118)

Reference	Criterion	N	Measure	E	A	C	N	O
Barchard, 2003	GPA	150	IPIP; NEO-PI	0	0	+++	0	+
Busato et al., 2000	GPA	409	5PFT	0	0	+	0	0
Conard, 2006	GPA	289	NEO-FFI	0	0	+++	0	0
de Fruyt & Mervielde, 1996	GPA	714	NEO-PI-R	0	0	++	0	0
Duff et al., 2004	GPA	146	16PFi	0	0	0	0	0
Farsides & Woodfield, 2003	GPA	432	NEO-FFI	0	0	0	0	++
Furnham et al., 2003	GPA	93	NEO-PI-R	- -	0	+++	0	0
Gray & Watson, 2002	GPA	300	NEO-FFI*	0	+	+++	0	+
Longford, 2003	GPA	203	BFM	0	0	+++	0	0
Oswald et al., 2004	GPA	636	IPIP; BFM	0	0	0	0	0
Ridgell & Lounsbury, 2004	GPA	140	PSI	0	0	0	0	0
Wolfe & Johnson, 1995	GPA	201	BFI	0	0	+++	0	0
Conard, 2006	Course grade	186	NEO-FFI	0	+	+++	0	0
Chamorro-Premuzic & Furnham, 2003a	Course grade	70	NEO-FFI	0	0	+++	- - -	0
Chamorro-Premuzic & Furnham, 2003a	Course grade	247	NEO-PI-R	0	0	+++	-	0
Furnham & Chamorro-Premuzic, 2004	Course grade	91	NEO-FFI	- -	0	++	0	0

P. Hair & Hampson, 2006	Course grade	236	BFI	-	0	+	0	0
Lounsbury et al., 2003	Course grade	175	PSI	0	0	+	0	+
Lounsbury et al., 2005	Course grade	434	APSI	+	+	+	- -	+
Ridgell & Lounsbury, 2004	Course grade	140	PSI	0	0	0	-	0
Mean effect size		**5,292**		**-.04**	**.09**	**.26**	**-.07**	**.05**

E: Extraversion; A: Agreeableness; C: Conscientiousness; N: Neuroticism; O: Openness; IPIP NEO-PI: abbreviated version of the IPIP version of the Revised NEO Personality Inventory (NEO-PI-R; Costa & McCrae, 1992; Goldberg, 1999; see Goldberg, et al., 2006); 5PFT: Vijf Persoonlijkheids-Factoren Test (Elshout & Akkerman, 1975); NEO-FFI: NEO Five Factor Inventory (Costa & McCrae, 1992); 16PFi: 16PFi Form A with second order factors for the Big Five (Cattell, 2000); BFM: Shafer's (1999) Bipolar Big Five Markers; IPIP BFM: IPIP version of the 50-item Big Five Marker measure; PSI: Personal Style Inventory (Lounsbury & Gibson, 2004); BFI: Big Five Inventory (John & Srivastava, 1999); APSI: Adolescent Personal Style Inventory (Lounsbury & Gibson, 2004).

0 refers to a nonsignificant correlation; - refers to a correlation between -.10 and -.19; - - refers to a correlation between -.20 and -.29; - - - refers to a correlation between -.30 and -1.00; similarly, the + signs refer to the parallel ranges of positive correlation coefficients; for all correlations marked with - or + signs, $p < .05$.

*NEO-FFI for all except Conscientiousness, which is measured with the NEO-PI-R.

Table 2.2 shows the strongest and most abundant correlations between academic outcomes and Conscientiousness. Examining multiple studies in this fashion establishes the link between personality and academic achievement.

This link can be further examined in determining how personality may affect performance later in life; do pre-existing traits predict future academic outcomes? To evaluate this relationship, one should consider longitudinal studies with multiple measures of academic outcomes. Table 2.3 summarizes only those longitudinal studies from Noftle and Robins' (2007) work, but differs by detailing the correlations between initial measures of personality and multiple measurements of academic outcomes in subsequent years.

Table 2.3 – Summary of longitudinal studies examining personality and academic performance

Reference	Criterion	N	Measure	Trait	Year 1	Year 2	Year 3	Final
Busato et al., 2000	GPA	409	5PFT	E	-.07	-.05	-.07	
				C	.16**	.21***	.18***	
				N	-.00	-.00	.03	
				A	.05	.06	.02	
				O	.03	.02	-.01	
Farsides & Woodfield, 2003	GPA	432	NEO-FFI	E	.04	.02	-.02	.00
				C	.06	.01	.05	.09
				N	.04	.07	.07	.03
				A	.04	.11	.15**	.14**
				O	.14	.24**	.09	.26**
Furnham et al., 2003	GPA	93	NEO-PI-R	E	-.36**	-.22*		-.29**
				C	.44*	.34**		.40**
				N	.18	.08		.14
				A	.10	.01		.06
				O	-.19	-.09		-.16
Chamorro-Premuzic & Furnham, 2003	Course grade	247	NEO-PI-R	E	-.17**	-.28**	-.28**	-.26**
				C	.25**	.36**	.39**	.36**
				N	-.01	-.22**	-.21**	-.16
				A	.07	.04	0.8	.07
				O	-.03	.06	.02	.02
Lounsbury et al., 2005	Course grade	434	APSI	E				.16**
				C				.14**
				ES				.23**
				A				.16**
				O				.13**

E: Extraversion; A: Agreeableness; C: Conscientiousness; N: Neuroticism; O: Openness; ES: Emotional Stability; 5PFT: Vijf Persoonlijkheids-Factoren Test (Elshout and Akkerman, 1975); NEO-FFI: NEO Five Factor Inventory (Costa & McCrae, 1992); 16PFi: 16PFi Form A with second order factors for the Big Five (Cattell, 2000); BFM: Shafer's (1999) Bipolar Big Five Markers; APSI: Adolescent Personal Style Inventory (Lounsbury & Gibson, 2004)

*: $p < .05$; **: $p < .01$; ***: $p < .001$; Year 1-3: GPA at end of each year; Final: Final GPA

From Table 2.3, some of the findings in the meta-analysis bear further discussion. First, not all traits were consistently associated with academic performance every year in all studies, nor were traits associated with academic performance in the same direction between studies. For example, Furnham and colleagues (2003) along with Chamorro-Premuzic and Furnham (2003) found a significant negative correlation between Extraversion and academic performance while Lounsbury et al. (2005) found a significant positive association between these two variables. However, Conscientiousness was positively associated with academic performance at all time points in all studies except for one (Farsides & Woodfield, 2003). This finding may be the most consistent among previous literature.

Ridgell and Lounsbury (2004) presented results in line with the assertion that other factors may influence the relationship between personality and academic achievement. The study measured academic performance, Big Five personality traits as measured by the Personal Style Inventory (PSI, Lounsbury & Gibson, 2002), and work drive in 140 undergraduate students (54% male, 46% female; $M_{age} = 19.18$ years; 73% freshmen, 20% sophomores, 3% juniors, 4% seniors). Academic success was determined through self-reported GPA and course grade. General intelligence significantly negatively correlated with Conscientiousness ($\rho = -.19$, $p < .05$); the course grade was positively correlated with Emotional Stability ($\rho = .18$, $p < .05$). No other significant correlations were found between any other personality traits and general intelligence, course grade, or GPA (Ridgell & Lounsbury, 2004). One explanation for these findings is that this sample was comprised mostly of first-year students and that course grade may be influenced by other factors such as "maturation, study habits, involvement in other activities on campus, and settling into the role of student during the first year or two at college" (Ridgell & Lounsbury, 2004, p. 616). Supporting this contention, Lounsbury, Sundstrom, Loveland, and Gibson (2003) found Openness positively correlated to course grade in a sample of 175 upperclassmen (36% male, 64% female; M_{age} = 22.7 years, SD = 3.44) responding to the PSI. Year of school may moderate personality traits predicting academic performance. This study may have offered a more complete picture of academic performance had personality traits been longitudinally assessed. However, it is worth noting that there were different relationships between personality traits and academic performance in comparing newer students to upperclassmen.

Table 2.3 indicates that the correlation between a trait and academic performance is not always significant at the initial assessment but may become significantly related at a later point in time. This observation warrants the longitudinal measurement of personality traits and academic performance. Furthermore, it introduces the question of how the relationship is formed. There may be a higher degree of trait variability at the beginning of university and that personality traits may be experiencing a time of greater change than stability, thereby negating any potential relationship between a personality trait and academic performance early on in a student's academic career. In addition, there exists the possibility that personality traits and academic performance have a reciprocal effect whereby pre-existing levels of a particular trait influence initial academic outcomes, but the feedback from the first year's grades may then be potent enough to shape personality. Similarly, the effect of pre-existing trait levels prior to starting university may influence the relationship between personality and performance. Finally, other potentially time-varying factors may determine the relationship between personality traits and academic performance.

There exists a plethora of other possible factors that may also moderate the personality/academic performance relationship. Adjustment to the university during the first year may serve as a potent mediator; this is the first time for many students that they are living away from home and have taken on a new set of responsibilities along with a new sense of independence. The course subject may also be a factor in that differing skills and abilities may be taught and utilized and some courses require more social interactions than others. The workload of each course may also potentiate the social aspect of one's higher education experience; even the social experience may influence trait dynamics. Additionally, how well the student "fits" into a given higher education environment may influence the strength of the relationship between traits and academic performance. Factors that may moderate or mediate the relationship between traits and academic performance will be addressed in the next chapter.

In summary, higher Conscientiousness, Agreeableness, and Openness are associated with academic performance; although there exists less conclusive evidence, higher Extraversion and Neuroticism impact negatively on academic achievement. In that trait dynamics may influence academic outcomes, it is worth researching personality over time in university students.

2.4 Conclusions/ Directions for Future Research

Despite work examining pre-existing personality traits as predictors of academic success, little has been done on trait change and stability trends in university student through repeated personality measurements, especially in first-year students. Furthermore, no research has yet related personality trait change scores to academic achievement. Another gap in the literature arises when seeking research that examines concurrent changes in university-related factors that may contribute to academic success. Simultaneously examining personality and psychosocial trends will not only establish their links to academic performance but also illuminate mechanisms to improve the higher education experience and can thereby improve a university's credence in the higher education market. By reviewing factors that may influence the trait/performance relationship, we can understand how traits operate in a higher education setting to impact academic outcomes. The following chapter will examine general psychosocial factors been linked to personality; those psychosocial factors specific to the university experience will be discussed in the subsequent chapter.

Chapter 3 - Global Psychosocial Correlates of Personality

Having introduced personality trait dynamics over time and methods for analyzing change and stability in Chapter 1 and then having focused on personality trait dynamics in university students in Chapter 2, this chapter will examine global psychosocial correlates of personality traits. During this point in the lifespan, there are a number of different psychosocial factors that may influence personality trait dynamics. Namely, dynamics of self-esteem (Section 3.1), loneliness (Section 3.2), satisfaction with life (Section 3.3), perceived stress (Section 3.4), life experiences (Section 3.5), general health (Section 3.6), and health behaviours (Section 3.7) will be presented with their personality trait correlates.

3.1 Self-esteem and Personality

Self-esteem is defined as the value one places on oneself; "it is the evaluative component of self-knowledge" (Baumeister, Campbell, Drueger, & Vohs, 2003, p. 2). The evaluation's accuracy is not incorporated in this definition, making self-esteem an indicator of self-perception (Rosenberg, 1989). Additionally, these self-beliefs can shape behaviour: "People's beliefs shape their actions in many important ways, and these actions in turn shape their social reality and the social realities of the people around them" (Baumeister et al., 2003, p. 2). Furthermore, the construct validity of self-esteem seems to be universal; the administration of the Rosenberg Self-Esteem Scale (1969) that was translated into 28 languages to 16,998 participants in 53 countries demonstrated a relatively invariant factor structure of self-esteem (Schmitt & Allik, 2005).

In selecting studies that reported correlations between self-esteem and personality, only those studies incorporating nomothetic, reliable, and validated measures of personality and self-esteem were included. Table 3.1 summarizes the correlations obtained from these studies.

Table 3.1 – Correlations between self-esteem and the Big Five traits

Study	Big Five Domain					Big Five Measure	Self-esteem measure	Participants
	E	A	C	ES	O			
Benet-Martinez et al., 2003	.39	.22	.40	.52	.34	BFI	RSE	122 European American undergraduates
Benet-Martinez et al., 2003	.42	.24	.31	.55	.29	BFI	RSE	199 Asian American undergraduates
Cheng & Furnham, 2003	.39	-	-	.55	-	EPQ	RSE	234 British college students
Costa et al., 1991	.49	.12	.51	.69	.16	NEO PI	Janis-Field	1539 21-64 year olds
Duffy et al., 2006	-	-	-	.38	-	IPIP	RSE	333 young adults
Duffy et al., 2006	-	-	-	.33	-	IPIP	RSE	291 young adults
Farmer et al., 2001	.44	.22	.37	.69	.24	25 FFM terms	RSE, CSEI	337 college students
Goldberg & Rosolack, 1994	.32	.09	.18	.40	.10	Adjective markers	RSE	503 college students
Graziano et al., 1997	.28	.32	.33	.39	.30	Adjective markers	GSW	317 10-14 year olds
Halamandaris & Power, 1997	.55	-	-	.59	-	EPQ	ISE	124 university students
Jackson & Gerard, 1996	.21	.11	.21	.53	.31	ACL	RSE	360 college students
Judge et al., 2002	.28	.21	.29	-	.18	NEO FFI	RSE	702 college students
Judge et al., 2002	.24	.30	.28	.69	.06	EPI, IPIP, NEO PI R	RSE, CSEI	270 college students
Judge et al., 2002	.37	.39	.17	.56	.18	EPQ, NEO FFI	RSE, CSEI	124 college students

Judge et al., 2002	.05	.15	.03	.47	.12	EPQ, NEO FFI	RSE, CSEI	72 college students
Judge et al., 2002	.43	.30	.44	-	.06	NEO FFI	RSE	440 salespeople
Judge et al., 2002	.22	-	.31	-	-	NEO FFI	RSE	277 food service workers
Kamath & Kanekar, 1993	.25	-	-	-	-	EPQ	RSE	50 Indian men
Kamath & Kanekar, 1993	.62	-	-	-	-	EPQ	RSE	50 Indian women
Keller, 1999	.46	.07	.28	.67	.12	NEO FFI	Janis-Field	238 college students
Kwan et al., 1997	.47	.13	.32	.69	.06	NEO FFI	RSE	183 US college students
Kwan et al., 1997	.43	.16	.43	.63	.17	NEO FFI	RSE	194 Hong Kong uni. students
Neustadt et al., 2006	.32	.10	.45	.62	.05	NEO PI R	RSE	248 corporate employees
Pullman & Allik, 1999	.31	-.04	.35	.59	.11	Estonian NEO PI	Estonian RSE	616 Estonian adults
Robins et al., 2001	.41/.39	.23/.04	.28/.23	.70/.57	.16/.11	NEO FFI	RSE/SISE	508 college students
Schmitt & Allik, 2005	.42	.24	.46	.31	.48	BFI	RSE	16,998 multicultural participants
Watson et al., 2002	.47	.25	.28	.49	.24	BFI	RSE	124 university students
Watson et al., 2002	.40/.48	.23/.32	.37/.43	.66/.66	.31/.29	BFI	RSE/CSEI	287 college students
Watson et al., 2002	.46	.12	.43	.69	.10	NEO PI R	RSE	346 college students
Zhang, 2005	.36	.22	.43	.55	.15	NEO FFI	RSE	1347 Chinese adults
Total N	**26809**	**26074**	**26351**	**25914**	**26074**			
Weighted Mean Correlation	**.40**	**.22**	**.43**	**.40**	**.37**			

E: Extraversion; A: Agreeableness; C: Conscientiousness; ES: Emotional Stability; O: Openness to Experience; NEO FFI: NEO Five-Factor Inventory (Costa & McCrae, 1992), NEO PI. NEO Personality Inventory; NEO PI R: Revised NEO PI (Costa & McCrae, 1992); ACL: Adjective Check List (John & Srivastava, 1999); Adjective markers (Goldberg, 1992); EPQ: Eysenck Personality Questionnaire (Eysenck & Eysenck, 1968); IPIP: International Personality Item Pool (Goldberg, 1996), BFI: Big Five Inventory (John, Donahue, & Kentle, 1991); RSE: Rosenberg Self-Esteem Scale (Rosenberg, 1965); SISE: Single-Item Self-Esteem Scale (Robins, Hendin, & Trzesniewski, 2001); Janis–Field: Revised Janis–Field Self-Esteem Scale (Blascovich & Tomaka, 1991); GSW: Global Self-Worth Scale (Harter, 1985); CSEI: Coopersmith Self-Esteem Inventory (Coopersmith, 1981); ISE: Index of Self-Esteem (Hudson, 1982)

From Table 3.1 that summarized 23 to 28 samples representing 25,914 to 26,809 participants, Conscientiousness correlated highest with self-esteem ($r = .43$); higher Conscientiousness may spur more self-esteem in that the trait focuses on goal-directed behaviour; the Competence facet, for example, assesses one's beliefs in one's self-efficacy (Costa & McCrae, 1992). Conscientious individuals may thereby possess more belief in their ingrained ability to accomplish task and thereby possess more self-esteem from their resulting accomplishments and accolades.

Extraversion is moderately correlated with self-esteem ($r = .40$); this trait taps into one's outward directedness into the social world (Costa & McCrae, 1992) which therefore may result in extraverts reciprocally receiving positive feedback from the environment and thereby increasing self-worth. Additionally, Extraversion can tap into positive emotions that can foster a sense of self-esteem.

Emotional stability was also moderately correlated with self-esteem ($r = .40$); those who were more emotionally stable possessed higher self-esteem and viewed themselves more positively. These two processes may synergistically exist rather than operate as co-dependent precursors and influence each other over time. The Self-Consciousness facet of Neuroticism reflects shyness or social anxiety (Costa & McCrae, 1992); those scoring high on this facet may not possess a sound self-belief. Furthermore, the despondent nature of the Depression facet of Neuroticism (Costa & McCrae, 1992) would not co-exist with higher self-worth.

Openness correlated moderately with self-esteem ($r = .37$). Again, this may not be surprising in that people open to experience seek and appreciate experiences for the sake of the experience (Costa & McCrae, 1992). Being open to experience may result from better self-esteem in that pre-existing self-esteem, characterized by high self-worth and self-acceptance, may translate into higher levels of acceptance of alternative ways of thinking and viewing the environment.

Finally, the correlation between Agreeableness and self-esteem was found to be .22. Agreeableness does not necessarily promote self-belief. The trait is characterized by more outward interactions with others; the Trust facet centers upon the good intentions of others while Altruism is concern for others (Costa & McCrae, 1992). Furthermore, someone with high Agreeableness may score high in Compliance that may be a result of not perceiving oneself as a potent force in an interpersonal conflict. Possibly the strongest facet-level explanation for a lower correlation between self-esteem and Agreeableness lies with Modesty whereby one high in this facet would have a higher Agreeableness score, but the nature of downplaying one's achievements and exuding humbleness can inherently decrease one's perceived value. Additionally, those low in Agreeableness but high in self-esteem may be narcissistic whereby inflated views of the self would result in higher self-esteem ratings but will sour interactions with others (Baumeister et al., 2003).

In the context of the present study, it is worth separating the data from higher education students; correlations between self-esteem and the Big Five traits in the present study should ultimately be closer to those values obtained from the student sample rather than the entire meta-analytic sample. Comparing these results to the overall meta-analytic results, the student sample correlation ($r = .37$, 95% CI: 0.35 to 0.40) was slightly lower for Extraversion (r = .40). The student sample correlation (r = .19, 95% CI: 0.17 to 0.21) was also lower than the meta-analytic correlation (r = .22) for Agreeableness. There was a larger discrepancy between Conscientiousness in the student sample (r = .29, 95% CI: 0.27 to 0.31) when compared to the entire meta-analytic results (r = .43). As mentioned earlier, Conscientiousness deals with goal-directed behaviour with its Competence facet measures self-efficacy (Costa & McCrae, 1992). However, it is possible that the delayed gratification mechanism present in higher education whereby grades may not be immediately offered may not provide a potent enough reward system for students to feel good about themselves after investing effort to achieve an academic goal. Therefore, the general absence of immediate and abundant performance feedback that "counts" toward overall success in higher education may mitigate the relationship between Conscientiousness and self-esteem; feeling "good" about one's work may not be realized until after higher levels of effort are invested into a task.

Interestingly, the correlation between self-esteem and Emotional Stability was considerably higher for the students (r = .60, 95% CI: 0.57 to 0.63) than in the entire meta-analytic sample (r = .40). The higher correlation in the student sample may be due to the perception that the higher education environment invokes more social anxiety, for example, than in the general population resulting in higher Self-Consciousness facet scores of the Neuroticism domain (Costa & McCrae, 1992). In that the higher education experience is considered as a significant developmental stage, one's adult self-concept may not have formed which may therefore promote a greater degree of self-questioning during such formative years.

Additionally, the high correlation between Emotional Stability and self-esteem suggests they may be the same construct. Judge and colleagues (2002) first conducted a meta-analysis of studies that concurrently measured Neuroticism or Emotional Stability and self-esteem; a population correlation of .64 was found between Emotional Stability and self-esteem (95% CI: .48 - .77, k = 19, N = 5565) (Judge et al., 2002). To empirically determine the potential commonality between Neuroticism and self-esteem, a second study employed three groups of university undergraduates (Sample 1: N = 325, 53% male, 47% female, M_{age} = 20.70; Sample 2: N = 126, 57% male, 43% female, M_{age} = 21.33; Sample 3: N = 72, 52% male, 48% female, M_{age} = 20.50). The Eysenck Personality Inventory (EPI; Eysenck & Eysenck, 1968) was used in the first two samples to measure Neuroticism; the IPIP (Goldberg, 1996) and Neuroticism items from the NEO-PI-R (Costa & McCrae, 1992) were also used as measures in the first sample. Additionally, the NEO-FFI was used in the second and third samples to measure Neuroticism. The 10-item Rosenberg Self-Esteem Scale (1965) and the 10-item Coopersmith Self-Esteem Inventory (1967) were used to measure self-esteem. A correlation of .69, .56, and .63 was found between Emotional Stability and self-esteem for the three samples, respectively. Collectively, all five samples representing 523 undergraduate university students generated a weighed mean correlation of .65 between Emotional Stability and self-esteem. In a sample of university undergraduates, it appears that Emotional Stability and self-esteem represent a similar construct which may explain the higher correlation between

Emotional Stability and self-esteem in the student sample (r = .60) than in the entire meta-analytic sample (r = .40); during this labile time in life, Emotional Stability and self-esteem may be more closely linked than at other times.

Finally, the correlation between self-esteem and Openness for the students (r = .18, 95% CI: 0.16 to 0.20) was lower than that obtained in the meta-analysis (r = .37). Citing the same study by Judge et al. (2002), correlations of .20, .15, and .35 respectively, were found between Openness and self-esteem which generated a weighed mean correlation of only .21 for the 523 undergraduate university students (Judge et al., 2002). This result is in line with the meta-analytic correlation between Openness and self-esteem from only university students (r = .18). Again, the relationship between Openness and self-esteem may not be as solidified during this particular period in life.

Although the meta-analysis above in Table 3.1 represents a large number of participants from numerous studies, a single study examined the relationship between personality traits and self-esteem in a ten-fold larger sample. Robins, Tracy, Trzesniewski, Potter, and Gosling (2001) amassed self-reported personality traits and self-esteem from an internet-based sample of 326,641 (43% males, 57% females; M_{age} = 24.0 years, SD = 9.7) participants aged 9 to 90 years. Participants completed the Single-Item Self-Esteem scale (SISE: "I see myself as someone who has high self-esteem"; reliability: .75; construct validity with the RSE (corrected): .93; Robins, Hendin, & Trzesniewski, 2001) while personality was assessed using the 44-item Big Five Inventory (BFI; John & Srivastava, 1999; E_{α} = .85, A_{α} = .79, C_{α} = .82, N_{α} = .83, O_{α} =

.78). Furthermore, 15 judges provided social desirability ratings of each BFI item to generate a social desirability score for each participant. Table 3.2 shows the correlations between self-esteem and the Big Five by gender.

Table 3.2 – Big Five correlations of self-esteem (Robins, et al., 2001, p. 471)

Scale	Total Sample (n = 326,641)	Females (n = 186,392)	Males (n = 140,249)
Extraversion	.38	.38	.42
	(.31)	(.30)	(.34)
Agreeableness	.13	.14	.13
	(.00)	(.02)	(-.01)
Conscientiousness	.24	.22	.29
	(.15)	(.13)	(.20)
Emotional Stability	.50	.50	.48
	(.46)	(.45)	(.45)
Openness	.17	.16	.18
	(-.03)	(-.03)	(-.05)

Partial correlations controlling for social desirability in parentheses

Self-esteem correlated positively with Extraversion (r = .38), Agreeableness (r = .13), Conscientiousness (r = .24), Emotional Stability (r = .50), and Openness (r = .17); high self-esteem individuals have socially desirable traits. By accounting for social desirability, correlations with the Big Five may only reflect the tendency of high self-esteem individuals to endorse socially desirable items; all correlations decreased after partialling out social desirability. The significant correlation between self-esteem with Agreeableness and Openness was eliminated after accounting for social desirability, suggesting that high self-esteem individuals may not be more agreeable nor open when accounting for social desirability. Additionally, males had higher self-esteem than females (d = .22) (Robins et al., 2001). As a critique to this study, social desirability may not have been of interest to a participant, thereby suggesting that the participant's score before social desirability was the "true" self-esteem score that was unrelated to socially desirable answering; this disambiguation cannot be determined from the data as reported.

Some similarities from Robins and colleagues' data (2001) are seen in the meta-analytic findings in Table 3.1. Notably, the data from Robins et al. (2001) are closer to the meta-analytic findings after controlling for social desirability for Agreeableness and Emotional Stability; there is a larger discrepancy between the correlations for Extraversion, Conscientiousness, and Openness after accounting for socially desirable responding. However, some differences may be due to the nature of the internet sample in Robins et al. (2001). The meta-analytic correlation for Extraversion (.40) is higher than the internet sample (.31); this may be explained by the finding in Landers and Lounsbury (2006) that reported a significant negative correlation between self-reported internet use and Extraversion ($r = -.21$, $p < .05$) from 117 undergraduate students who completed the Adolescent Personal Style Inventory (APSI, Lounsbury et al., 2003). Landers and Lounsbury (2006) also report a similar negative correlation between internet use and Conscientiousness ($r = -.21$, $p < .05$) which may account for the meta-analytic correlation (.43) to be higher than Robins et al.'s (2001) internet sample ($r = .24$; $r_{partial} = .15$). The Agreeableness correlations were markedly different when socially desirable responding was controlled for; those who are more Agreeable would tend to provide answers expected of them, possibly acquiescing to an expected answer. Greater Emotional Stability was seen in the internet sample ($r = .50$; $r_{partial} = .46$) than in the meta-analytic findings (.38); this may be due to greater differences between participants in the meta-analytic sample than in the internet sample whereby the former incorporated cross-cultural measures while the latter was restricted to internet users who comprehended English. Finally, the largest discrepancy between the meta-analytic results and the internet sample was noted for Openness (.39 versus a partial correlation of -.03, respectively). This difference may again be due to the nature of the sample; however, Landers and Lounsbury (2006) did not find a significant correlation between overall self-reported internet use and Openness ($r = -.08$) and leisure-related internet use and Openness ($r = -.17$). Overall, further discrepancy between the meta-analysis and internet sample may be explained by the nature of the internet sample; the medium itself attracted a greater proportion of participants who were young. Furthermore, random internet sampling may have certain drawbacks aside from socially desirable responding; providing nonsensical answers, even on a Likert-type scale, may generate responses that may not be considered as outliers due to the large sample size. Additionally, the anonymity of the sampling may have introduced another confounding variable in obtaining truthful answering. Amassing the meta-analytic results and the internet sample together, those high in self-esteem were more emotionally stable, more extraverted, more conscientious, and somewhat more open while the relationship between Agreeableness and self-esteem is conflicting. Gender, age, socioeconomic status, ethnicity, and nationality did not mediate nor moderate these relationships. Overall, the literature points to a strong inverse relationship between Neuroticism and self-esteem, moderate positive correlations with Extraversion and Conscientiousness, and weaker correlations between self-esteem and Openness and Agreeableness.

3.2 Loneliness and Personality

Loneliness is defined as the feeling of social isolation stemming from the difference between one's actual and desired relationships (Peplau & Perlman, 2000). Feelings of loneliness stemming from perceived inadequacies in interpersonal relationships rather than objective measures of the relationship with others (Russell, 1996). Table 3.3 summarizes previous studies that report a correlation between loneliness and personality using nomothetic measures whose reliability and validity have been established.

Table 3.3 – Summary of Big Five traits correlations of loneliness

Study	Big Five Domain					Big Five Measure	Loneliness Measure	Participants
	E	A	C	ES	O			
Amichai-Hamburger et al., 2003	-.20	-	-	-.32	-	EPQ	UCLA	85 student internet users
Asendorpf & et al., 2003	-.37	-.05	-.09	-.33	-.11	BFQ	UCLA	174 17-year olds
Benet-Martinez et al., 2003	-.59	-.27	-.33	-.35	-.19	BFI	UCLA	122 European American undergraduates
Benet-Martinez et al., 2003	-.56	-.35	-.27	-.48	-.29	BFI	UCLA	199 Asian American undergraduates
Cheng & Furnham, 2002	-.46/ -.51	-	-	-.28/ -.11	-	EPQ	UCLA F1/F2	90 adolescents
Halamandaris et al., 1997	-.60	-	-	-.44	-	EPQ	UCLA	124 university students
Halamandaris et al., 1997	-.61	-	-	-.47	-	EPQ	UCLA	183 first year home students
Hojat & Lyons, 1998	-.39	-	-	-.36	-	EPQ	UCLA	141 female allied health students

Hojat, 1983	-.44	-	-	-.49	-	EPQ	UCLA	232 Iranian students
Hojat, 1983	-.48	-	-	-.53	-	EPQ	UCLA	305 Iranian students
Kamath & Kanekar, 1993	-.41	-	-	-	-	EPQ	UCLA	50 Indian men
Kamath & Kanekar, 1993	-.69	-	-	-	-	EPQ	UCLA	50 Indian women
Long & Martin, 2000	-.35	-	-	-	-	16PF	UCLA	100 middle-aged adults
Long & Martin, 2000	.00	-	-	-	-	16PF	UCLA	100 elderly
Lyubomirsky et al., 2006	.13	-	-	.21	-	EPQ	SF	621 retired employees
Russell, 1996	-.40	-	-	-.49	-	EPQ	UCLA	489 college students
Saklofske & Yackulic, 1989	-.48/ -.13	-	-	-.51/.09	-	EPQ	UCLA	93 male university students
Saklofske & Yackulic, 1989	-.13	-	-	.09	-	EPQ	UCLA	165 female university students
Stober, 2003	-.46/ -.52	-.11/ -.32	-.26/ -.17	-.52/ -.16	-.04/ -.26	NEO-FFI	UCLA F1/F2	141 German university students
Stokes, 1985	-.32	-	-	-.46	-	EPQ	UCLA	179 undergraduate students
Wilson et al., 1989	-.41	-	-	-.31	-	EPQ	UCLA	80 White male Zimbabwean adolescents
Total N	**3723**	**636**	**636**	**3423**	**636**			
Weighted Mean Correlation	**-.33**	**-.20**	**-.23**	**-.30**	**-.17**			

E = Extraversion, A = Agreeableness, C = Conscientiousness, ES = Emotional Stability, O = Openness to Experience; UCLA: UCLA Loneliness Scale; UCLA F1/F2: UCLA Loneliness Scale Factor 1 (Intimate others) & Factor 2 (Social others); EPQ: Eysenck Personality Questionnaire; SF: Short-Form Measure of Loneliness (Hays & DiMatteo, 1987), BFQ: Big Five Questionnaire (Ostendorf, 1990), NEO-FFI: NEO Five Factor Inventory (Costa & McCrae, 1992); BFI: Big Five Inventory (Benet-Martinez & John, 1998)

As can be seen in Table 3.3 that summarizes data from 636 to 3723 participants, most studies focus solely on Extraversion and Neuroticism (Emotional Stability) using the Eysenck Personality Questionnaire and the UCLA Loneliness Scale. The UCLA Loneliness Scale (Russell, 1996) measures subjective feelings of loneliness or social isolation. The scale has 20 statements with eight reverse-keyed items. Participants indicated how often they felt the way described in the statement, with responses ranging from "Never" to "Always". Only two studies provide correlations between loneliness and all Big Five traits. Weighted mean correlations between loneliness and the Big Five traits were -.33 for Extraversion, -.20 for Agreeableness, -.23 for Conscientiousness, -.30 for Emotional Stability, and -.16 for Openness. Although the most often-measured traits of Extraversion and Neuroticism are the most highly correlated to loneliness, the other three traits are worth measuring for those seeking a complete picture of personality trait dynamics.

All correlations for undergraduate students were greater than in the entire sample. There was a larger correlation between self-esteem for Extraversion (r_{all} = -.33 vs. $r_{students}$ = -.44), Agreeableness (r_{all} = -.20 vs. $r_{students}$ = -.26), Conscientiousness (r_{all} = -.23 vs. $r_{students}$ = -.28), Emotional Stability (r_{all} = -.30 vs. $r_{students}$ = -.43), and Openness (r_{all} = -.17 vs. $r_{students}$ = -.19). The largest discrepancies between the results for all participants and the students' correlations were found for Extraversion and Emotional Stability; there appears to be a stronger link in lonely university students who are more introverted and less emotionally stable when compared to the general population. This finding may be due to the nature of the university; the loneliness experienced by university students may be magnified by the setting in those who are more introverted and higher in neuroticism. In summary, extraverted and easy-going people who have a greater need for stimulation which may stem from a lower level of cortical arousal, exhibit those behaviours that increase the quality and frequency of interpersonal and social contact that results in a lower experience of loneliness (Saklofske & Yackulic, 1989). In that loneliness is perpetuated by those characteristics that hinder the initiation or continuance of interpersonal relationships (Peplau & Perlman, 1979), higher levels of Neuroticism and Introversion typically prevent outward behaviours that promote quality of interpersonal relationships. Loneliness had higher trait correlations with all traits in the university student population than in the general population; this may be due to such factors as being away from home, not feeling included in social activities, or the potentially isolating factor of increased work demands that limits interpersonal interaction.

3.2.1 Loneliness and Self-Esteem

Psychosocial factors have significant and salient links between each other; aside from its relationship to personality traits, loneliness also is inversely related to self-esteem. Table 3.4 presents correlations between self-reported loneliness and self-esteem.

Table 3.4 – Correlations between loneliness and self-esteem

Study	Loneliness / self-esteem correlation	Self-Esteem Measure	Loneliness Measure	Participants
Benet-Martinez et al., 2003	-.59	RSE	UCLA	122 European American undergraduates
Benet-Martinez et al., 2003	-.58	RSE	UCLA	199 Asian American undergraduates
Halamandaris & Power, 1997	-.62	ISE	UCLA	124 students
Hojat, 1983	-.43	RSE	UCLA	305 Iranian students
Hojat, 1983	-.52	RSE	UCLA	232 Iranian students
Hojat & Lyons, 1998	-.49	RSE	UCLA	141 female allied health students
Kamath & Kanekar, 1993	-.48	RSE	UCLA	50 Indian men
Kamath & Kanekar, 1993	-.52	RSE	UCLA	50 Indian women
Kraus et al., 1993	-.34	RSE	UCLA	100 elderly
Lyubomirsky et al., 2006	-.29	RSE	SF	621 retired employees
Mahon & Yarcheski 1992	-.56	RSE	UCLA	113 early adolescents
Mahon & Yarcheski 1992	-.41	RSE	UCLA	106 middle adolescents
Mahon & Yarcheski 1992	-.39	RSE	UCLA	106 late adolescents
Moore & Schultz, 1983	-.06	RSE	UCLA	99 high school students
Overholser, 1993	-.57	RSE	UCLA	323 college students
Riggio et al., 1993	-.58	RSE	UCLA	136 college students
Total N	**2827**			
Weighted Mean Correlation	**-.45**			

UCLA: UCLA Loneliness Scale (Russell, 1996); UCLA F1/F2: UCLA Loneliness Scale Factor 1 (Intimate others) & Factor 2 (Social others) (Russell, 1996); SF: Short-Form Measure of Loneliness (Hays & DiMatteo, 1987); RSE: Rosenberg Self-Esteem Scale (1965); ISE: Index of Self-Esteem (Hudson, 1982)

Table 3.4 provides correlational data from 11 studies representing 16 samples comprised of 2827 participants that almost uniformly measured self-esteem using the Rosenberg Self-Esteem Scale (1965) and the UCLA Loneliness Scale (Russell, 1996). Moderate negative correlations between loneliness and self-esteem were found for most of the studies with a weighted mean correlation of -.45. Participants higher in self-esteem felt less lonely. Examining only those samples comprised of university students (Benet-Martinez et al., 2003; Halamandaris & Power, 1997; Hojat, 1983; Hojat & Lyons, 1998; Overholser, 1993; Riggio et al., 1993), the correlation between loneliness and self-esteem from six studies with eight samples comprised of 1261 participants was -.52, somewhat higher than for all samples combined. This finding indicates a stronger relationship between loneliness and self-esteem in university students than in the general public. Again, this may be due to a greater feeling of loneliness in university students than in the general public.

3.3 Satisfaction with Life and Personality

Satisfaction with life has been researched alongside personality. This section aims to elucidate the connection between life satisfaction and Big Five personality traits; implementation of the Satisfaction with Life Scale (Diener, Emmons, Larsen, & Griffin, 1985) was the main tool examined in studies that nomothetically measured personality with a validated and reliable inventory.

Table 3.5 – Big Five trait correlates of satisfaction with life ratings

Study	Big Five Domain E	A	C	ES	O	Big Five Measure	Sat w/ Life Measure	Participants
Austin et al., 2005	.19	.17	-.01	.19	-.05	NEO-FFI Form S	TSWLS	212 adults
Benet-Martinez et al., 2003	.34	.26	.26	.47	.18	BFI	SWLS	122 European American undergraduates
Benet-Martinez et al., 2003	.39	.23	.24	.45	.25	BFI	SWLS	199 Asian American undergraduates
Chico Libran, 2006	.28	-	-	.43	-	EPQ	SWLS	368 Spanish university students
Diener et al., 1985	-	-	-	.48	-	EPQ	SWLS	163 undergraduate students
Emmons & Diener, 1985	.29	-	-	.31	-	EPQ	SWLS	74 undergraduate students
Emmons & Diener, 1985	.30	-	-	.08	-	EPQ	SWLS	62 undergraduate students
Gannon & Ranzijn, 2005	.435	.237	.367	.553	.135	NEO-FFI	SWLS	191 adults
Hart, 1999	.17	-	-	.31	-	NEO-PI	SWLS	282 police officers
Hart, 1999	.07	-	-	.30	-	NEO-PI	SWLS	180 police officers
Hart, 1999	.23	-	-	.31	-	NEO-PI	SWLS	226 police officers
Hayes & Joseph, 2003	.42	.06	.38	.54	-.15	NEO-FFI	SWLS	111 British adults
Heaven, 1989	.14	-	-	.48	-	JR EPQ	SWLS	94 Australian male adolescents
Heaven, 1989	.11	-	-	.37	-	JR EPQ	SWLS	100 Australian female adolescents
Heaven, 1989	.14	-	-	.33	-	JR EPQ	SWLS	41 Australian male adolescents

Heaven, 1989	.13	-	-	.45	-	JR EPQ	SWLS	58 Australian female adolescents
Herringer, 1998	.525	-	-	-	-	NEO-PI-R	SWLS	56 male undergraduates
Herringer, 1998	.343	-	-	-	-	NEO-PI-R	SWLS	106 female undergraduates
Judge et al., 2002	-	-	-	.25	-	NEO-FFI/ NEO-PI-R	SWLS	1517 adults
Kluemper, 2008	.35	.25	.30	.39	.09	NEO-FFI	SWLS	180 adult employees
Lipkus et al., 1996	.38	-.15	.17	.45	.01	NEO-FFI	SWLS	94 undergraduate students
Lipkus et al., 1996	.34	.25	.26	.42	.23	IPIP	SWLS	201 undergraduate students
Pychyl & Little, 1998	.40	.13	.15	.31	.21	NEO-PI Form S	SWLS	78 doctoral candidates
Rigby & Huebner, 2005	.09	-	-	.29	-	What I'm Like	SLSS	212 high school students
Schimmack et al., 2003	.42	.14	.35	.49	.18	IPIP	SWLS	124 university students
Schimmack et al., 2003	.42	-	-	.48	-	NEO-PI R	SWLS	146 adults
Suh et al., 1996	.41	-	-	.48	-	NEO-PI	SWLS	115 upperclass college students
Suh et al., 1996	.55	-	-	.48	-	NEO-FFI	SWLS	115 upperclass college students
Vitterso, 2001	.216	-	-	.394	-	Norwegian Big 5	SWLS	264 high school students
Vitterso, 2001	.138	-	-	.474	-	Norwegian Big 5	SWLS	224 high school students
Wong et al., 2007	.32	.23	.05	.38	-.03	Big 5 Mini	SWLS	189 Australian undergraduates
Wong et al., 2007	.14	.25	.20	.34	.02	Big 5 Mini	SWLS	243 Singaporean undergraduates

Zhang, 2005	.21	.17	.24	.29	-.09	NEO-FFI	Gen. Life Sat.	1347 Chinese adults
Total N	6014	3291	3291	7532	3291			
Weighted Mean Correlation	**.26**	**.18**	**.23**	**.35**	**.02**			

E: Extraversion; A; Agreeableness; C: Conscientiousness; ES: Emotional Stability; O: Openness to Experience; EPQ: Eysenck Personality Questionnaire (Eysenck & Eysenck, 1968); NEO-FFI: NEO Five Factor Inventory (Costa & McCrae, 1992); NEO-PI: NEO Personality Inventory (Costa & McCrae, 1985); NEO-PI-R: Revised NEO PI (Costa & McCrae, 1992); IPIP: International Personality Item Pool (Goldberg, 1997); BFI: Big Five Inventory (Benet-Martinez & John, 1998); JR EPQ: Junior Eysenck Personality Questionnaire (Eysenck & Eysenck, 1975); Norwegian Big 5: Norwegian Big Five Inventory (Engvik, 1993); Big 5 Mini: Big Five Mini Marker Scale - Brief Version (Saucier, 1994); What I'm Like (Scholte et al., 1997); SWLS: Satisfaction with Life Scale (Diener et al., 1985); TSWLS: Temporal Satisfaction with Life Scale (Pavot, Diener, & Suh, 1998); Gen. Life Sat.: General Life Satisfaction Scale (Leung & Leung, 1992); SLSS: Students' Life Satisfaction Scale (Huebner, 1991)

Overall, there appears to be a small to moderate correlation between any of the Big Five traits and life satisfaction as seen in Table 3.5 representing up to 6014 participants. Focusing only on correlations between satisfaction with life and the Big Five personality traits in university students, four of the five traits correlated higher with satisfaction with life for the student sample than with the general population: Extraversion (r_{all} = .26 vs. $r_{students}$ = .33), Agreeableness (r_{all} = .18 vs. $r_{students}$ = .20), Emotional Stability (r_{all} = .35 vs. $r_{students}$ = .42), and Openness (r_{all} = .02 vs. $r_{students}$ = .12). Conscientiousness had a slightly lower correlation with satisfaction with life in the student sample than in the general sample depicted in Table 3.5 (.21 vs. .23, respectively); both Agreeableness and Conscientiousness do not appear to markedly differ between the two samples.

The nature of the university combined with the potentially labile nature of personality traits at this point in life may account for the larger correlational differences between samples. It is possible that Extraversion appears to be more closely related to satisfaction with life in the student sample because those extraverted behaviours can garner better interpersonal relationships and enhance life satisfaction. For example, Cheng and Furnham (2002) measured self-reported Extraversion using the EPQ and happiness with the Oxford Happiness Inventory (Argyle, Martin, & Crosland, 1989) in 90 adolescents (49 males, 41 females; M_{age} = 17.23 years, SD = .65). Regressing happiness scores on to personality, Extraversion significantly predicted happiness ($\beta = 0.27$, $t(14, 75) = 2.38$, $p < .05$); happier individuals possess greater life satisfaction.

There was a moderate difference between the samples' correlations for Emotional Stability and life satisfaction whereby the student samples provided a higher correlation. One explanation for this incorporates coping or managing stressful situations. Being more emotionally stable may be associated with greater resiliency or coping in the university environment; the correlation between Emotional Stability and life satisfaction may be moderated or mediated by resiliency or coping. For example, Saklofske and Yackulic (1989) administered the EPQ and Coping with Loneliness scale (CWL; Grant, 1986) to 93 male and 165 female university undergraduates. Less emotionally stable neurotic students engaged in less problem-focused coping ($r_{males} = -.10$, $r_{females} = -.19$) and more maladaptive wishful thinking ($r_{males} = .31$, $r_{females} = .45$) (Saklofske & Yackulic, 1989). In that the lack of beneficial coping skills was associated with greater neuroticism, and that poor coping skills are associated with a lower satisfaction with life, this relationship may be more potent in university students than in the general population and would account for the stronger relation in the former group.

Finally, there was a meaningful difference between the Openness and life satisfaction correlation between the general population (r = .02) and university students (r = .12). This difference indicates that students who are more open to experience also report higher satisfaction with life; again, this may be due to the nature of the higher education setting that promotes and fosters abstract thought. In that Openness is marked by the appreciation of experiences for their own sake and engaging in creative thought and intellectual curiosity (Costa & McCrae, 1992), greater life satisfaction can be seen to easily accompany the active appreciation of life in conscientious people.

3.3.1 Satisfaction with Life and Self-Esteem

Satisfaction with life also has potent correlates with self-esteem; a summary of studies that reported self-esteem correlates to satisfaction with life measures are reported in Table 3.6.

Table 3.6 – Summary of studies reporting correlations between satisfaction with life and self-esteem

Study	Correlation with Self-Esteem	Self-Esteem Measure	Sat w/ Life Measure	Participants
Diener et al., 1985	.54	RSE	SWLS	163 undergraduate students
Emmons & Diener, 1985	.26	Self-Percep. Inventory	SWLS	74 undergraduate students
Emmons & Diener, 1985	.26	Self-Percep. Inventory	SWLS	62 undergraduate students
Zhang, 2005	.32	RSE	Gen. Life Sat.	1347 Chinese adults
Chen et al., 2006	.39	RSE	SWLS	359 Chinese college students
Benet-Martinez et al., 2003	.70	RSE	SWLS	122 European American undergraduates
Benet-Martinez et al., 2003	.67	RSE	SWLS	199 Asian American undergraduates
Judge et al., 2002	.35	RSE	SWLS	1517 adults
Weighted Mean Correlation	**.38**		**Total N**	3843

SWLS: Satisfaction with Life Scale (Diener et al., 1985); RSE: Rosenberg Self-Esteem Scale (Rosenberg, 1965); Self-Percep. Inventory: Self-Perception Inventory (Soares & Soares, 1965); Gen. Life Sat.: General Life Satisfaction Scale (Leung & Leung, 1992)

In that self-esteem measures the value one places on one's life (Rosenberg, 1989), one who is satisfied with themselves can also project this externally (Baumeister et al., 2003), resulting in a high correlation between these two constructs. The correlation between self-esteem and life satisfaction was also computed for students only; a correlation of .49 representing 979 university undergraduates is considerably higher than the .38 correlation for the general population. Again, this difference may point to the higher education experience as providing a stronger linkage between these two factors when compared to the experiences of the general population.

Additionally, the data presented in Table 3.6 may also suggest that there may be a potential overlap between the constructs. Although self-esteem and satisfaction with life are considered distinct constructs, there exists the possibility that certain items overlap with one another, thereby producing the higher correlations seen in Table 3.6. For example, the Rosenberg Self-Esteem Scale (Rosenberg, 1965) has the statement "On the whole, I am satisfied with myself." The Satisfaction with Life Scale (Diener et al., 1985) has the statement "I am satisfied with my life." This potential item overlap between the constructs may result in the higher observed correlations across many studies.

3.4 Perceived Stress and Personality

Perceived stress is germane in examining personality in that it can serve as a phenotypic expression of personality traits; for example, those with higher Neuroticism scores would have higher perceived stress for a given situation. Perceived stress quantifies the subjective experience of an objective event (Cohen et al., 1983). The concept behind the Perceived Stress Scale (PSS; Cohen et al., 1983) is that it is designed simultaneously determine the objective elements of the event (frequency and occurrence) from the subjective rating of the event (positive, negative or neutral). The perception of stressful events can then be examined in relationship to personality traits. Furthermore, the impact on both physiological and psychological outcomes from perceived stress may be moderated by individual differences in personality traits.

There is evidence for the heritability of perceived stress; Federenko and colleagues (2006) examined responses to the Perceived Stress Scale (Cohen et al., 1983 in 103 monozygotic and 77 dizygotic twin pairs. A correlation of .40 between monozygotic twins and a correlation of .18 between dizygotic twins for Perceived Stress Scale Scores was found. Genetics accounted for 30% of the variance in Perceived Stress Scores, shared environmental factors only accounted for 5% of the total variance, and non-shared environmental factors accounted for 65% of the variance (Federenko et al., 2006). This study underscores the role of genetics and those mechanisms and structures, such as hormone systems, which contribute to perceived stress, but also highlights the potent role of the environment in the perception of stress.

Whereas the literature on personality correlates of self-esteem, loneliness, and satisfaction with life is extensive, research is sparse in non-clinical populations in examining Big Five traits and perceived stress. Much of the literature devoted to perceived stress examines those with psychological or physiological illnesses; furthermore, the literature on perceived stress also examines environmental variables in predicting perceived stress. The literature that reports a correlation between the Big Five traits and perceived stress is detailed below; studies were included in the summary if they reported correlation coefficients between the Big Five traits and perceived stress, both of which must have been measured with a validated instrument for that construct.

Table 3.7 – Personality correlates of perceived stress

Study	Big Five Domain					Big Five Measure	Perceived Stress Measure	Participants
	E	A	C	ES	O			
Klag & Bradley, 2004	-	-	-	-.64	-	NEO-FFI	POMS	50 male university staff
Klag & Bradley, 2004	-	-	-	-.46	-	NEO-FFI	POMS	80 female university staff
Kluemper, 2008	-.28	-.33	-.37	-.53	-.29	NEO-FFI	PSS	180 adult employees
Kocalevent et al., 2007	-	-	-	-.48	-	TIPI	PSQ	2552 German adults
Total N	**180**	**180**	**180**	**2862**	**180**			
Weighted Mean Correlation	**-.28**	**-.33**	**-.37**	**-.49**	**-29**			

E = Extraversion, A = Agreeableness, C = Conscientiousness, ES = Emotional Stability, O = Openness to Experience; NEO-FFI: NEO Five Factor Inventory (Costa & McCrae, 1992); NEO-PI-R: Revised NEO Personality Inventory (Costa & McCrae, 1992); TIPI: Ten-Item Personality Inventory (Gosling et al., 2003); POMS: Profile of Mood States (Lorr & McNair, 1992); PSQ: Perceived Stress Questionnaire (Levenstein et al., 1993); PSS: Perceived Stress Scale (Cohen et al., 1983)

In commenting on the studies in Table 3.7, only one study that reported correlations for each of the Big Five (Kluemper, 2008) was more focused on emotional intelligence rather than personality correlates of perceived stress. Furthermore, a literature search did not produce any studies that specifically measured the Big Five traits and perceived stress in a university student population using a validated instrument. This limits comparing personality trait correlates of perceived stress in university students to the general population, but this relationship can still be discussed from the two studies in Table 3.7 that represents 180 to 2862 adults.

Conrad and Matthews (2008) present work examining personality and perceived stress in 403 full-time undergraduates (75 males, 328 females; M_{age} = 19.83, SD = 2.69; 94% Caucasian), although their global stress measurement was a single-item that determined how stressed participants usually felt on a day-to-day basis during the academic semester. Neuroticism and Extraversion were measured using the 60-item NEO FFI Form S (Costa & McCrae, 1992). Extraversion was negatively correlated to stress (-.17) and Neuroticism was positively correlated to stress (.50) at the 1% significance level. Although the perceived stress measure was not in the form of a validated questionnaire, this study provides additional evidence for perceived stress being negatively related to Extraversion and positively linked to Neuroticism which is in line with the results from Table 3.7.

Bolger and Zuckerman (1995) tested models of personality influences on stress. Neuroticism, interpersonal conflicts, coping, and distress were measured in 65 female and 29 male undergraduate psychology students. For 14 days, participants completed the Eysenck Personality Inventory (Eysenck & Eysenck, 1964), an interpersonal conflicts checklist, a 27-item short form of the Ways of Coping Scale (Folkman, Lazarus, Dunkel-Schtter, DeLongis, & Gruen, 1986), and the Profile of Mood States (Lorr & McNair, 1977). The results indicated that those with higher neuroticism reported more exposure and greater reactivity to interpersonal conflicts. It is not surprising that higher Neuroticism has been linked with higher perceived stress.

If perceived stress is related to personality through coping mechanisms whereby one's personality dictates coping styles which, in turn, determines perceived stress, it is worth mentioning the relationship between personality and coping. A meta-analysis by Connon-Smith and Flachsbart (2007) reported 2653 effect sizes from 165 samples representing 33,094 participants. Each of the Big Five traits predicted specific strategies. Problem-solving and cognitive restructuring coping techniques were predicted by Extraversion and Neuroticism. Neuroticism predicted the greatest proportion and degree of problematic coping styles, such as wishful thinking, withdrawal, and emotion-focused coping; Neuroticism, however, also predicted support seeking (Connor-Smith & Flachsbart, 2007). In relating perceived stress to personality traits, one can examine those maladaptive coping skills and the traits that are most related to those styles. In relation to this meta-analysis, those higher in Neuroticism would be expected to engage in poor coping strategies and thereby report greater perceived stress; this is in line with the findings in Table 3.7 that reported a -.48 correlation between Emotional Stability and perceived stress. This observation is concordant with other review-based findings (DeLongis & Holtzman, 2005). Furthermore, there may be overlap between personality traits and coping; Vollrath (2001) calls for redefining coping as a personality process that "aims at the self-regulation of the personality in specific stress situations according to its own goals, needs, inclinations, and reaction tendencies" (Vollrath, 2001, p. 341).

3.5 Life Experiences and Personality

The impact of life experiences in relationship to personality can also serve as a meaningful indicator of how traits function in a particular environment; the states associated with life experiences can be interpreted in relation to how they are perceived (as positive or negative). This interpretation of an experience can then modulate the dynamics of personality traits over time.

The Life Experiences Survey (Sarason, Johnson, & Siegel, 1978) provides a validated and reliable instrument that measures the frequency and impact of the various life events. Participants indicate how recently an event occurred and then rate each event's impact as being positive, negative, or neutral. The frequency of life experiences are mostly beyond one's control although purposefully entering a particular environment may result in more stressful experiences; choosing to attend university will result in having to take exams.

The literature does not have many studies that repeatedly measured personality and life events. One key study by Magnus, Diener, Fujita, and Pavot (1993) twice administered the NEO-PI (Costa & McCrae, 1985), the List of Recent Events (Henderson, Byrne, & Duncan-Jones, 1981), the Social Readjustment Rating Scale (Holmes & Rahe, 1967), and the Life Experiences Survey (Sarason, Johnson, & Siegel, 1978) to 87 University of Illinois students (62 female, 35 males) with a four-year span between assessments. Correlations between events and personality variables are presented in Table 3.8; life events are those experienced since Time 1.

Table 3.8 – Correlation of personality traits and life events (Magnun, Diener, Fujita, & Pavot, 1993, p. 1050)

Variable	1	2	3	4	5	6
1. Extraversion: Time 1	1.00					
2. Neuroticism: Time 1	-.41	1.00				
3. Objective positive events	.24	-.15	1.00			
4. Objective negative events	.07	.23	.37	1.00		
5. Extraversion: Time 2	.73	-.24	.24	.16	1.00	
6. Neuroticism: Time 2	-.40	.54	-.19	.02	-.31	1.00
M	120.17	90.81	6.46	3.47	43.31	12.18
SD	16.97	24.14	2.72	2.13	7.29	3.94

Correlations of .37 and higher are significant at $p < .01$ and correlations of .23 and higher are significant at $p < .05$

Table 3.8 reports the correlations between personality at an initial assessment and the subsequent life experiences over a four-year span. Notably, Extraversion at Time 1 significantly and positively correlated with objective positive life events over the four-year span (.24, $p < .05$) while initial levels of Neuroticism negatively correlated with objective negative events (.23, $p < .05$). Subsequently, the objective positive events occurring between assessments correlated significantly and positively with Extraversion at the second assessment (.24, $p < .05$); the reciprocal relationship did not hold for Neuroticism over time. This may be due to a decrease in Neuroticism over time; Neuroticism between assessments had a correlation of .54 (Magnus et al., 1993). From these findings, the study concluded that Extraversion predisposed participants to experience a greater number of objective positive events, whereas Neuroticism predisposed the occurrence of objective negative events.

Notably, with life experiences in relationship to personality, the literature focuses primarily on how personality can predict subsequent positive and negative life events; in other words, personality traits can predispose people to experience life events. Vaidya, Gray, Haig, and Watson (2002) report the correlations between traits and life events, both prospective and retrospective to the trait measurement in 392 undergraduates (M_{age} = 21.09 (2nd assessment); 96 males, 296 females) with 2.5 years between assessments. Participants completed the Big Five Inventory (BFI: John, Donahue, & Kentle, 1991) and the Life Experiences Survey (Sarason, Johnson, & Siegel, 1978). The results of these findings are presented in Table 3.9.

Table 3.9 – Correlations between personality traits and future and later life events (Vaidya, Gray, Haig, & Watson, 2002, p. 1478)

	Prospective		Retrospective	
Trait	**Positive Events**	**Negative Events**	**Positive Events**	**Negative Events**
Neuroticism	-.07	**.20**	-.10	**.24**
Extraversion	**.24**	-.09	**.29**	-.04
Openness	.09	-.01	**.11**	.01
Agreeableness	**.12**	**-.20**	**.15**	**-.14**
Conscientiousness	**.16**	**-.16**	**.17**	**-.15**

N = 392. Correlations in bold are significant at $p < .05$. Prospective: correlations between traits and future life events; Retrospective: correlations between traits and past life events

In line with the findings from Magnus et al. (1993), Table 3.9 indicates that Neuroticism predisposed participants to negative life events and that Extraversion predisposed participants to positive life events. This relationship also held in the reverse where life events were significantly related to future trait levels (negative life events and Neuroticism; positive life events and Extraversion). Furthermore, Conscientiousness and Agreeableness were positively correlated with both prospective and retrospective positive events and negatively correlated with negative events both in the past the future. Openness only correlated with previous positive events (.11, $p < .05$) (Vaidya et al., 2002). Taken together, it is worth measuring personality traits in tandem with life events in that there is a gap in the literature on work that concurrently measures both constructs in order to determine how personality may predispose one to experience a particular type of life event which may then in turn influence personality trait ratings.

3.6 General Health and Personality

General health is a construct relating to one's mental status. One commonly implemented inventory to measure general health is the General Health Questionnaire-12 (GHQ-12; Goldberg, 1992) which detects cases and degrees of non-psychotic psychiatric disorders while avoiding the identification of physical illness symptoms. One's general health has demonstrated links to personality; previous research is summarized in Table 3.10.

Table 3.10 – General Health correlates of personality

Study	Big Five Domain					Big Five Measure	General Health Measure	Participants
	E	A	C	ES	O			
Ivkovic et al., 2007	-.23	-	-	-.54	-	EPQ-R	GHQ-30	995 Croatian adults
Greven et al., 2008	-.29	-.18	-.21	-.54	-.17	BFI	GHQ-12	1038 university students
Stewart et al., 2005	-.26	-	-	-.54	-	EPQ-R	GHQ-28	347 male adults
Stewart et al., 2005	-.21	-	-	-.52	-	EPQ-R	GHQ-28	550 female adults
Weighted Mean Correlation	**-.25**	**.18**	**-.21**	**-.54**	**-.17**			

E = Extraversion, A = Agreeableness, C = Conscientiousness, ES = Emotional Stability, O = Openness to Experience; EPQ-R: Eysenck Personality Questionnaire - Revised; BFI: Big Five Inventory (John & Srivastava, 199);GHQ-30: 3 item General Health Questionnaire (Goldberg, 1978); GHQ-12: 12 item General Health Questionnaire (Goldberg & Williams, 1988); GHQ-28: 28 item General Health Questionnaire (Goldberg, 1978)

In Table 3.10, Extraversion and Emotional Stability were the only two traits repeatedly measured in multiple studies; sample comparisons (university students compared to female adults) do not show much difference in their correlations. Overall, there was a moderate to high correlation between general health and Emotional Stability (r = -.54). People who were more neurotic reported greater levels of adverse mental states. In that those who inherently have lower mental stability, it is not surprising to see a high correlation between these constructs.

3.7 Conclusions

The global psychosocial factors discussed in this chapter have significant correlations with personality traits. Furthermore, some psychosocial factors have demonstrated reciprocal effects whereby personality has a significant association with subsequent levels of psychosocial factors which, in turn, are significantly related to personality traits measured at a later assessment. In comparing the general population with university student samples has revealed some notable differences; these differences can most parsimoniously be explained by the higher education setting. It is therefore worth examining the nature of the university setting itself in orchestrating psychosocial factor dynamics over time.

Importantly, this chapter has found that correlations between psychosocial factors and personality traits are higher in university students than in samples comprised of the general public. In other words, personality traits have deeper, more salient connections with transient psychosocial factors. This observation lends importance to measuring these psychosocial factors along with personality when examining university students and when attempting to better understand personality dynamics during the transition into adulthood. Additionally, measuring potentially overlapping latent constructs incorporates redundancy into the measurement itself, allowing for the creation of higher-order factors.

Students arrive at university with a particular set of personality traits that can influence subsequent psychosocial factors; these psychosocial factors, in turn, shape personality development. Caspi and Moffitt assert:

> Individual differences are most likely to be accentuated during transitions into new situations that are characterized by unpredictability, when there is a press to behave but no information about how to behave adaptively. Such transition situations are revealing because, during these periods of social disequilibria, individuals must summon their resources and work out ways of handling new problems" (Caspi & Moffitt, 1993, p. 248).

Caspi and Moffitt (1993) compare conditions that favour personality trait change and stability: although both occur during transitions into new situations in the presence of a strong press to behave, continuity results if there is no external information about how to behave adaptively. In contrast, change will be observed when certain previous behavioural responses are discouraged and clear information on behaving adaptively is given (Caspi & Moffitt, 1993). Provided that the higher education environment in question provides clear reward contingencies in developing behaviours that increase academic achievement, change in personality traits in line with optimizing student success should be observed. The greater level of overlap between traits and psychosocial factors may represent these more state-like psychosocial factors solidifying into deep-seated personality traits. In comprehensively examining personality trait dynamics, this study has further justification for measuring personality traits longitudinally and in tandem with psychosocial factors.

Chapter 4 - University-Specific Psychosocial Influences of Trait Dynamics

Personality trait dynamics do not occur independently without any influence from other sources (McCrae, Jang, Livesley, Riemann, & Angleitner, 2001; Roberts, 2007; Lönnqvist, Mäkinen, Paunonen, Henriksson, & Verkasalo, 2008); this is the argument that will be demonstrated in light of personality trait influencers, moderators, and mediators in university students. The experience at the university should be examined in the context of the influence of the environment on personality traits. Elucidating the nature of the higher education surroundings is crucial to understanding personality trait dynamics along with psychosocial factors at this point in life. Having previously addressed those global psychosocial factors (self-esteem, loneliness, satisfaction with life, perceived stress, impact of life experiences, and general health) in relation to personality traits, the focus can turn to the specific higher education environment that may be involved in these dynamics and interrelationships. This chapter will introduce psychosocial measures specific to the university setting. There is a lack of previous literature that examines the longitudinal trends in person-environment interaction and fit and, in the context of higher education, whether personality traits tend to change in relation to the environment and how, if at all, this change influences academic performance. This chapter will first describe the nature of the higher education experience (Section 4.1) and will then present evidence that has examined the relationship between personality traits and the university environment (Section 4.2). Evidence that links personality and environmental typologies will be detailed (Section 4.3) before explaining how person-environment fit may function to shape the course of personality trait dynamics over time (Section 4.4).

4.1 Describing the Higher Education Environment

In order to understand the influence of the higher education environment, one needs to examine work on the dynamics of the university setting. Holland's theory on categorizing environments and persons has applications to the university setting (Holland, 1997; for a general review of Holland's theory, see Spokane, 1985). Holland's theory focuses on careers and vocations, specifically those environmental and personal characteristics that lead to job satisfaction and achievement (Holland, 1997). Extending Holland's vocational theory to higher education (Gottfredson, Jones, & Holland, 1993), three premises emerge. First, one's career reflects one's personality; people can be categorized along six personality types (Realistic (R), Investigative (I), Artistic (A), Social (S), Enterprising (E), Conventional (C); RIASEC) based on patterns of attitudes, interests, and abilities. Second, there are six corresponding academic environments that reflect its physical and social settings. Third, student-environment congruence is related to higher educational stability, satisfaction, and achievement (Smart & Umbach, 2007).

To develop the mechanism through which the higher education environment may have an impact on its students, the method through which the environment develops its characteristics should be discussed. The reflection of the environment to form one of Holland's six types has been postulated as a product of collective institutional efforts in setting the requirements and reinforcement contingencies for students to acquire the attitudes, interests, and abilities of the analogous personality types who dominate them. This socialization process can occur through members of the higher education environment, namely faculty members, who conduct students' participation in preferred activities set forth by the environment in order to develop the competencies germane to that environment. Furthermore, students are encouraged to develop self-perceptions concordant with the environment's values and are rewarded in displaying those values (Smart & Umbach, 2007).

To further detail the six types, realistic types seek out environments utilizing tools, objects, animals, or machines and avoid social interaction. Investigative types place themselves in settings in which they can observe and systematically examine physical, biological, or cultural phenomena and avoid persuasive activities. Artistic types prefer ambiguous unstructured activities that permit the creation of art from physical, verbal, or human materials and avoid clerical and computational activities. Social types enjoy working with others to teach or develop and avoid working with machines. Enterprising types enjoy persuasive and leadership roles and avoid scientific endeavors. Conventional types enjoy systematically examining data and avoid environments with ambiguous, unstructured activities (Fritzsche, McIntire, & Yost, 2002).

There is evidence for the emergence of the RIASEC environments in higher education; either individual units within a university, such as a department, or the entire university, as would be seen in an engineering college, can be classified according to the RIASEC model depending on the scope of the institution. Part of the influence of the higher education environment depends on the type of the environment; Smart and Umbach (2007) framed university environments in relationship to Holland's theory by assigning 14,336 faculty members' survey responses to the academic environments of Holland's theory using *The Educational Opportunities Finder* (Rosen, Holmberg, & Holland, 1997). The four academic environments extracted from the responses along with representative academic departments assigned to each environment are summarized in Table 4.1.

Table 4.1 – Four academic environments based on Holland's Theory (Smart & Umbach, 2007, p. 188)

Environment	Activities	Competencies	Self-Perceptions	Behaviours Rewarded	Disciplines
Investigative	Analytical/ intellectual; aim of creating & using knowledge; deficit in persuasive, social, repetitive activities	Analytical, scientific, mathematical; deficit in persuasive & leadership abilities	Cautious, critical, complex, curious, independent, precise, rational, scholarly	Skepticism, persistence in problem solving, documenting new knowledge, understanding solutions of common problems	Biology, civil engineering, economics, mathematics, sociology
Artistic	Ambiguous, free, unsystematized involving expressing emotion; deficit in explicit, systematic, ordered activities	Innovative & creative; deficit in clerical and business system competencies	Having unconventional ideas or manners; possessing aesthetic values	Imagination in literary, artistic, or musical accomplishments	Art, English, foreign languages, journalism, music, speech, & theater
Social	Mentoring, treating, healing, or teaching others; deficit in explicit, ordered, systematic activities with materials, tools, or machines	Interpersonal; deficit in manual and technical competencies	Cooperative, empathetic, generous, helpful, idealistic, responsible, tactful, understanding, and having concern for the welfare of others	Display of empathy, humanitarianism, sociability, & friendliness	American history, counseling psychology, elementary education, home economics, nursing, & student personnel services
Enterprising	Manipulation of others to attain organizational goals or economic gain; deficit in observational, symbolic, & systematic activities	Acquisition of leadership, interpersonal, speaking, & persuasive competencies; deficit in scientific competencies	Aggressive, ambitious, domineering, energetic, extroverted, optimistic, popular, self-confident, sociable, & talkative	Display of initiative in the pursuit of financial or material accomplishments, dominance, & self-confidence	Business administration, communications, finance, industrial engineering, marketing, pre-law, & public policy analysis

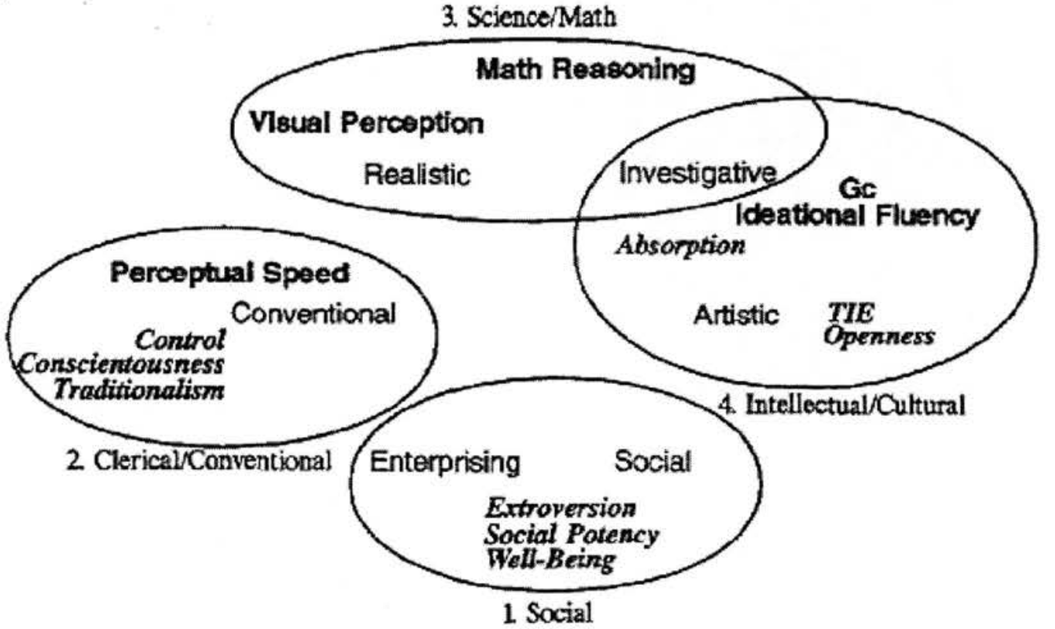
Table 4.1 indicates four latent environmental types based on faculty response. In that these types were obtained from respondents in multiple departments and

institutions, there is a certain degree of universality to this framework. Having established that Holland's theory provides a framework for describing people and environments, the link between environment and personality can be discussed.

4.2 The Relationship Between Personality and Holland's Types

Correlations between the Big Five traits, Holland's personality types, interests, and types of intelligence were summarized in a meta-analysis by Ackerman and Heggestad (1997) that included 135 studies representing 188 independent samples, 2033 correlations, and 64,592 participants. Figure 4.1 pictorially shows the findings from the meta-analysis.

Figure 4.1 – Commonalities between traits (italics), abilities (bold), and interests (plain text) (Gc: crystallized intelligence; TIE: typical intellectual engagement; Ackerman & Heggestad, 1997, p. 239)



Meta-analytic results did not find significant correlations between Agreeableness or Neuroticism to any of the six Holland types. Conscientiousness correlated with the Conventional domain ($r_{median} = .18$). Extraversion correlated with the Enterprising ($r_{median} = .38$) and Social ($r_{median} = .26$) environment type. Openness moderately correlated with the Investigative ($r_{median} = .20$), Artistic ($r_{median} = .10$), and Social types ($r_{median} = .12$) (Ackerman & Heggestad, 1997). One would expect to find people with high levels of a particular trait in a concordant environment. In summary, this section has evidenced how certain personality types have corresponding environmental types. By identifying and classifying environmental types, one can better understand how environments may influence personality traits.

4.3 University Student Evidence for Trait/Environment Correlations

To further explain how personality types relate to higher education settings and to provide a transition in to how personality and environment fit may serve as a driving force to influence trait change and stability via psychosocial factors, two studies that concurrently examined Holland's RIASEC vocational interests along with personality will be detailed. De Fruyt and Mervielde (1997) determined the relationship between the Big Five and Holland's RIASEC vocational interests by administering the NEO-PI-R (Costa & McCrae, 1992) and the Self-Directed Search (SDS; Holland, 1977, 1979) to 934 final year undergraduate students (498 males, 436 females; $M_{age} = 23.4$ years, $SD = 2.2$). A summary of the correlations between the Big Five traits and the RIASEC scale scores are presented in Table 4.2.

Table 4.2 – Correlations between Big Five traits and RIASEC scales (de Fruyt & Mervielde, 1997, p. 94)

Trait	R	I	A	S	E	C
N	-.19**	-.10	.10	.04	-.33**	-.24**
male	-.13*	-.10	.13*	.09	-.24*	-.23*
female	-.05	-.03	-.05	-.13*	-.36*	-.19-
E	.10	.00	.08	.29**	.48**	.14**
male	.14*	.00	.01	.29*	.54*	.25*
female	.13*	.03	.15*	.28*	.46*	.00
O	-.05	.09	.56**	.30**	.01	-.18**
male	-.03	.15*	.56*	.36*	.10	-.10
female	.18*	.09	.50*	.15*	.12	-.22*
A	-.07	.04	-.10	.29**	-.23**	-.03
male	.07	.07	-.06	.21*	-.21*	-.02
female	-.07	.06	-.05	.30*	-.20*	.03
C	.11	.05	-.16**	.02	.32**	.42**
male	.17*	.05	-.23*	-.01	.32*	.45*
female	.01	.05	-.08	.07	.31*	.39*

N = 934; * $p < .01$, ** $p < .001$; Holland's personality type abbreviations: R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional

Table 4.2 reveals negative correlations between Neuroticism and the Realistic, Enterprising, and Conventional types, positive correlations between Extraversion and the Social, Enterprising, and Conventional types, a positive correlation between Openness and the Artistic and Social types and a negative correlation with the Conventional type. Agreeableness correlated positively with the Social type and negatively with the Enterprising type while Conscientiousness was negatively correlated with the Artistic type and positively correlated with the Enterprising and Conventional types in this sample of students.

In a second study that measured environment and personality, Holland's vocational personality types theory and work environments were examined as a moderator of GPA performance predicted by personality in 559 undergraduates (38% male, 62% female) who completed the NEO PI-R Form S (Costa & McCrae, 1992) and the Self-Directed Search Form CP to determine RIASEC interest type (SDS; Holland, 1990) (Fritzsche, McIntire, & Yost, 2002). Participants were classed according to RIASEC person types. There was a positive correlation between Extraversion and Enterprising scores (r = .44), Openness and Artistic scores (r = .51), Agreeableness and Social Scores (r = .18), and Conscientiousness and Conventional scores (r = .27; all $p < .05$). All traits other than Neuroticism were differentially associated with each of the six RIASEC types ($p < .05$). Post hoc tests determined that Enterprising types had highest Extraversion scores, Artistic types were highest in Openness, Social types were highest in Agreeableness, and Conventional participants had highest Conscientiousness scores. Correlations between Holland's SDS scales and the NEO PI-R are presented in Table 4.3.

Table 4.3 – Correlations of the Big Five with SDS Scale scores (Fritzsche et al., 2002, p. 429)

Scale	N	E	O	A	C
R	-.18*	-.07	.18*	-.07	.00
I	-.20*	-.02	.22*	.01	.13*
A	.01	.18*	.51*	-.04	-.10*
S	-.08	.37*	.25*	.18*	.12*
E	-.20*	.44*	.16*	-.12*	.18*
C	-.09	.09	.01	.04	.27*

N = 455; * $p < .05$; Holland's personality type abbreviations: R = Realistic; I = Investigative; A = Artistic; S = Social; E = Enterprising; C = Conventional

Correlations between personality and performance found positive correlations between GPA and Conscientiousness ($r = .16$) and Agreeableness ($r = .14$) at the 5% significance level. Significant positive zero-order correlations were found between GPA and Agreeableness and Conscientiousness in the Investigative ($r_A = .24$; $r_C = .24$) and Social ($r_A = .25$; $r_C = .30$) environments ($p < .05$). SDS Scores moderated the personality-performance relationship; regressing GPA on Agreeableness and environment type was statistically significant ($F(11, 362) = 3.363$, $p < .05$) which accounted for 9.3% of the variance in GPA. Significant interactions were found between Agreeableness and the Investigative ($\beta = .388$, $t = 2.984$, $p < .10$), Artistic ($\beta = .130$, $t = 1.727$, $p < .10$) and Social ($\beta = .261$, $t = 2.615$, $p < .10$) environments, suggesting a stronger relation between Agreeableness and GPA in those three environments than in the other RIASEC environments. Regressing GPA on Conscientiousness and environment type was also significant ($F(11, 362) = 3.593$, $p < .05$), accounting for 9.5% of the variance in GPA. Conscientiousness impacted performance in the Investigative ($\beta = .246$, $t = 1.754$, $p < .10$) and Social ($\beta = .170$, $t = 1.723$, $p < .10$) environments (Fritzsche et al., 2002). Academic performance can be influenced by personality and environment type in a higher education setting which lends importance to examining personality in the context of the environment. The implication and significance of these relationships is that given a particular type of higher education environment, certain personality traits will be fostered in certain environments; for example, Conscientiousness would be fostered in an Enterprising or Conventional setting and those who are high in Conscientiousness would be better suited for a university or department/subject area with such characteristics. Furthermore, a particular university setting could influence the levels of its corresponding trait if the influence of the environment is strong enough and if personality traits are at a less concrete development point. Having established distinct and potent correlations between personality traits and the loosely defined environment, the concept of how one fits into his or her surroundings offers a mechanism for the environment to act upon and influence personality traits.

4.4 How Fitting Into an Environment Influences Personality Trait Dynamics

After establishing that an environment type can correlate with personality traits in the higher education setting, the concept of fit can be discussed. A lack of person-environment fit, or lack of congruence, may account for an unexpected relationship of academic performance to personality. Additionally, one can examine how person-environment fit is achieved; are beliefs about the environment changing or do personality traits themselves shift in line with the demands of the setting?

Examining person-environment fit in the context of the university may elucidate the impact of the higher education setting on personality. Roberts and Robins (2004) measured person-environment fit as part of the Berkeley Longitudinal Study. The sample comprised 305 undergraduates assessed at the end of each of the four years of university. Personality was measured using the NEO-FFI (Costa & McCrae, 1994); change and stability was determined through calculation of the Reliable Change Index (RCI: Jacobson & Truax, 1991). Self-esteem was measured using the Rosenberg Self-esteem scale (RSE: Rosenberg, 1989) and was analyzed using growth curve modeling whereby the slope and mean of all four scores were determined for each participant; positive slopes of a best fit line to the scores indicated an increase in self-esteem. Academic ability was noted for each participant by determining SAT scores and high school GPA. Person-environment fit was determined by asking participants to rank the degree to which 10 values taken from Holland's typology of environments (Holland, 1997) described both their actual and ideal university environment.

In order to assess how well participants fit into a particular environment, ideal versus actual environments were analyzed according to two types of fit originally detailed by Murray (1938). Trait ratings of a person or an environment can be objectively or subjectively defined (Caplan, 1987; Pervin, 1968). Objective person ratings can be acquired through peer ratings; subjective person ratings can come from self-report measures. Similarly, the objective environment can be assessed through normative or consensual environment judgments; in other words, determining a group's average rating of an environment. Subjective environment can be determined through self-report environment evaluations.

Objective and subjective ratings can be incorporated through two types of fit: alpha and beta (Murray, 1938). Alpha fit is the congruence between a person's subjective values and desires and the consensus or objective judgment of the environment. Beta fit is the link between the person's subjective values and subjective ratings of the environment (Murray, 1938). In the study by Roberts and Robins (2004), students provided subjective ratings of the environment through questions describing their actual environments and provided subjective needs through ratings of ideal environmental variables. Consensus or objective judgments of the university were determined through the mean of all scores at all assessments.

One of the key points raised by Roberts and Robins (2004) is the impact of the environment on the person. Theories on person-environment interactions postulate that a person's values will change in the direction of the organization's values through the process of socialization (Chao, 1997; Chao, O'Leary-Kelly, Wolf, Klein, & Gardner, 1994; Chatman, 1989, 1991; Kristoff, 1966). "With time, individuals respond to the role expectations and cultural press of their environment, and change in the direction of the organization's values" (Roberts & Robins, 2004, p. 92). Conversely, the perception of the environment may change as well. Loftquist and Dawis (1991) assert that changes in person-environment fit can be due to changing one's values in reaction to the environment or by acting upon the environment such as changing one's perceptions of one's surroundings. Relating this to the study in discussion, Roberts and Robins (2004) also determined if change was due to students' perceptions of the actual university environment or in their ideals of the university or a combination of both; was person-environment fit related to change in personality traits over time? Since person-environment fit is specific to each environment (Chatman, 1991; Smart & Umbach, 2007), environments reward different qualities in its persons depending on the person's trait attributes.

Roberts and Robins (2004) used growth modeling for alpha fit (congruence between the subjective and objective values of the environment), beta fit (relationship between the person's subjective values and the subjective ratings of the environment), and self-esteem; each participant's data from each assessment determined the trajectory of change in the data. This technique provides a more reliable index of change compared to difference or residual change scores and is less confounded by a regression using the mean of the group. Furthermore, growth modeling accounts for missing data in that trajectories are computed using all available data for each participant (Willett, 1988). Growth estimates were determined by regressing scores on assessment period centered at the midpoint of the time period. Increases were signified by positive slopes, decreases by negative slopes. The intercept of the data was centered at the midpoint of the longitudinal period to give an average of each variable over all assessments. Rank-order consistency for alpha and beta fit revealed through year-to-year correlations ranged from .35 to .52 ($p < .05$). Examining mean-level changes in fit using growth modeling, only alpha fit showed a significant positive rate of change ($Z = 1.87$, $p < .05$); there was no significant beta fit change (Roberts & Robins, 2004).

Individual differences in person-environment fit was examined by correlating actual and ideal growth trajectories for each item to the overall person-environment fit trajectory; changes in person-environment fit due to change in the ideal rankings indicated students changed their values to achieve better fit with the environment (Roberts & Robins, 2004). If students changed their beliefs about the environment, interpreted as students changing their environment to find greater fit, then change in person-environment fit would be due to changes in the actual environment. Roberts and Robins (2004) found that students increasing in alpha fit changed their rankings of the ideal environment in the direction of the mean rankings of the university environment. Students' values were found to change in that an increase in alpha fit was related to idealizing a more competitive (r = .33), achievement-oriented environment (r = .35) and decreasing idealization of a supportive (r = -.48) and cooperative environment (r = -.41; all $p < .05$). The only significant correlation between change in the actual environment and an increase in alpha fit was with seeing the environment as less competitive (r = -.17, $p < .05$). Alpha fit changes were due to students changing their values rather than their perceptions of the environment. Beta fit was due to change in perceptions of actual and ideal environment; beta fit growth was significantly correlated with changes in the actual environment through viewing the university as less competitive (r = .31) and dictated by rules (r = .29) and more innovative (r = -.26) and people oriented (r = -.14; all *ps* < .05). Increases in beta fit were due to idealizing a more competitive and achievement-oriented university and by viewing the actual university as less competitive than originally thought, indicating a change in both values and perceptions of the environment.

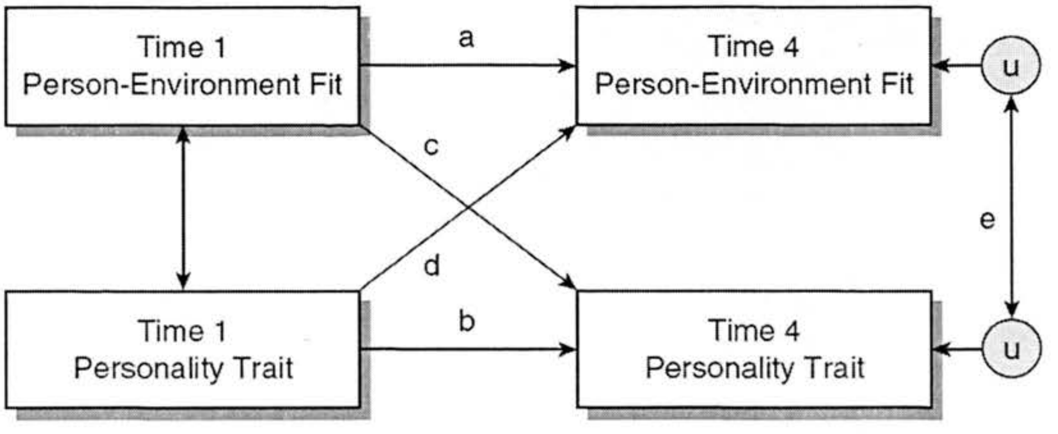
Analyzing person-environment fit with personality development, demographic, ability and personality was first correlated with mean levels of person-environment fit; average alpha fit levels were correlated with being male (r =

.13), higher high school GPA ($r = .12$), higher SAT scores ($r = .16$), and lower Agreeableness ($r = -.19$) and Neuroticism ($r = -.16$; all $p < .05$). Conscientiousness was the only significant correlation to higher beta fit ($r = .12$, $p < .05$). Higher personality consistency was found in students who had higher person-environment fit scores by correlating fit to RCI scores; RCI was negatively correlated to alpha ($r = -.13$) and beta ($r = -0.18$, $p < .05$) indicating higher personality consistency with better person-environment fit.

To test the relation between person-environment fit and personality change, fit indices were correlated with final year personality controlling for first-year personality, GPA, and SAT scores. Increases in beta fit were positively correlated with increases in self-esteem ($r = .13$, $p < .05$). Higher mean levels of alpha fit were associated with decreases in Agreeableness over time ($r = -.15$, $p < .05$). Increases in alpha fit over time correlated with decreases in Neuroticism ($r = -.14$, $p < .05$). For Agreeableness and Neuroticism, individuals who were less agreeable and more emotionally stable experienced better fit in the environment and, in turn, those who fit with the environment or grew in alpha fit became less agreeable and more emotionally stable with time. Neither average levels nor change in beta fit correlated to Big Five trait change (Roberts & Robins, 2004). Overall, these results indicate that better person environment fit was related to personality consistency, an increase in self-esteem, and a decrease in Agreeableness and a decrease in Neuroticism. Furthermore, change in alpha fit was due to socialization through a change in values rather than a change in university environment perception.

Harms, Roberts, and Winter (2006) provided a model for how person-environment fit may orchestrate personality dynamics in Figure 4.2.

Figure 4.2 – Model relating person-environment fit to personality trait dynamics over time (Harms et al., 2006, p. 861)



In this model, the paths labeled a and b represent consistency in person-environment fit and personality, respectively, over time. Paths c and d are the prospective effects of person-environment fit on personality development (c) and personality traits on the development of later person-environment fit (d) over time. The reciprocal path marked e is the correlation of the residuals of the two prior regression equations which reflects the correlations between the changes experienced in both person-environment fit and the trait being tested. This latter relationship represents the degree to which changes occur simultaneously over time. This model is termed an autoregressive cross-lagged paths model (Harms et al., 2004; Bollen & Curran, 2006, p. 209): pre-existing traits not only influence trait levels in the future but also environment ratings. Additionally, initial ratings of external factors influence the factor's future score along with future trait scores. Overall, person-environment fit may provide the explanation for how psychosocial factors and personality traits dynamically shift stability and change over time.

4.5 Conclusions

In that personality types can be attributed to the environment according to Holland's theory, and that certain personality types "fit" in particular environments, it stands to reason that the environment may "shape" a person into a particular personality type if the person's traits are at a period of life when personality shows greater flux than continuity. During these times, the environment may be molding the person by rewarding particular behaviours before optimal fit is achieved. This does not stipulate that a person's interests are ignored; someone who has a passion for art will not find an engineering university very engaging. However, attendance at a particular institution identifies the person's interests; the setting itself, however, builds upon pre-existing interests to shape traits if the person is in such a transitory period in life and is open to such change. Potentially, the by-product of environmental shaping of labile personality traits may be expressed or conceptualized as achievement. Modern-day concepts of optimal performance, such as the concept of 'flow' (Csikszentmihalyi, 1990), may have unknowingly operated on such a basis: create an environment that best addresses a person's interests which can then be used as a vehicle for personality change. This is not to say that the personality change is drastic; past research does not indicate that massive within-person changes in personality traits can occur quickly in most settings including higher education institutions. This theory warrants further research to longitudinally measure environmental variables along with personality traits and psychosocial influences; data analysis should incorporate pre-existing traits in an autoregressive model (Bollen & Curran, 2006) so as not to ignore the effect of initial trait and environmental conceptualization levels on subsequent scores. Assuming that interests are met, the university setting, according to Holland's typology, should mould personality traits to be more in line with the environment; the effect should be greater in those students whose interests are highly met. The fulfillment of interests could therefore be revealed through achievement measures.

The use of achievement measures in determining fulfillment of interests will be employed by the present study. In that the concept of person-environment fit is a potential mechanism for personality trait change and/or stability rather than a main outcome, personality "fit" in a particular environment will not be directly measured in the present study. Although some of the studies reviewed in this chapter on person-environment fit would have benefitted from longitudinal measurements, adding this dimension to the present study on personality dynamics would have added another level of analysis that is beyond the scope of this thesis. Presently, person-environment fit will be relied upon as an explanation for the link between psychosocial factors and personality trait dynamics. The present study now turns to biological mechanisms of stress and immune functioning; physiological processes may underpin the relationship between trait dynamics and psychosocial forces.

Chapter 5 - Biological Links to Personality and Psychosocial Factors

Examining personality dynamics in a biological context may elucidate mechanisms underpinning trait change and stability. This chapter will demonstrate that traits have salient links to health outcomes and that these outcomes can be objectively measured; simultaneous measurement of subjective traits with objective health can lead to a better understanding of the biological correlates of personality and psychosocial factors. Importantly, how do personality and psychosocial factors impact health? Furthermore, how do changes in traits and psychosocial factors influence changes in health? This chapter will address these questions.

First, research establishing health outcomes to traits (Section 5.1.1) and psychosocial factors (Section 5.1.2) will be reviewed. Third, the immune response due to hypothalamic-pituitary-adrenal (HPA) axis activation will be detailed (Section 5.2); the HPA axis is the major neuroendocrine-based system involved in the stress response and may serve as a link between psychosocial factors and personality in that psychosocial factors may elicit an immune response that moderates or mediates trait dynamics. Next, an overview of the immune system will be given to better understand how psychosocial factors may acutely moderate physiological processes (Section 5.3). In that this present study utilizes measures of mucosal immunity, the relationship between the body's nonspecific defenses and general health will be addressed (Section 5.4). Finally, to tie all concepts in this chapter together, after providing the background between the stress response and immune functioning (Section 5.5), evidence tying these two constructs together that focus on personality traits (Section 5.6) and psychosocial factors (Section 5.7) will be detailed.

5.1 Associations with Health Outcomes

One significant caveat in reviewing literature relating personality to health and stress outcomes is that the literature included in the present discussion deals solely with individual differences in personality trait levels within the range of normal variation. The following discussion deals solely with research examining normal trait variation and its relation to stress, health, and immune functioning.

Caspi and colleagues (1997) found that personality traits in childhood predict the incidence of health risk behaviours in adulthood. The Multidimensional Personality Questionnaire (Tellegen, 1982) was administered to 961 18-year old participants as part of the Dunedin Multidisciplinary Health and Development Study; health risk behaviours were measured at age 21 including alcohol dependence (Diagnostic Interview Schedule; Robins & Regier, 1991) and sexual behaviour (National Survey of Sexual Attitudes and Lifestyles; Wellings, Field, Johnson, & Wadsworth, 1994). Earlier, at age 3, observational measurements were used to classify participants' temperaments. At age 21, participants with alcohol dependence scored lower at age 18 on Traditionalism ($d = .49$), harm avoidance ($d = .44$), Control ($d = .64$), and Social Closeness ($d = .40$), and higher on Aggression ($d = .86$), Alienation ($d = .66$), and Stress Reaction ($d = .50$); on a domain level, alcohol dependent participants had lower Constraint (d = .73) and higher Negative Emotionality (d = .90; all *ps* < .05) (Caspi et al., 1997). Participants at age 21 who engaged in unsafe sex when compared to healthy controls scored lower at age 18 on Traditionalism (d = .48), Harm Avoidance (d = .61), Control (d = .47), and Social Closeness (d = .31), and high Aggression (d = .73); this amounted to lower Constraint (d = .71) and higher Negative Emotionality (d = .29, all $p < .05$). Overall, those at age 18 who scored lower on Traditionalism (d = .77), Harm Avoidance (d = .67), Control (d = .79), and Social Closeness (d = .69), and higher on Aggression (d = 1.36) and Alienation (d = .70) were significantly more likely to become involved in a health risk behavior at age 21 (all $p < .05$; Caspi et al., 1997). At the domain level, participants who at age 18 scored low on Constraint (d = 1.01) and high on Negative Emotionality (d = .94) were significantly more likely to be involved either in one or in multiple health-risk behaviors at age 21 ($p < .05$). Examining childhood temperament, undercontrolled and confident children were significantly more likely to be involved in more health-risk behaviors; undercontrolled children were 2.05 times more likely to be involved in a health-risk behavior (95% CI of 1.17-3.37); confident children were 1.49 times more likely to be involved in a health-risk behavior (95% CI: 0.97-2.30). This study evidences an association between individual differences in personality and health-risk behavior.

5.1.1 Trait Associations with Health Outcomes

In that health is an outcome of immune functioning, Austin, Saklofske, and Egan (2005) provide evidence that personality is linked to self-rated health. Health and self-reported personality trait ratings (Personality Mini-Markers, Saucier, 1994; NEO-FFI Form S, Costa & McCrae, 1988) were provided by 133 participants. Self-reported health was negatively and significantly correlated with Neuroticism ($r = -.22$, $p < .01$) and positively to Extraversion ($r = .19$, $p < .05$). Lower Neuroticism and higher Extraversion were found to be associated with better self-reported health. However, the relationship between health and personality does not exist solely on subjective, self-reported evidence; research also indicates that traits have salient correlates to objective measures of health.

Brummett and colleagues (2006) examined the linkage between personality traits and, among other measures of health, body mass index over a 14 year span. Participants were part of the University of North Carolina Alumni Heart Study comprised of 3401 adults ($M_{age} = 41.6$ years, $SD = 1.5$) who provided height and weight measurements to generate BMI on four occasions along with self-report measures on the NEO-PI-R (Costa & McCrae, 1992). Individual growth curve models were used to examine the potential effects of each trait on BMI at midlife and on the change in BMI as participants aged. In females, Neuroticism significantly and positively correlated with higher BMI at all four time points ($r_{1989} = .19$; $r_{1992} = .20$; $r_{1994} = .17$; $r_{2002} = .12$; all $p < .01$); Conscientiousness negatively correlated with BMI at all four time points ($r_{1989} = -.20$; $r_{1992} = -.15$; $r_{1994} = -.16$; all $p < .01$; $r_{2002} = -.10$, $p < .05$). For males, Extraversion correlated positively with BMI only at the first three time points ($r_{1989} = .05$, $p < .01$; $r_{1992} = .05$, $p < .05$; $r_{1994} = .06$, $p < .01$). Openness correlated negatively with BMI at the first time point ($r_{1989} = -.05$, $p < .05$). Agreeableness ($r_{1989} = -.07$, $r_{1992} = -.07$, $r_{1994} = -.08$, $r_{2002} = -.07$) and Conscientiousness ($r_{1989} = -.06$, $r_{1992} = -.07$, $r_{1994} = -.09$, $r_{2002} = -.10$) both correlated negatively with BMI at all four time points at the 1% significance level (Brummett et al., 2006). In that poor health is associated with higher BMI, those traits correlating negatively with this objective measure would be considered as being beneficial to health.

Hardiness was examined in relationship to stress and illness by Klag and Bradley (2004) in 50 male and 80 female university staff members. Hardiness is operationally defined as a trait comprised of a sense of commitment, control, and challenge; hardiness may have a direct, indirect (through coping), or moderating effect on stress or illness. In relationship to the Big Five, there is evidence for some overlap between hardiness and Neuroticism especially if hardiness is measured using negatively-worded items (Sinclair & Tetrick, 2000). Participants completed the Dispositional Resilience Scale (DRS: Bartone et al., 1989) to measure resiliency, the 12-item Neuroticism scale from the NEO-FFI (Costa & McCrae, 1992), the tension-anxiety scale from the Profile of Mood States (POMS; Lorr & McNair, 1992) to measure stress, Ruffin's Symptom checklist (RSC; Ruffin, 1985) to assess symptoms of illness, and the Coping Orientation to Problems Experienced scale (COPE: Carver, Scheier, & Weintraub, 1989) to determine coping strategies. Before controlling for

Neuroticism, in males, there was a significant negative correlation between the composite hardiness score along with the control and commitment subscales with stress and illness (hardiness total: $r_{stress} = -.30$, $r_{illness} = -.45$; control: $r_{stress} = -.39$; $r_{illness} = -.48$; commitment: $r_{stress} = -.33$, $r_{illness} = -.44$; all $ps_{\ stress} < .05$, $ps_{\ illness} = <.01$) (Klag & Bradley, 2004). In females, all hardiness measures were significantly negatively related to stress and all but commitment were significantly negatively correlated to illness (hardiness total: $r_{stress} = -.36$, $r_{illness} = -.31$, both $ps < .01$; control: $r_{stress} = -.27$; $r_{illness} = -.23$; commitment: $r_{stress} = -.27$, $p < .05$; challenge: $r_{stress} = -.25$, $r_{illness} = -.24$, ; all subscales $p < .05$) (Klag & Bradley, 2004). Overall, increased hardiness was related to lower reported stress and fewer illnesses. In that the hardiness measure implemented positively-worded items, Neuroticism appears to be inversely related to perceived stress and health which evidences physiological links to personality.

Additionally, personality traits have been linked to physiological dysfunction. Vollrath and colleagues (2007) examined child and parental personality associations with glycemic control in Type 1 diabetes in 64 children aged 6 to 16 years. Glycemic control was assessed at 6 months, 1 year, and 2 years after diagnosis while personality was assessed at 4-6 weeks, 6 months, and 1 year after diagnosis. Higher Agreeableness ($r = .31$) and Conscientiousness ($r = .35$) along with low Neuroticism ($r = -.25$; all $ps < .05$) were associated with better glycemic control (Vollrath et al., 2007). Personality traits demonstrate evidence of serving as moderators of health in this diabetic sample.

Certain personality types have been shown to be linked to disease. Although not a singular trait, those with higher levels of Type A personalities find situations more demanding in general. This perception of greater environmental demand is translated biologically into greater physiological reactivity; these larger cardiovascular and neuroendocrine responses to threat lead to poor health outcomes (Harbin, 1989). However, there is evidence for Type A behaviours as the consequence of heightened sympathetic nervous system responsivity (Krantz & Durel, 1983). One manner in which Type A personality is thought to elicit a physiological response is through higher hostility; this characteristic has been associated with stress-induced changes in immune responses (Christensen, Edwards, Wiebe, Benotsch, & McKelvey, 1996). Hostility has also been associated with larger daily secretions of cortisol (Pope & Smith, 1991) along with higher ambulatory blood pressure responses to interpersonal stress (Jamner, Shapiro, Goldstein, & Hug, 1991). Hostility is thought to accompany a greater exposure to stressful situations and a lack of interpersonal resources to deal with those stressors.

Examining the link between illness, stress and the Big Five traits as domains rather than the individual facets, Neuroticism has been implicated as having potent associations with health outcomes. Neuroticism has been linked to self-reported illness (Costa & McCrae, 1987; Watson & Pennebaker, 1989). However, the question remains as to whether the illness is actually present or if a somatization is occurring due to higher levels of the trait; it would help to objectively measure health in tandem with self-reported illness. The present study will incorporate objective health measures to circumvent this ambiguity in explaining this association:

> Given the pervasive association of Neuroticism/Negative Affect with a variety of measures of personality traits, virtually any correlation between a personality characteristic and an illness outcome influenced by illness behavior might be open to this alternative interpretation; rather than reflecting a link between psychological traits and actual illness, such correlations could reflect an association between neuroticism and illness behavior (Smith & Gallo, 2001, p. 153).

In other words, the somatic complaints are more aptly considered a characteristic of the trait rather than a correlate of the trait.

However, some studies have demonstrated an association with Neuroticism and actual illness by controlling for confounds; Neuroticism has been found to predict objectively verified morbidity and mortality. It is thought that the mechanism of association between Neuroticism and illness is that those with high Neuroticism scores tend to have increased perception of somatic sensations, they tend to construe benign sensations as an indication of illness, and overall have a lower threshold for seeking medical care (Cioffi, 1991; Watson & Pennebaker, 1989; Smith & Gallo, 2001). Neuroticism has been postulated to increase the degree of stress and negative emotions which has been associated with immunosuppression (Kiecolt-Glaser & Glaser, 1995). Those high in Neuroticism would perceive stressors with more negative emotion and have a poorer immune response thereby increasing the likelihood of illness onset. Overall, previous research has examined the association between Neuroticism and illness with less emphasis on the psychological underpinnings of the link (Smith & Gallo, 1991); future work should be directed at explaining the psychological ramifications of this association.

Dispositional optimism and its opposite, pessimism, have also been shown to have a link to illness. Specifically, optimism has been linked to good health. Optimism is relevant to Neuroticism in that correlations between optimism and self-reported physical symptoms have been attributed to shared variance with Neuroticism (Mroczek, Spiro, Aldwin, Ozer, & Bosse, 1993; Scheier, Carver, & Bridges, 1994; Smith, Pope, Rhodewalk, & Poulton, 1989).

To disambiguate this overlap, objective health outcomes have been used in some studies. Peterson, Seligman, and Vaillant (1988) found that self-reported pessimistic attributional style predicted subsequent physician ratings of physical health in 99 males followed over 35 years who were initially healthy. In another study with objectively measured health outcomes, a pessimistic explanatory style predicted lower cell-mediated immunity, as measured by T-helper cell/T-suppressor cell ratio and T-lymphocyte response to mitogen challenge, in 26 older adults when controlling for current health, depression, medication, recent weight change, sleep and alcohol use (Kamen-Siegel, Rodin, Seligman, & Dwyer, 1991). Peterson, Seligman, Yurko, Martin, and Friedman (1998) reported ratings of global attributions for negative events predicted mortality over a 50-year span. Taken together, this research demonstrates that individual differences in optimism are related to health outcomes even when health is objectively measured. In terms of the mechanisms of this association, both the stress moderation and health behaviour models have been suggested. An optimistic disposition can lead people to positively cope with potential stressors through adaptive, active, and problem-solving coping strategies. These positive coping strategies have been found to account for the association between optimism scores and immune functioning (Segerstrom, Taylor, Kemeny, & Fahey, 1998). Fifty first semester law students were given the Life Orientation Test (Schier & Carver, 1985); counts of helper T cells, cytotoxic T cells, B cells, and natural killer cells were also determined at the beginning and end of the first semester. Optimism was positively correlated with helper T cells (.35; $p < .05$) and cytotoxic T cells (.24; $p < .10$) along with adjusted natural killer cell cytotoxicity (.31; $p < .05$) when controlling for immune parameters at the first time point. This study demonstrates the link between health, as objectively measured through immune functioning, and personality.

Repression as a coping style, is a defense mechanism characterized by the avoidance of attention to or awareness of threatening events (Weinberger, 1990). Those who score high on repressive coping show low trait anxiety and high social desirability. Measuring objective outcomes, Weinberger, Schwartz, and Davison (1979) measured self-reported anxiety (Taylor Manifest Anxiety Scale; Bendig, 1956) and defensiveness (Marlowe-Crowne Social Desirability Scale; Crowne & Marlowe, 1960) while recording heart rate, skin conductance, and forehead muscle tension in 40 male college students during a phrase association task. Weinberger and colleagues (1979) found that repressive copers had low self-reported anxiety ($t(27) =$

2.62, $p < .01$) and heightened physiological reactivity in response to the task ($F(2, 37) = 5.0$, $p = .012$). This evidence links repression and physiological activity.

Having established a link to physiological reactivity, repression has been associated with illness. Repression has been implicated as a risk factor for cancer. Dattore, Shontz, and Coyne (1980) sought to determine the personality correlates of cancer by administering the MMPI and Byrne's Repression-Sensitization Scale (Byrne, 1961) to 200 male veterans prior to illness diagnosis; 75 patients did not have cancer. Less self-report of depression and greater repression scores were found in the cancer group ($\chi^2(7) = 15.73$, $p = .028$). This study provides evidence for the link between illness and personality, namely cancer and repression.

Other links between certain personality factors and illness have been established. Aggression suppression has been associated with hypertension. Perini, Muller, and Buhler (1991) examined this relationship in 98 normotensive and 23 borderline hypertensive participants aged 18-24 years. Participants completed the Rosenzweig Picture-Frustration Test (Rauchfleisch, 1979), the Giessen test (Beckmann & Richter, 1975) for personality and social behaviour, and the State-Trait Anxiety Inventory (Spielberger, Porsuch, & Lushene, 1970); blood pressure and heart rate were also recorded in response to both a physical and a mental stressor. Externalized or suppressed aggression accounted for 11% of the variance in systolic blood pressure ($p = .004$). Furthermore, aggression status predicted change in hypertension status at a follow-up session, with 6% of the variance explained by aggression scores ($p < .05$). These results suggest that aggression is not only a significant predictor of higher blood pressure but also helps predict hypertension status over time and demonstrates a link between personality factors and illness.

In terms of the mechanisms of association between repressive coping and illness, evidence supports a model whereby repression is associated with greater autonomic reactivity during stressful situations. Barger, Kircher, and Croyle, (1997) administered the Marlowe-Crowne social desirability scale (Crowne & Marlowe, 1960) and the Taylor Manifest Anxiety Scale (Bendig, 1956) to 121 undergraduates (52 males, 67 females, median = 19 years) along with having them perform a public speaking task while recording skin conductance and interbeat intervals. During the speech task, low anxiety scorers had greater increases in skin conductance response frequency than did high scorers ($F(1,111) = 4.86$, $p < .05$); repressors had more nonspecific skin conductance responses than did nonrepressors during the task ($t(115) = 2.10$, $p < .05$) (Barger et al., 1997). This study provides evidence for physiological arousal characterized by electrodermal activity as being indicative of suppression and provides a possible mechanism of increased physiological reactivity in linking repressive coping and poor health outcomes.

Another domain-level trait with links to health outcomes is Conscientiousness. Friedman and colleagues (1993) found that Conscientiousness predicted longevity. Examining data from the Terman Life-cycle Study, 856 male and 672 female children were assessed on childhood personality using parent and teacher ratings on items later factor analyzed to represent Conscientiousness. In predicting longevity, Conscientiousness significantly predicted mortality ($\chi^2(6, N = 1178) = 24.68, p < .01$) whereby higher levels of the trait ensured greater longevity. Furthermore, there was evidence for Conscientiousness to have a curvilinear effect on mortality ($p < .05$) whereby differences at the lower end of the Conscientiousness distribution were more strongly associated with longevity than differences in the upper half of the distribution (Friedman et al., 1993). The analysis of this longitudinal study provides evidence to support the contention that greater Conscientiousness is associated with a longer life span.

One mechanism through which Conscientiousness may operate is that higher levels of the trait are associated with increased frequency of positive health behaviours. In addition to Conscientiousness, one study incorporated measures of the Big Five with health behaviours. Booth-Kewley and Vickers (1994) administered the NEO-PI (Costa & McCrae, 1985) and the Health Behavior Check List (Vickers et al., 1990) to 103 male U.S. Navy personnel during basic training ($mean_{age} = 19.3$ years, $SD = 2.7$). Correlations between the Big Five Traits and health behaviours are presented in Table 5.1.

Table 5.1 – Correlation coefficients between Big Five traits and health behaviors in 103 male U.S. Navy personnel (from Booth–Kewley & Vickers, 1994, p. 286)

Health Behaviours	N	E	O	A	C
Wellness Behaviours	-.39**	.41**	.04	.22*	.45**
Accident Control	-.27**	.33**	.10	.18*	.54**
Traffic Risk Taking	.24**	.12	.07	-.26**	-.24**
Substance Risk Taking	.07	.15	.24**	-.05	-.07

* = $p < .05$ (1-tailed); ** = $p < .01$ (1-tailed); N = Neuroticism; E = Extraversion; O = Openness to Experience; A = Agreeableness; C = Conscientiousness

From Table 5.1, Conscientiousness was positively correlated with Wellness Behaviours (.45) and Accident Control (.54) and negatively correlated to Traffic Risk Taking (-.24). These robust correlations indicate that Conscientiousness is related to self-protective behaviours that enhance health. Similarly directioned correlations held for Agreeableness, but these correlations were not as strong (.22, .18, and -.26, respectively). Interestingly, there were significant correlations between the health behaviours and Neuroticism (-.39, -.27, and .24, respectively). Extraversion was only significantly related to positive health behaviours (Wellness Behaviours, .41; Accident Control, .33). Openness had a positive correlation to Substance Risk Taking (.24) (Booth–Kewley & Vickers, 1994). There are meaningful relationships between Big Five traits and health behaviours that indicate greater levels of Conscientiousness and Extraversion are associated with positive health behaviours and that greater Openness and Neuroticism may be more deleterious to health. The association of these traits with health behaviours may be the mechanism through which these traits have their associations with illness and health. The studies that reviewed in this chapter suggest links between Big Five traits, stress, and health.

5.1.2 Psychosocial Associations with Health Outcomes

Having established that personality has health-related outcomes, this section will discuss psychosocial associations of health as markers of immune system functioning. Psychosocial correlates of health are believed to be mediated by neuroendocrine regulation; a review by Seeman and McEwen (1996) highlight support for this theory. Differences in neuroendocrine reactivity might influence patterns of health and ageing; it is thought to occur through differential perceptions of the external environment on allostatic load. The term allostatic load refers to the link between neuroendocrine activity and poor health; it is the "cumulative strain on the body produced by repeated ups and downs of physiologic response, as well as by the elevated activity of physiologic systems under challenge..." (McEwen & Stellar, 1993, p. 2094). Physiological activation occurs due to interactions with the external environment. However, the environment can have an additive effect; differences in cumulative allostatic loads are thought to contribute to differential risks for various health outcomes through repeated and enduring physiologic activation (Seeman & McEwen, 1996).

5.1.2.1 Evidence Linking Psychosocial Factors and Health Outcomes

Studies have established the link between psychosocial factors and health; the mechanisms through which this relationship operates will be covered later. Soderstrom, Dolbier, Leiferman, and Steinhardt (2000) twice administered the Perceived Stress Scale (PSS; Cohen et al., 1983) and the Symptoms Checklist (Bartone et al., 1989) to measure psychosomatic symptoms of illness. Two samples were assessed: 110 corporate employees (M_{age} = 42.4 years, SD = 8.5) and 270 undergraduate university students (M_{age} = 19.2 years, SD = 3.0). There were large positive correlations found between perceived stress and symptoms of illness in both samples ($r_{corporate} = .70$; $r_{student} = .61$; $p < .05$) (Soderstrom et al., 2000). Higher perceived stress correlated highly with a greater number of psychosomatic symptoms of illness; this indicates that the perception of stress may activate the HPA axis and suppress immunity against external pathogens.

In another study with subjectively-measured health outcomes, Kohn, Lafreniere, and Gurevich (1991) administered the Perceived Stress Scale (Cohen et al., 1983) along with the Hopkins Symptom Checklist (HSCL: Derogatis et al., 1974) and the Health Problem Inventory (HPI) to 211 undergraduate students (M_{age} = 23.06 years, SD = 5.69; 50 males, 159 females, 2 unknown). Perceived stress correlated positively with scores on the HSCL ($r = .69$) and HPI ($r = .36$; $p < .005$ for both), indicating that with greater perceived life stress reported more symptoms of physical ailments (Kohn et al., 1991).

Smolderen and colleagues (2007) measured perceived stress (Perceived Stress Scale, Cohen et al., 1983) and personality (Type-D Scale-14: DS14, Denollet, 2005) along with self-reported influenza symptomatology in 5404 Dutch participants (M_{age} = 45.8 years, SD = 15.9; 49.9% male, 49.1% female). The DS14 measured negative affectivity and social inhibition which are similar constructs to Neuroticism (r = .68) and Extraversion (r = -.65), respectively (correlations with NEO-FFI traits; Denollet, 2005). Multivariable logistic regression found that negative affectivity (OR = 1.05, p = .009), social inhibition (OR = 0.97, p = .011), and perceived stress (OR = 1.03, p = .048) predicted influenza symptomatology reporting (Smolderen et al., 2007). This study implicates those with higher levels of Neuroticism and lower levels of Extraversion had greater influenza symptomatology; in that influenza infection would normally be controlled by the Th1 response or cellular immunity, greater HPA activation to suppress the Th1 response is seen in those with these trait levels.

5.2 Immune Response Due to HPA Axis Activation

In that the stress response via activation of the hypothalamic-pituitary-adrenal (HPA) axis can have an immunosuppressant effect (Deinzer & Schüller, 1998; Volkmann & Weekes, 2006), measurement of immune functioning can be used as an indicator of stress and a potent correlate to observed changes in personality traits and psychosocial factors. Previous research on the stress response has focused on an individual's psychological attributes in dictating the magnitude of the stress response. HPA axis activation has been attributed to numerous individual attributes;

one's personality along with their psychosocial perceptions can be linked to the stress response and thereby individual differences in HPA activation (Farnè, Boni, Corallo, Gnugnoli, & Sacco, 1994; Spangler, 1997). Importantly, biological measurements of stress through immune functioning provide an objective means for measuring the stress response and can help explain trait and psychosocial dynamics over time.

The hypothalamic-pituitary-adrenal (HPA) axis is the physiological system that is the backbone of the human stress response. Specifically, the HPA axis maintains basal and stress-related homeostasis (Chrousos, 1995). The HPA axis is the major component of the neuroendocrine system that interacts with the autonomic nervous system to together activate and regulate the immune system. The HPA axis consists of the hypothalamus, the anterior pituitary, and the adrenal cortex (Kuby, 1997).

5.2.1 Hormones of the HPA Axis

The endocrine system refers to the internal secretion of biologically active substances called hormones which are released from endocrine glands into the blood stream to act on a distant tissue (Uchino, Cacioppo, & Kiecolt-Glaser, 1996). In turn, hormones can act on the cells that produced them (autocrine functioning) or on cells other than those that produced them (paracrine functioning). The primary signaling cells of the HPA axis are corticotropin releasing hormone (CRH), adrenocorticotropin hormone (ACTH), and glucocorticoid hormone (cortisol in humans and corticosterone in murine models) (McEwen et al., 1997; Kuby, 1997). CRH is produced by parvocellular neurons in the paraventricular nucleus (PVN) of the hypothalamus; CRH stimulates ACTH production and secretion. ACTH is produced by a subset of anterior pituitary cells which subsequently stimulates glucocorticoid synthesis and secretion from cells in the adrenal cortex. Glucocorticoids are the end product of HPA axis activation and are the primary effectors of this neurohormonal circuit. Glucocorticoid receptors are found in the PVN and the anterior pituitary allowing glucocorticoids to negatively feedback on CRH and ACTH synthesis and secretion (McEwen et al., 1997; Kuby, 1997).

Glucocorticoids serve as a major link between the external environment and the brain, connecting waking and sleeping states, cognitive behaviours with physiological responses, and conducting immune system cell movement. Stressful events violate expectations of the external environment, releasing glucocorticoids; however, hippocampal activity regulates glucocorticoid secretion. The hippocampus is the part of the brain responsible for learning and memory, especially spatial and working memory (McEwen et al., 1997). It is here in the hippocampus where cognitive responses to stress occur to regulate behaviour.

One major glucocorticoid, cortisol, along with another group of hormones called catecholamines that includes norepinephrine and epinephrine, are the primary hormones in the stress response. The production of cortisol initiates a negative feedback loop to both the hypothalamus and the anterior pituitary glands

(Zuckerman, 2005, p. 83; Carlson, 2000, p. 85). As for the catecholamines, epinephrine is produced and released from the adrenal medulla; norepinephrine is synthesized in the adrenal medulla but is primarily produced in the central nervous system and peripheral sympathetic nerves. Catecholamines bind to adrenergic receptors to increase oxygen and heat consumption and activate glucose and fat storage. Catecholamines thereby increase heart rate, myocardial contractility, alter vascular resistance, and regulate renin secretion from the kidneys (Uchino et al., 1996). One of the key concepts in understanding how glucocorticoids function in relationship to the immune system relies not only on their patterns of release but also on their targets. Specifically, receptors for various glucocorticoids are differentially expressed on immune system cells which allow the immune system to have some regulation over how hormones can influence immune system activation (McEwan et al., 1997). In summary, greater levels of glucocorticoids and catecholamines are indicative of a greater stress response and HPA axis activation.

5.3 Immune System Overview

It is best to begin an overview of human immunity by detailing the types of immune responses that can occur: non-adaptive or innate immunity and adaptive or specific immunity (McEwen et al., 1997; Kindt et al., 2006). Non-adaptive immunity non-specifically protects the body from pathogens; its cells have a degree of selectivity in recognizing different types (i.e., viruses versus bacteria). It is an initial line of defense and does not have memory in amplifying resistance in future invasions. Natural killer (NK) cells are the primary cells of non-specific immunity, do not require prior activation to function, and serve as the primary defense in acting as a complement system to the adaptive immune system (Kindt et al., 2006).

Adaptive immunity is characterized by immune response specificity along with immunological memory that can increase the degree of the response upon subsequent pathogenic invasions; it also possesses the ability to recognize self from non-self. B and T lymphocytes are the primary cells involved in adaptive immunity. B cells produce immunoglobulins whereas T cells can serve as helpers/inducers of responses or as effectors. Specifically, T cells can differentiate as T helper 1 (Th1) cells or T helper 2 (Th2) cells, or as cytolytic T lymphocytes (CTL) that can directly lyse target cells (Kuby, 1997). The Th1 response is cell-mediated, activating cytotoxic T cells and macrophages; cytokines are then secreted along with self-cells that are infected or altered due to the presence of a pathogen. The Th2 response is the humoral response whereby antibodies specific to a particular pathogen is created by the immune system. Both are considered acquired or adaptive immunity. An effective, adaptive immune response consists of three phases: induction phase, when a pathogen is detected and antigens are presented to T cells; activation phase, when cells responsible for the actual eradication of the pathogen proliferate and mobilize via the orchestration of cytokines; and effector phase, when the pathogen is neutralized and eliminated (McEwen et al., 1997; Kuby, 1997).

5.4 Salivary sIgA as a Direct Measure of Immune Functioning

While measuring health-related outcomes can potentially provide directly observable correlations of personality and psychosocial factors, direct measurements of immune system functioning can better illustrate how the immune system functions in relation to psychological parameters. One such measure is salivary secretory immunoglobulin-A (sIgA).

Salivary secretory immunoglobulin-A (sIgA) is a key antibody in mucosal immunity found in saliva in the mouth that serves as a primary defense against pathogens. sIgA is an integral part in the host's nonspecific defenses. It is polymeric, which means that it is comprised of large repeating subunits that easily adhere to large pathogens that have multiple epitopes or antibody binding sites (Kuby, 1997). sIgA binding to a pathogen renders it unable to invade the mucosal cells in the mouth and colonate. sIgA-pathogen complexes are easily trapped in mucous and then eliminated. Salivary concentrations of sIgA serve as an objective marker of the immune functioning in that it is characteristic of humoral or Th2 immunity, indicating that HPA axis activation has dampened the Th1 response and has allowed the Th2 response to operate unchecked. In summary, sIgA is an antibody indicating that humoral or Th2 immunity is operating; increased sIgA serves as a readily available and easily obtainable marker of HPA axis activation.

Before detailing previous studies involving personality traits and/or psychosocial factors in relationship to salivary sIgA, it is worth expanding upon a methodological note. sIgA levels are typically reported as secretion rates. This is due to the fact that this type of immunity is dependent upon both the absolute sIgA concentration and the salivary flow in that both measures combined determine the total amount of sIgA that covers the mucosal surfaces (Mackinnon & Hooper, 1994). Keeping this in mind, the previous literature along with the present study employs this computation in discussing sIgA levels.

Volkmann and Weekes (2006) present evidence for endocrine parameters of stress-related outcomes. Self-reported stress and health were measured in 34 healthy participants (17 males, 17 females; $M_{age} = 20.49$ years, $SD = 0.98$) who also provided saliva samples for sIgA and cortisol during a baseline low-stress session (mid-summer when school was not in session) and subsequent high stress session (fall semester when at least three major assignments were due). Participants completed the STAI (Spielberger, 1983), the Inventory of College Students' Recent Life Experiences Scale (ICSRLE; Kohn, Lafreniere, & Gurevich, 1990), and the PSS (Cohen et al., 1983) to generate a measure of stress while health was measured with the Upper Respiratory Tract Infection symptoms scale (URTI; Cohen, Doyle, & Skoner, 1999; Cohen, Doyle, Turner, Alper, & Skoner, 2003). Cortisol levels increased between sessions in participants who experienced an increase in perceived stress ($F(1,14) = -2.20$, $p = .047$). Multiple linear regression demonstrated baseline sIgA ($R^2 = 0.26$, $R^2_{adj} = 0.20$, $F(2,27) = 4.68$, $p = 0.018$) and cortisol ($R^2 = 0.21$, $R^2_{adj} = 0.15$, $F(2,27) = 3.57$, $p = 0.042$) levels moderated the stressor exposure and health outcome relationship. Overall, those with low sIgA levels and high cortisol levels at baseline had poorer health outcomes during the stressful examination session than those with high sIgA and low cortisol levels at baseline; reactivity in either biomarker moderated the stressor exposure/health outcome relationship. Taken together, these results implicate individual differences in basal immune and endocrine activity as potent predictors of stress-related susceptibility to poor health.

There is evidence linking stress to salivary sIgA secretion rates. Jemmott and colleagues (1983) measured salivary sIgA secretion rate in 64 first-year dental school students (48 men, 16 women; M_{age} = 23.4 years, SD = 2.38) who also completed measures of perceived stress and the Thematic Apperception Test (TAT) at five times during the academic year. Students reporting higher perceived stress had lower salivary sIgA than when he or she reported it as less stressful (mean Fisher z across all students = -.29, $p < .05$). Based on TAT responses, students were divided into those needing a power and those with a need for affiliation; those with a higher need for affiliation had higher salivary sIgA at all time points ($p < .06$); salivary sIgA highest release rates were found during examinations in June when the program was deemed most demanding ($p < .02$). Those with higher power striving demonstrated a linear decrease in salivary sIgA secretion over time which was significantly different ($p < .02$) than the curvilinear pattern seen in students who needed affiliation (Jemmott et al., 1983). Interestingly, there were no significant differences in reported stress between those who needed power compared to those who needed affiliation. This study indicates that psychosocial academic exam stress lowers salivary sIgA independent of enduring traits.

5.5 Stress and Immune Functioning

There is evidence for stress priming an organism to be more susceptible to infection and ill-health. This is thought to occur in that after host invasion, the Th1 rather than the Th2 response occurs. However, a stress-induced Th2 shift can weaken the ability to ward off pathogens that are meant to be eradicated in a Th1 response. Epidemiological studies provide evidence that severe self-reported stress precedes the development of Th1-mediated autoimmune states (Elenkov & Chrousos, 1999). Severe stress and subsequent severe suppression of cellular immunity allows for pathogen invasion.

In reviewing immune functioning to stress, Chrousos (2000) discussed how glucocorticoids inhibit lymphocyte activity and suppress cytokines. Glucocorticoids suppress the production of TNF-α, IFN-γ, and IL-2 (Chrousos, 1995). Glucocorticoids can also act through cytoplasmic/nuclear receptors on antigen presenting cells to suppress production of the main inducer of Th1 responses, IL-12; it is believed that this is the primary means through which glucocorticoids affect the Th1/Th2 balance. This decreased production of IL-12 from monocytes and macrophages results in lowered production of IFN-γ by antigen-primed $CD4^+$ T cells and an increase of IL-4 from T cells due to the disinhibition from the suppressive effects of IL-12 on Th2 activity. Further, glucocorticoids downregulate IL-12 receptor expression on T and NK cells (Visser, De Kloet, & Nagelkerken, 2000). Taken together, glucocorticoids directly suppress Th1 cells, inhibit IL-12 production by antigen presenting cells causing decreased production of IFN-γ, and decrease IL-12 responsiveness of NK and Th1 cells. To summarize, stress hormones differentially regulate Th1/Th2 patterns and type 1/ type 2 cytokine secretion. Chronic activation of the stress system increases production of glucocorticoids and catecholamines, thereby suppressing the Th1 response and causing a Th2 shift. Importantly, the degree to which this aforementioned mechanism depends on the system undergoing the stress and the nature and intensity of the stress; individual differences can operate at this physiological level: "... different types of stressors with their own central neurochemical and peripheral neuroendocrine 'signatures' might have different effects on the immune response" (Chrousos, 2000, p. 54).

This outcome implicates stress as being immunosuppressive in that chronic stress increases HPA axis activity and thereby suppresses immune-mediated inflammation (Chrousos, 1995; 2000). Specifically, glucocorticoids inhibit IL-12 and TNF-α production that normally stimulate the Th1 response and cellular immunity. In absence of this stimulation and in that glucocorticoids do not have an effect on IL-10 which, in turn, stimulates Th2 immunity and thereby humoral immunity, the Th2 response is further activated (Kuby, 1997). Since humoral immunity involves the increased production of eosinophils, B cells, and mast cells, this response does little to prevent the progression of external pathogens and autoimmune responses. It would therefore stand to reason that chronic stress would increase susceptibility to external pathogens. In that the immune response is related to stress, it is worth exploring the idea that the perception of an event combined with a pre-existing level of a particular trait would have differential stress reactions, HPA axis activation, and therefore immune system activation.

5.6 Personality Moderating Stress and Immune Functioning

Brown and colleagues (1996) employed an objective measure of health in investigating traits and illness by examining individual differences in repressive-defensiveness and basal salivary cortisol levels. Thirty-nine male undergraduates (18-22 years) completed the Weinberger Adjustment Inventory (Weinberger, 1991; Weinberger & Schwartz, 1990), the Marlowe-Crowne Inventory (Crowne & Marlowe, 1964), and the Taylor Manifest Anxiety Scale (Bendig, 1956); participants also provided saliva samples for cortisol analysis. The low anxious group had significantly lower cortisol levels than the combined repressor and high-anxious groups ($t(59) = 2.70$, $p < .005$) (Brown et al., 1996). This study objectively links higher repression with higher levels of stress as indicated by higher salivary cortisol.

One proposed mechanisms is that the autonomic responsivity linked to repressive coping styles is mediated by enhanced central endogenous opiod activity. Jamner, Schwartz, and Leigh (1988) randomly sampled 312 patients at an outpatient clinic. Notably, patients completed the Marlow-Crowne Social Desirability (Crowne & Marlowe, 1964) and Taylor Manifest Anxiety (Bendig, 1956) scales. Blood samples were analyzed to determine levels of monocytes, eosinophils, and serum glucose. Coping style was found as a main effect for monocyte count ($F(3,292) = 9.90$, $p < .001$), eosinophil count ($F(3,290) = 3.82$, $p < .01$) and serum glucose levels ($F(3,308) =$

3.07, $p < .03$); monocytes were highest in the low-anxious group and lowest in the defensive high-anxious group; eosinophils and serum glucose were highest in the repressive group and lowest in the low-anxious group (Jamner et al., 1988). In that opiate use was also recorded, participants in the repressive and defensive high-anxious group reported less opiate use (Fisher's Exact = 7.04, 1 *df*, $p < .005$) (Jamner et al., 1988). In summary, this study demonstrated that individual differences in coping styles are also related to basal differences in physiology, specifically that repressive coping had higher opiod activity as shown by less opiate use; this leads to greater levels of corticosteroids such as cortisol which is indicative of greater HPA activation and stress. Endogenous opiates along with corticosteroids modulate immune functioning; increased corticosteroids in the presence of increased levels of opiates could have an overall additive effect and increase immunosuppression which was seen in those with higher defensiveness having lower monocyte levels (Jamner, 1988). Lower immune functioning leads to poor health outcomes; this mechanism potentially explains the link between repression and illness.

Past research examining HPA axis activity or its outcomes in relationship to personality will be addressed in this section. One of the key reasons to examine personality in relationship to stress and immune functioning deals with health outcomes. Cohen and Hamrick (2003) proposed that immune reactivity can moderate stressor-induced risk for illness in light of the fact that not all those who are stressed develop illness. The concept of stress reactivity – a stable, trait-like individual difference in physiological response to stresors – may explain variability in stress-induced susceptibility. Those who have greater nervous system responses and HPA activation to stressors would experience greater stressor-induced changes to immunity, namely immunosuppression (Cohen & Hamrick, 2003). People who typically have greater immunosuppression are more vulnerable to pathogens in a stress-by-reactivity interaction. Therefore, those who characteristically have high resting states of naturalistic stress would experience greater immunosuppression when acutely stressed. This framework necessitates the examination of traits in relationship to stress and immune functioning; those traits associated with higher levels of baseline stress levels should be associated with greater stress reactivity, greater immunosuppression, and worse health outcomes. Overall, there is evidence for certain traits being associated with longevity; Masui and colleagues (2006) found higher Conscientiousness, Extraversion, and Openness in centenarians when compared to calculated scores from a younger control. Furthermore, Shipley and colleagues (2007) reported a 12% increase in risk of death from cardiovascular disease associated with a one standard deviation unit increase in Neuroticism in the Health and Lifestyle longitudinal study. Both studies necessitate the need to better understand personality and its correlates to stress in predicting health outcomes.

In order to find past research examining personality correlates of stress and immune functioning, the literature was searched for references that specifically measured personality trait levels and stress reactivity or immune functioning. Conraads and colleagues (2006) assessed Type D personality style, characterized by experiencing negative emotion and inhibition of the emotion's expression, was assessed in 91 patients (79% males, 21% females, $mean_{age} = 57 \pm 13$ years). Type-D personality style has been found to describe people low in Extraversion and high in Neuroticism (Costa & McCrae, 1998; Costa & Piedmont, 2003). Examining those cytokines and receptors involved in cardiovascular disease, plasma levels of tumor necrosis factor (TNF)-α, soluble TNF-α receptor 1 and 2 (sTNFR1 and sTNFR2) and interleukin-6 (IL-6) were measured by ELISA. Patients with higher Type D personality trait levels, after controlling for sex, age, ischemic etiology and disease severity, were found to be the strongest predictor of higher TNF-α (OR = 2.9, 95% CI: 1.01 to 8.5, $p = 0.048$) and sTNFR2 levels (OR = 3.9, 95% CI: 1.3 to 12.1, $p = 0.018$). Physiologically, Type D personality style was positively associated with increased circulating levels of TNF-α and sTNFR2 in patients with chronic heart failure suggesting a linked between greater immune activation and heart failure.

Schneider (2004) examined the role of Neuroticism on psychological and physiological stress responses by administering the PANAS (Watson, Clark, & Tellegen, 1988) and the NEO-PI R (Costa & McCrae, 1985) to 59 undergraduates. Electromyographic (EMG) measurements, cardiovascular reactivity from electrocardiographic readings, blood pressure, and heart rate were recorded for each participant during an acute stressor; participants also appraised the threat of the stressor. Personality traits accounted for 26% of the variance in threat appraisal, with higher Neuroticism and lower Agreeableness correlating with higher threat perception (.42 and -.32 respectively, $p < .05$). Furthermore, those with greater threat perceptions had greater peripheral resistance ($F(1,21) = 3.50$, $p < .10$), less cardiac output ($F(1,21) = 4.07$, $p < .05$), and less heart rate reactivity ($F(1,21) = 10.02$, $p < .01$). In summary, higher Neuroticism demonstrates greater sensitivity to the physiological impact of stress and may be an important mechanism for explaining how higher levels of this trait ultimately contribute to poor health outcomes.

Friedman (2000) reported trait correlations of health using data from the Terman Gifted Children Study. The study began in 1921-22 when the 1528 participants were still in elementary school; data was regularly collected over 70 years throughout the participants' lifespan; date and cause of death were also recorded. In 1922, each participant's teacher and parents rated the student on Conscientiousness and Neuroticism. Childhood Conscientiousness was related to survival in middle to old age; aside from establishing that childhood personality is related to adult survival; childhood Conscientiousness promoted positive health behaviours in adulthood (Friedman, 2000). As for Neuroticism, evidence must take into account the observation that those high in neuroticism tend to feel and report symptoms of disease more often (Costa & McCrae, 1987). In the Terman data, Neuroticism was considered as a risk factor to illness along two separate mechanisms. First, those scoring high in Neuroticism tend to harbor pessimism, resentment, and anxiety that can lead to medical noncompliance and a lack of health-protective behaviours. Second, high levels of Neuroticism may also lead to obsessive behaviours regarding one's health to the point of causing large degrees of self-inflicted stress. Overall, both mechanisms link higher levels of Neuroticism with poor health outcomes.

Metabolic syndrome, also termed insulin resistance syndrome, is a set of pathological symptoms that include increased abdominal fat, insulin resistance, hyperglycemia, hypertension, and dyslipidemia; taken together, these hallmarks of poor health increase the risk for cardiovascular disease and type II diabetes (Tamar, Sesiter, & Levy, 2000; Shen, Todaro, Niaura, McCaffery, Zhang, Spiro, & Ward, 2003). Zhang and colleagues (2006) examined the link between insulin resistance and hostility in 643 men ($mean_{age}$ = 63.1 years); participants completed the MMPI (Butcher, Dahlstrom, Grahm, Tellegen, & Kaemmer, 1989) and the Cook-Medley Hostility Scale (Cook & Medley, 1954). Controlling for variables that contribute to insulin resistance such as BMI, hip-to-waist ratio, smoking, and alcohol intake, hostility and norepinepherine predicted insulin resistance ($\beta = 0.14$, $p < .05$) with the cynicism subscale being most related to insulin resistance (Zhang et al., 2006). This study provides evidence linking traits to poor health outcomes after controlling for variables associated with those outcomes which demonstrates that traits can play a significant role in physiological functioning.

5.7 Psychosocial Factors Moderating Stress and Immune Functioning

Using an objective measure of health outcomes, Zorrilla, DeRubeis, and Redei (1995) examined self-esteem correlates of HPA axis hormone levels in 37 healthy male volunteers who were part of a pool of 18-19 year old first-year college students. Participants completed the Rosenberg Self-Esteem Scale (1965), the Hardiness Scale (Bartone et al., 1989), the Hypomaniac Personality Scale (Eckblad & Chapman, 1986), and the Social Readjustment Rating Scale (SRRS: Holmes & Rahe, 1967). The 60-item version of the SRRS included 13 student-relevant items ("Failing a course", "Academic probation", "Changing a major") in addition to the life experiences listed on the original SRRS; intraclass correlation was found to be .89. Participants provided whole blood samples approximately two weeks apart that both occurred at least one week before academic and extracurricular stressors. Psychological measures were recorded only at the first session other than the SRSS which was measured at both assessments. Circulating levels of cortisol and β-endorphin, both measures of HPA-axis activity, were assayed from plasma. Hardiness and self-esteem were found to be significantly correlated ($r = .85$, $p < .05$). Plasma cortisol was found to be higher in those participants with higher self-esteem ($t(32.3) = 2.10$, $p < .05$) but there was no significant difference between those with moderate and high self-esteem for β-endorphin. Higher cortisol correlated with higher self-esteem ($r = .36$, $p < .05$) and remained significant after controlling for other dispositional factors, which indicated that self-esteem was independently related to cortisol, and when controlling for major life stresses, which indicated that significant correlations were not due to differential exposure to recent life events. In other words, cortisol levels were found to be positively related to self-esteem irrespective of those traits measured on the questionnaires that were administered; this association was also not due to differential perception of recent life events. This study provides evidence for a direct association between self-esteem and HPA activation independent of personality traits and environmental perceptions; self-esteem appears to have a physiological impact on its own.

Evidence exists linking low self-esteem to poor health later in life. Trzesniewski and colleagues (2006) prospectively examined data from the Dunedin Multidisciplinary Health and Development Study birth cohort. Self-esteem was measured using the Rosenberg Self-Esteem Scale (RSE; Rosenberg, 1965) at ages 11, 13, and 15. Objective physical health was determined through cardiorespiratory fitness, BMI, waist-to-hip ratio, and systolic blood pressure; participants reported self-perceived fitness level. Low self-esteem significantly predicted poor adult cardiorespiratory health (OR = .13, $p < .05$), high adult waist-to-hip ratio (OR = .13, $p < .05$), and low self-perceived adult health (OR = .12, $p < .05$) (Trzesniewski et al., 2006). Even when controlling for other variables such as gender, socioeconomic status, or adolescent depression, low self-esteem still predicted these poor health outcomes. These findings point to self-esteem as being an important construct in determining health outcomes; further research is warranted to understand the underlying mechanisms that link self-esteem to life outcomes. In the context of the present study, self-esteem will be measured in relationship to health and perceived stress to determine if the relationship with health and self-esteem holds in first-year university students.

In another study with objectively-measured health outcomes, cytokine production was shown to covary with psychosocial risk factors in a study by Marsland and colleagues (2007). The pro-inflammatory cytokines IL-1β, IL-6, TNF-α, and IL-8 were assessed in 183 healthy adults (59% male, 41% female) aged 30 – 54 years; all participants' blood was aliquoted as both a control sample and a lipopolysaccharide-stimulated sample. Depression was measured using the Center for Epidemiological Studies Depression Scale (CESD; Radloff, 1977) and the Beck Depression Inventory (BDI; Beck et al., 1961); the researchers also administered a 2-item Hopelessness Scale (Everson et al., 1996), the Perceived Stress Scale (PSS; Cohen et al., 1983), the NEO-PI-R (Costa & McCrae, 1992), the Multidimensional Personality Questionnaire (MPQ-SF; Tellegen, 1982), the Interpersonal Support Evaluation List (ISEL: Cohen et al., 1985), and a health behaviours checklist. All scales measuring depression (CESD, BDI, Hopelessness Scale) correlated positively with stimulated IL-8 concentrations (r = .19, .24, .21, respectively; $p < .05$). Trait negative affect (NEO-Neuroticism, MPQ-Negative Emotionality) correlated positively with stimulated IL-8 levels (r = .20, .30, respectively; $p < .01$). Social support (ISEL, Social network size) correlated negatively with IL-8 (r = -.21 for both, $p < .05$). After controlling for demographic factors, health behaviours, blood pressure, and white blood cell count, hierarchical regression indicated a positive relationship between only IL-8 production and depressive symptoms ($F(11, 172) = 5.28$, $p < .001$; adj $R^2 = .22$; b = .15, $p < .04$), trait negative affect ($F(11,173) = 5.45$, $p < .001$; adj $R^2 = .22$; b = .18, $p < .02$), and perceived stress ($F(11,172) = 4.12$, $p < .001$; adj $R^2 = .2$; b = .13, $p < .05$); there was an inverse relationship between IL-8 production and perceived social support ($F(11,172) = 5.38$, $p < .001$; adj $R^2 = .22$; b = -.16, $p < .03$) and none of the other cytokines significantly correlated with any measured psychosocial factors after the aforementioned controls (Marsland et al., 2007). Zero-order correlations found that exercise correlated significantly with depressive symptoms (r = -.21, $p < .005$), negative affect (r = -.25, $p < .001$), social support (r = .15, $p < .03$), and social network size (r = .16, $p < .03$); stress did not significantly correlate with any measured health behaviours (Marsland et al, 2007).

This study evidences an association between psychosocial risk factors for inflammatory disease and stimulated production of IL-8; this cytokine is produced by macrophages and endothelial cells that target neutrophils and it serves as a chemokine to chemotactically attract other cytokines. IL-8 is characteristic of a Th2 response and is not well-suited for external pathogenic invasion. Furthermore, IL-8 induces adherence to the vascular endothelium and extravsation of cytokines into tissues (Kuby, 1997). In the study by Marsland and colleagues (2007), negative affect, depression, and perceived stress were found to be positive related to the inflammatory mediator IL-8; social support was associated with lower IL-8 production. In that IL-8 is a marker of an innate immune response, these psychosocial factors can be deemed as precursors to such a response in the absence of any real pathogen. This mechanism can explain how higher levels of IL-8 due to increased perceived stress, for example, can increase the incidence of cardiovascular disease; there clearly exists potent and clinically significant associations between psychosocial factors and health outcomes that are mediated by psychosocial factors' interactions activation and inhibition of the immune system through the HPA axis.

Ellard, Barlow, and Mian (2005) examined the effect of stress on the non-specific immunity in 28 undergraduates (6 males, 22 females; median age = 21 years, SD = 3.28). Blood pressure and heart rates were recorded and blood was drawn; participants completed the Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983) and a health questionnaire (Ellard, Barlow, & Mian, 2004) to assess general health and health behaviours. Data from six assessments were collected over one academic year. A significant positive relationship between PSS scores and the percentage of activated neutrophils was found with correlations ranging from ($r = 0.507$, $p = .0059$) in period 2 to ($r = 0.810$, $p < .0005$) at period 4 indicating that as the level of perceived stress increases so too does the percentage of activated neutrophils. Fisher's z was calculated to normalize the 28 correlations for each participant which generated a positive significant correlation between PSS scores and neutrophil activation ($r = .818$, $p < .0005$). Without any significant correlation between PSS scores and illness, stress was not related to illness as measured using self-reported health (Ellard et al., 2005). This study links perceived stress and objectively-measured poor health (as hallmarked by neutrophil activation) but not between perceived stress and subjectively-measured health; it does introduce the possibility that the wording and the construction of the health questionnaire may confound self-reported health outcomes.

Health outcomes of negative life events, perceived stress, and negative affect were examined by Cohen, Tyrrell, and Smith (1993). Susceptibility to the common cold was examined by exposing 394 healthy participants (154 males, 266 females, $M_{age} = 33.6$, $SD = 10.6$) to a common cold virus. Participants responded to the List of Recent Experiences (Henderson, Byrne, & Duncan-Jones, 1981), the Perceived Stress

Scale (Cohen & Williamson, 1988), and Zevon and Tellegen's (1982) list of Negative Emotions and the Feelings of Inadequacy Scale to assess self-esteem (Fleming & Watts, 1980); stress scales were amassed to form an index of stressful events, a continuous stress variable, and a dichotomous stress variable. Cold symptom severity was objectively recorded through measures of body temperature, mucus weights, and serum antibody concentrations. Higher scores on the three stress scales were positively associated with development of a cold ($\beta = .10$, $p < .02$ for the index; $\beta =.74$, $p < .04$ for continuous life events variable; and $\beta = .51$, $p < .02$ for dichotomous life events). Logistic regression analysis found that only the relation between perceived stress and infection approached significance ($\beta =.04$, $p =.06$ for the continuous variable; $\beta = .05$, $p < .05$ for the dichotomous variable). Similar results were found when life events were entered into a regression with negative affect and their residualized interaction, only negative affect was a reliable predictor ($\beta =.04$, $p < .02$ for the continuous variable; $\beta = .04$, $p < .02$ for the dichotomous variable). Taken together, the results from two regression analyses suggest that the components of perceived stress and negative affect that predict illness are independent of events tracked by the life events scale. Also, the relation between perceived stress and infection was significant but was reduced when the effect of self-esteem was removed from the regression ($\beta = .03$, $p = .31$). In summary, Cohen et al. (1993) found that higher objective stress and higher stress perceptions independent of life stress severity increased the risk of developing a cold, underscoring the biological link between psychosocial factors and health.

Evidence of psychosocial modifiers of immunocompetence in a student sample was investigated by Kiecolt-Glaser and colleagues (1984). Blood drawn from 75 first-year medical students (49 males, 26 females; $M_{age} = 23$ years), initially drawn one month before final examinations and the second on the day before exams, showed that natural killer cell activity, which is hallmarked as antitumor and antiviral, significantly decreased between the two times ($F(1,68) = 9.87$, $p < .003$). Furthermore, high scores on stressful life events ($F(1,68) = 8.19$, $p < .006$) and loneliness ($F(1,68) = 5.48$, $p < .02$) had lower NK activity. Finally, total plasma IgA, a marker of humoral immunity, increased significantly between time points ($F(1,42) = 6.05$, $p < .02$). This study indicates that higher education related stress, such as exams, along with perceived stress and loneliness can weaken natural killer cell responses and trigger humoral immune activity in the absence of a pathogen.

Hawkley and colleagues (2006) elucidated physiological and endocrinological correlates of loneliness. Specifically, cardiovascular activity, including blood pressure and pulse, were recorded in 229 adults (47.6% male, 52.4% female; $M_{age} = 57.5$ years, $SD = 4.4$) along with urinary catecholamines and hormones. Participants completed the Revised UCLA Loneliness Scale (Russell, 1996), the 20-item Center for Epidemiologic Studies – Depression Scale (CES-D; Radloff, 1977), the Perceived Stress Scale (PSS; Cohen et al., 1983), the Interpersonal Support Evaluation List (ISEL; Cohen & Hoberman, 1983; Cohen, Mermelstein, Kamarck, & Hoberman, 1984), and the Cook-Medley Hostility Scale (CMHo; Cook & Medley, 1954). Correlations between psychosocial predictor variables and physiological measures found significant positive associations between loneliness and systolic blood pressure ($r = .19$, $p < .01$) and urinary epinephrine ($r = .17$, $p < .05$). Depressive symptoms significantly correlated with systolic blood pressure ($r = .15$, $p < .05$), urinary epinephrine ($r = .18$, $p < .05$), and urinary norepinepherine ($r = .13$, $p < .10$). Perceived stress was positively and significantly related to systolic blood pressure ($r = .20$, $p < .01$) and urinary epinephrine ($r = .18$, $p < .05$). Hostility correlated positively with systolic blood pressure ($r = .23$, $p < .01$), urinary epinephrine ($r = .15$, $p < .05$), and urinary norepinepherine ($r = .15$, $p < .05$). No significant correlations were found between any of the physiological measures and social support (Hawkley et al., 2006). Overall, loneliness had the strongest and most abundant correlations to physiological measures; the positive correlations between epinephrine/norepinephrine and loneliness, depression, perceived stress, and hostility indicate that higher levels of these negative psychosocial measures were related to greater HPA axis activation and higher levels of catecholamines.

The immune response to influenza vaccination in relationship to loneliness and social network size was examined by Pressman and colleagues (2005) in a sample of 83 healthy, first-year university students (37 men, 46 women) who completed the UCLA Loneliness Scale (Russell, 1996) and provided two blood samples after vaccination. A poor antibody response was related to greater loneliness (1 month: $\Delta R^2 = .04$, $F(1,72) = 4.79$, $p < .05$; 4 months: $\Delta R^2 = .04$, $F(1,71) = 5.04$, $p < .05$) and smaller network size (1 month: ($\Delta R^2 = .07$, $F(2,71) = 4.91$, $p < .05$; 4 months: $\Delta R^2 = .08$, $F(2,70) = 5.35$, $p < .01$). Loneliness was associated with greater psychological stress ($r = .31$) and negative affect ($r = .74$), less positive affect ($r = -.31$; all $p < .01$). Stress was found to reduce the relationship between loneliness and the antibody response when loneliness was added as a second step in a regression (1 month: $\Delta R^2 = .02$, $F(1,71) = 2.80$, $p < .10$; 4 months: $\Delta R^2 = .02$, $F(1,70) = 3.07$, $p = .08$); health behaviours did not mediate or moderate the relationship between loneliness and antibody response. This study demonstrates that loneliness and stress can alter immune functioning; psychosocial factors can change the immune response.

Hawkley and Cacioppo (2003) review potential paths between loneliness and disease. The review specifically focuses on loneliness, or perceived social isolation; the perception of social isolation comprises the dominant factor underlying the UCLA loneliness scale (Russell, Peplau, & Cutrona, 1980). In that disease is linked to loneliness, Hawkley and Cacioppo propose two pathways that appear to most effectively explain this link: differential stress reactivity and ineffective physiological repair and maintenance. Differential reactivity to stress suggests that lonely individuals are more likely to perceive daily events as stressful when compared to those who are not lonely. Differential cardiovascular activation in response to stress was found by Cacioppo and colleagues (2002) in 99 participants (45 men, 44 women; $M_{age} = 19.26$ years, $SE = 0.12$) who provided self-reported loneliness scores (UCLA; Russell et al., 1980) whereby lonely individuals had smaller cardiac responses than non-lonely participants. Interestingly, a second study of 6 men and 19 women ($M_{age} = 65$ years, $SE = 1.4$) found that participants with higher loneliness had greater peripheral resistance and lower cardiac output which impact chronic cardiovascular functioning (Cacioppo et al., 2002). Another link between loneliness and disease may be due to alterations in physiological maintenance and repair. Organisms can normally maintain and heal themselves unless a physiological disturbance to the organism is consistent and can thereby affect physiological functioning. For example, Marucha, Kiecolt-Glaser, and Favagehi (1998) created punch biopsy wounds in the hard palate of 11 dental students (9 males, 2 females; M_{age} 24.36 years, SE = 1.11), once during summer vacation and again three days prior to the first examination of the year. Wound size was found to be significantly smaller during vacation time than exam time over the first 5 days after wound placement ($F(1,10) = 67.65$, $p < .001$); vacation time healing was shorter (7.82 days $\pm$ 0.62) than during exams (10.91 days $\pm$ 0.69; $F(1,10) = 28.47$, $p < .001$). The pro-inflammatory cytokine IL-1β is beneficial in higher quantities during infection in that it can recruit additional cytokines and produce energy to help fight infection; mean IL-1β concentrations were higher during the summer (2.43 $\pm$ 0.30) than during exams (0.70 $\pm$ 0.10; $F(1,8) = 38.19$, $p < .001$) (Marucha et al., 1998). In summary, this evidence supports Hawkley and Cacioppo's assertion that psychosocial factors can affect physiological repair; loneliness serves as a potent factor that can lead to ill health through differential stress responses and imbalances in repair and maintenance of normal physiological functioning.

Health behaviours, specifically exercise, may moderate the physiological responses to psychosocial stress. Rimmele and colleagues (2007) compared 22 elite sportsmen (M_{age} = 21.50 years, SD = 2.35) and 22 healthy untrained men (M_{age} = 21.84

years, SD = 2.24) to the Trier Social Stress Test; salivary free cortisol levels, heart rate, mood, calmness, and anxiety were repeatedly measured before and after exposure to stressors. The Perceived Stress Scale (PSS; Cohen et al., 1983), the State-Trait Anxiety Inventory (STAI; Spielberger et al., 1970), and the Inventory on Competence and Control Beliefs (ICCB; Krampen, 1991) to measure self-efficacy were administered to all participants. Trained men had lower trait anxiety scores (32.19 $\pm$ 7.30) than did untrained men (36.45 $\pm$ 6.44, $p = .055$); trained men also had higher self-efficacy scores (71.24 $\pm$ 8.48) than did untrained men (62.90 $\pm$ 8.97, $p = .004$). Cortisol levels and heart rate significantly increased for both sets of participants (cortisol: $F(1,39) = 5.47$, $p < .05$; heart rate: $F(1,37) = 7.27$, $p < .05$); baseline averages were not significantly different. Taken together, athletes had lower cortisol and heart rate responses to the stressor and reported significantly higher calmness and better mood than did untrained men (Rimmele et al., 2007). Overall, elite sportsmen showed less reactivity to the psychosocial stressor as indicated by lower adrenocortical, autonomic, and psychological stress responses therefore suggesting that physical activity may protect against stress-related disorders.

5.8 Conclusions

Chapter 5 has covered the biological correlates of personality and psychosocial factors in relationship to health; examining personality dynamics in a biological context may elucidate mechanisms underpinning trait change and stability. Incorporating objectively measured health outcomes can signal the types of processes that occur in tandem with subjectively reported traits and psychosocial factors. Ultimately, simultaneous measurement of subjective traits with objective health can lead to a better understanding of the biological correlates of personality and psychosocial factors. For example, we have seen that higher Neuroticism can be deleterious to health, particularly in terms of cardiovascular health. This chapter has also explained that the HPA axis serves as a major effector of the altered immune response whereby stressors activate the HPA axis which, in turn, downregulates Th1 or cell-mediated immunity and thereby allows Th2 or humoral immunity to progress unchecked. Aside from self-reported measures of health that can outwardly measure this imbalance, objective measures of humoral immunity such as salivary sIgA would be indicative of HPA axis activation. The present study will implement both subjective and objective measures of biological markers of immune functioning and stress in relationship to personality and psychosocial variable measurements over time. Incorporating this measurement along with subjective measures of personality and psychosocial factors can lead to a better understanding of how the dynamics of these two human characteristics over time are linked to biological processes involved in stress, immunity, and health outcomes.

Chapter 6 - Methods

The present chapter will review the aims of the present study (Section 6.1), highlight its hypotheses (Section 6.2), present the study design (Section 6.3), detail the measures (Section 6.4), and then explain the procedure (Section 6.5).

6.1 Aims

The introduction to this study has covered personality trait dynamics over time (Chapter 1), trait dynamics in university students (Chapter 2), general psychosocial correlates of personality (Chapter 3), university-specific psychosocial correlates of personality (Chapter 4), and the biological mechanisms of stress and immune functioning in relationship to both personality traits and psychosocial factors (Chapter 5). There still remain gaps in the literature in understanding the relationship between these variables. In unifying these themes, the present study will seek to understand how stress and immune functioning are related to personality and psychosocial factor dynamics over multiple assessments during the first year of university in undergraduate students aged 18-21.

6.1.1 Outstanding Questions

First, the literature is spare in regards to studies that nomothetically and longitudinally measure personality traits at more than two time points in first-year university students. This population serves as a salient group to examine personality dynamics over time. The present study will assess personality at four time points over the course of the first-year of university. Four measurements will allow for the examination of trait change and stability over time. This will lead to a better understanding of their dynamics and how change or stability occur.

Second, past research has yet to longitudinally measure psychosocial factors in relation to personality trait dynamics over time in first-year university students. The literature provides evidence for psychosocial correlates to personality including those environmental factors specific to the university but lacks a longitudinal aspect. The present study will attempt to connect psychosocial and personality trait dynamics over time; this will determine correlates of change rather than relationships at a single time point.

Third, the relationships between personality and psychosocial factors have individually been linked to stress and immune responses, but these mechanisms have yet to be measured over time. Again, measuring these objective and subjective constructs over time can lead to a better understanding of how personality and psychosocial factors impact health through immune system functioning. The present study will repeatedly measure biological markers of immune functioning as an indicator of stress over time.

Taken together, the literature does not have a study that concurrently measures personality traits, psychosocial factors (both general and university-specific), and immune markers of stress activation in new university students at four assessments over the course of a year. In doing so, the study has the potential to widen the understanding of the personality and psychosocial dynamics that occur during the first year of university and elucidate the biological mechanisms, namely immune functioning, that can lend further support linking health and traits.

6.2 Hypotheses

In unifying those concepts outlined in the previous three sections (personality, psychosocial factors, and immune functioning as a marker of stress activation), the present study seeks to concurrently measure these three variables in a sample of new university students. By measuring personality, general and university-specific psychosocial factors, and salivary sIgA as a marker of stress activation along the HPA axis in new university students, this study aims to better understand how these processes dynamically operate in tandem in the context of the impact of entering the higher education environment.

Personality was hypothesized to exhibit some mean-level change, less rank-order stability, and a higher degree of individual-level change in line with previous work that distinguishes university students from the general population. Psychosocial factors were hypothesized to be more labile and show greater change over the first year of university. In line with previous findings, participants with higher Conscientiousness, higher Openness, and lower Neuroticism should predict better academic outcomes and that the variance in slopes and intercepts over time in these traits should be associated with exam marks.

Salivary sIgA was hypothesized to be lowered at times of higher stress, such as at the beginning of the academic year and at exam time. Furthermore, higher Neuroticism should specifically relate to poorer mucosal immunity. Trends in psychosocial factors should be related to changes in mucosal immunity as revealed by growth curve modeling whereby increasing scores on negative factors (negative affect, general mental health, perceived stress, loneliness) would predict a trend toward lower salivary sIgA while increases in those positive factors (self-esteem, life satisfaction, interaction with students and professors, positive affect) would be associated with sIgA trends conferring better innate immunity.

6.3 Study Design

To understand personality trait and psychosocial factor dynamics in relation to salivary markers of immune functioning and stress as an indicator of health, a longitudinal study was conducted over the course of an academic year from September 2005 to October 2006. The study was repeated in the following year (September 2006 to October 2007) with identical questionnaires but did not include the immunological measures. For both studies, participants were assessed at four time points over an academic year: the first phase took place within six weeks from the start of the first semester, the second phase was within seven weeks of the start of the second semester, the third was within the last three weeks of the second semester, and the fourth assessment took place within 6 weeks of the start of the first semester of the students' second year. The number of days that had elapsed from the start of the semester was recorded at each assessment for each participant.

The first study comprised 68 first-year students (27 males, $M_{age} = 18.94$ years, $SD = 0.15$; 41 females, $M_{age} = 18.85$ years, $SD = 0.11$); this sample also visited the lab to provide a saliva sample. During the subsequent academic year, 187 first-year students participated (62 males, $M_{age} = 18.75$ years, $SD = 0.67$; 125 females, $M_{age} = 18.73$ years, $SD = 0.64$) and completed the questionnaire entirely online.

6.3.1 Ethical Approval

The study was granted ethical approval by the Department of Psychology at the University of Edinburgh and by the Lothian Local Research Ethics Committee of the NHS (REC reference number 05/S1104/38).

6.3.2 Participants

For both studies, to limit age confounds, participants were required to be between the ages of 18 and 21 on recruitment. Additionally, in that the experience of starting university may influence personality trends (Farsides & Woodfield, 2003), all participants must not have previously attended a higher education institution.

Additional participant exclusion factors were considered due to the salivary hormone assay in the first study. Although salivary measurements provide an easy, non-invasive method to determine steroid hormones (Riad-Fahmy, 1983), there are limitations and considerations. The HPA axis does not operate in isolation; other hormones are triggered during this cascade which signals to various other structures. For example, the hypothalamus also releases gonadotropin releasing hormone which stimulates the hypothalamus to release follicle stimulating hormone; this then triggers the follicle in the ovary to produce estrogen. Increased levels of estrogen negatively feedback to the hypothalamus to decrease the release of gonadotropin releasing hormone and would therefore affect HPA axis functioning (Carlson, 2001). Therefore, female participants who were taking oral contraceptives were excluded from the study. Furthermore, female participants were asked to note their menstrual cycles on a calendar at each assessment.

6.3.3 Recruitment

For both studies, first-year undergraduate students across all disciplines from the University of Edinburgh were recruited. Recruitment was performed through five means: mass emails, paper flyers, word-of-mouth, posting information on the investigator's web page, and posting on the University of Edinburgh's online job message board for students.

6.3.3.1 Mass Email

Email lists of first-year students were obtained from individual departments along with directory lists available within the University. Initial emails asked for participants meeting the above requirements and gave an overview of the study. Potential participants were invited to email for further details and to determine if they were eligible for the study (See Appendix C).

6.3.3.2 Flyers

Approximately 50 paper flyers were posted at various locations at the University of Edinburgh. The flyers provided a brief overview of the study; detachable paper strips providing email contact details were attached to each flyer (See Appendix D).

6.3.3.3 Word-of-Mouth

Investigators informed colleagues to contact the investigators if they knew of any potential participants who would be interested in the study. Furthermore, participants who completed the study were given the investigator's contact details if they knew of any potential participants.

6.3.3.4 Web Page Posting

Details of the study were published on the investigator's web page. The information posted was similar to the information in the mass email. Potential participants were instructed to contact the investigator for further information.

6.3.3.5 SAGE

Student and Graduate Employment (SAGE) is a live database of jobs supplied by the Career Services Office at the University of Edinburgh. The database is searchable only to students at the University of Edinburgh. A description of the study was posted on the database with the above requirements; students were asked to contact the investigators via email (See Appendix E).

6.3.3.6 Information Verification

For all means of recruitment, participants were asked to provide matriculation numbers in an email in order to receive further information. Upon receipt of an initial request for further information, the investigators verified the age and the absence of any previous higher education experience. If a participant met the requirements, the investigator sent an email that provided full details of the study along with the requirements of the study with the first study having additional selection criteria due to the salivary marker assay (See Appendix F).

Specifically, potential participants in the first study had to be comfortable with the procedure of coming to the lab to provide a timed saliva sample.

Furthermore, females were required to indicate on a calendar the dates of their menstrual cycle to control for this variable during the salivary assays. For both studies, participants were instructed that the study was a longitudinal study that required four assessments over a year-long period. The email also detailed a compensation scheme and a prize draw for participants completing all stages of the study. Participants who met the selection criteria and were interested in participating in all phases of the study were instructed to send an email back to the investigator to schedule a time to attend the lab session for the first study whereas those interested in the second study were emailed a link to the questionnaire.

6.4 Measures

The questionnaires contained several sections that assessed personality, psychosocial factors, and demographic variables (see Appendix G).

6.4.1 Personality

For the first study, personality was measured using the 60-item NEO-FFI Form S (Costa & McCrae, 1994) measuring Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness. The NEO-FFI has 12 items per trait. Participants responded to each statement by indicating agreement or disagreement on a five-point Likert-type scale; certain items were reversed keyed. The NEO-FFI was scored by giving *T*-scores for each of the five traits; there are different raw scores conversions to *T*-scores for males and females.

The 60-item NEO-FFI Form S was used rather than the longer NEO-PI-R in the interest of brevity. Furthermore, the NEO-FFI Form S reflects correlations of .88-

.94 with the NEO-PI-R (Costa & McCrae, 1994). The NEO-FFI has been found to be valid in numerous studies (McCrae & Costa, 1987; Detrick, Chibnall, & Luebbert, 2004). Internal test reliability was reported by Viswesvaran and Ones (2000); a meta-analysis of 1,359 internal consistency reliabilities were found to be 0.78 for Neuroticism (SD = 0.11, n = 370), 0.78 for Extraversion (SD = 0.09, n = 307), 0.73 for Openness (SD = 0.12, n = 251), 0.75 for Agreeableness (SD = 0.11, n = 123), and 0.78 for Conscientiousness (SD = 0.10, n = 307).

In the second study, personality was measured using the 100-item Big Five Factor Markers from the International Personality Item Pool (IPIP; Goldberg, 1999). Each trait was comprised of a scale of 20 items which correlated highly with the domains on the NEO-PI-R (Neuroticism: α = .91; Extraversion: α = .91; Openness: α = .89; Agreeableness: α = .85; Conscientiousness: α = .90). The IPIP correlates highly with the Big Five traits (Goldberg et al., 1999): Neuroticism, .86; Extraversion, .79; Openness, .83; Agreeableness, .78; and Conscientiousness, .80.

6.4.2 Loneliness

The UCLA Loneliness Scale, Version 3 (Russell, 1996), measured subjective feelings of students' loneliness or social isolation. The scale has 20 statements with eight items that are reverse-keyed. Participants indicated how often they felt the way described in the statement, with responses ranging from "Never" to "Always". Scores range from 20 to 80 by summing the responses with values from 1 to 4.

Amassing data from four samples representing 1387 participants, reliability was found to range from .89 to .94 (Russell, 1996). Convergent validity was found via high correlations with other measures of loneliness from the NYU Loneliness Scale (Rubenstein & Shaver, 1982) (r = .65) and the Differential Loneliness Scale (Schmidt & Sermat, 1983) (r = .72); loneliness scores were also negatively correlated with social support (Social Provisions Scale, Curtona & Russell, 1987) (range: r = -.39 to -.68). Further construct validity was found through correlations to Neuroticism (r = .49) and Introversion-Extraversion (r = -.40) (Russell, 1996). Discriminant validity of the loneliness measures was achieved using confirmatory factor analyses that indicated that the measures of loneliness and social support were distinct factors that related differently to the mood and personality measures; the UCLA Loneliness Scale scores were negatively correlated to self-esteem (r = -.60) and positively correlated to depression (r = .52). Additionally, there was a low but significant negative correlation between social desirability and loneliness (r = -.21) (Russell, 1996). High construct validity to burnout (Maslach Burnout Inventory; Maslach & Jackson, 1981) was also reported (r = .45, $p < .001$) (Russell, 1996). The UCLA Loneliness Scale, Version 3, provides an accurate and reliable measure of loneliness and is one of the most extensively used inventories to measure this construct.

6.4.3 Self-Esteem

The Rosenberg Self-Esteem Scale (RSE) (Rosenberg, 1989) was employed to measure participants' self-esteem, which is defined as a positive or negative orientation toward oneself or an overall evaluation of one's worth or value. The RSE has 10 items, 5 of which are reverse keyed. Participants respond to statements regarding self-worth on a four point scale ranging from "Strongly Agree" to

"Strongly Disagree". Responses are coded from 0-3 and are summed together, giving the scale a range from 0 to 30.

The RSE's face validity was examined by examining self-esteem scores in relationship to other data that theoretically measures the same constructs. Of 2695 patients, self-reported self-esteem scores inversely related to depressive ratings; 88% of participants rated as not depressed had the highest self-esteem scores while 80% of those ranked as highly depressed scored the lowest possible self-esteem scores (Rosenberg, 1989). As a control measure, 50 healthy volunteers who were rated on depressive affect by nurses were found to have similar relationships whereby 91% participants rated as "not gloomy" and 87% as rated "not frequently disappointed" had the highest self-reported self-esteem scores (Rosenberg, 1989).

A study by Tippett and Silber (1965) administered the Rosenberg Self-Esteem Scale to 44 late adolescents to establish test-retest reliability (methods detailed in Silber & Tippett, 1965). Over a two-week span, test-retest reliability was found to be .53 ($p < .05$) (Tippett & Silber, 1965a). Cronbach's alpha has been reported to be between .77 and .88 (Rosenberg, 1989). The test-retest reliability was acceptable and reported to be .85 in Silber and Tippett's (1965) study on late adolescents.

6.4.4 Life Experiences

To assess the frequency and impact of life experiences, the Life Experiences Survey is a 57-item self-report measure developed by Sarason, Johnson, and Siegel (1978) that separately assesses positive and negative life experiences along with individualized ratings of the impact of events. Additionally, it asks when these events occurred which can generate trends in the frequency and intensity of the experience when administered longitudinally. Specifically, participants indicate events having occurred 0 to 6 months ago or 7 months to 1 year ago. Furthermore, the Life Experiences survey has two sections: Section 1 (47 items) inquires about life changes that are common to individuals in a wide variety of situations. Section 2 (10 items) deals specifically with changes experienced in the academic environment. Ratings of the impact of events are on a 7-point scale ranging from extremely negative (-3), moderately negative (-2), somewhat negative (-1), no impact (0), to slightly positive (+1), moderately positive (+2), and extremely positive (+3). Summing the impact ratings of those events designed as positive by the subjects provides a positive change score. A negative change score is derived by summing the impact ratings of those events considered negative. By adding these two values, a total change score can be obtained. Sarason and colleagues (1978) reported a test-retest correlation of .63 and .64 (both $p < .001$) in two separate samples of university students assessed 5 to 6 weeks apart. Furthermore, construct validity was confirmed through the correlation between the Life Experiences Survey and state (.46) and trait (.40, both $p < .001$) anxiety in 76 US Navy personnel (Sarason et al., 1978).

6.4.5 General Health

The General Health Questionnaire-12 (GHQ-12; Goldberg, 1992) detects cases and degrees of non-psychotic psychiatric disorders. The GHQ-12 is a 12-item shortened version of the 60-item full version, but is equally valid and reliable in that the items load heavily in the factor analysis of the full version and avoid identifying symptoms of physical illness. Each question asks the participant if he or she has experienced a particular symptom or item of behaviour recently using a four-point scale: "Less than usual," "No more than usual," "Rather more than usual," or "Much more than usual." The GHQ-12 was scored as a Likert scale from 0-3, giving a range from 0 to 36 and avoiding a skewed distribution of scores (Goldberg, 1978).

Internal consistency was high with Cronbach's alpha ranging from .82 to .90 (Goldberg & Williams, 1988). The split-half reliability was .83 and test-retest reliability was .73. Validity has been evaluated by assessing its sensitivity in detected cases of psychiatric disorder; sensitivity was found to be 93.5% and specificity in detecting cases of disorder only was 78.5% in the GHQ-60 (Goldberg, 1992; Goldberg & Williams, 1988).

The reliability of the GHQ-12 was reported by Pevalin (2000) from a sample of 4749 participants assessed seven times over six years as part of the British Household Panel Survey. Over the course of the seven assessments, there were no significant differences found for the mean GHQ-12 scores for either males (range: 10.01 to 10.38) or females (range: 11.07 to 11.98) (Pevalin, 2000).

6.4.6 Perceived Stress

The Perceived Stress Scale (PSS) is an inventory designed to determine the degree to which situations in one's life are appraised as stressful (Cohen, Kamarck, & Mermelstein, 1983). The scale has 14 items requiring subjective appraisals of events occurring within a one-month time frame. Participants respond to how often the event occurred: "Never," "Almost Never," "Sometimes," "Fairly Often," or

"Very Often." Items are scored from 0 to 4, with seven items reverse keyed. Scores range from 0 to 56; higher scores indicate more perceived stress.

Cohen and colleagues (1983) administered the PSS to three samples to determine reliability and validity. The first sample was 332 (121 male, 209 female, 2 non-responders; M_{age} = 19.07 years, SD = 2.75) freshman university students. The second sample consisted of 114 college students (53 females, 60 males, 1 not specified; M_{age} = 20.75 years, SD = 4.41). In addition to the PSS, these two samples completed the College Student Life-Event Scale (CSLES; Levine & Perknis, 1980), the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977), the Cohen-Hoberman Inventory of Physical Symptoms (CHIPS; Cohen & Hoberman, 1983), and the Social Avoidance and Distress Scale (SADS; Watson & Friend, 1969). The third sample were 27 males and 37 females enrolled in a smoking cessation program (M_{age} = 38.4 years, SD = 11.57); participants completed the PSS along with a life-event scale with items taken from the Unpleasant Events Schedule (Lewinsohn & Talkington, 1979) and the CHIPS. Coefficient alpha reliability for the PSS was .84, .85, and .86 for the three samples, respectively (Cohen et al., 1983). The second college sample and the smoking cessation sample provided test-retest reliability; the college sample was retested after two days whereas the smoking cessation sample was retested after six weeks. The college sample provided a test-retest correlation of .85 while the smoking cessation sample had a correlation of .55 (Cohen et al., 1983). Age was found to be unrelated to PSS scores, thereby giving evidence for measurement invariance (Cohen et al., 1983).

Concurrent validity was found in all three samples, with significant correlations between life-event scores and the PSS; correlations were .35, .24, and .49 for the three samples, respectively ($p < .01$) (Cohen et al, 1983). Predictive validity was confirmed with the PSS in that it had higher correlations to future physical symptomatology (.52 to .70) than life event measures (Cohen et al, 1983). Additionally, the PSS correlated with indices of depressive symptomatology (.76 and .65, respectively) in the two college sample ($p < .001$) (Cohen et al., 1983).

6.4.7 Life Satisfaction

One factor of general subjective well-being is life satisfaction. The Satisfaction with Life Scale (SWLS) is a 5-item inventory that measures life satisfaction or a cognitive judgement of one's life. Developed by Diener, Emmons, Larsen, and Griffin (1985), participants indicate their level of agreement or disagreement on a 7-point Likert-type scale, ranging from "Strongly Disagree" to "Strongly Agree" to statements concerning life satisfaction such as "The conditions of my life are excellent". The scores range from 7 to 35 with higher scores reflecting higher satisfaction with life.

Diener et al. (1985) examined the psychometric properties of the SWLS using a sample of 176 undergraduates from the University of Illinois. The two month test-retest correlation coefficient was .82 and coefficient alpha was .87 (Diener et al., 1985). The validity of the SWLS was determined employing a second sample of 163 undergraduates who completed a variety of subjective well-being measures, personality questionnaires, a symptom checklist, and the Marlowe Crowne (Crowne

& Marlow, 1964) scale of social desirability (Diener et al., 1985). In that there was no significant correlation with the Marlowe-Crowne scale of social desirability, the SWLS does not evoke a socially desired response pattern. In that other measures of subjective well-being correlated significantly in both samples with correlation coefficients between .32 and .75 at the 5% significance level, high construct validity was found for the SWLS (Diener et al., 1985). To expand the investigation of the psychometric properties of the SWLS, 53 elderly participants (21 males, 32 females, Mage = 75.0) were administered the SWLS and the Life Satisfaction Index (LSI; Adams, 1969); participants were also interviewed by a pair of trained interviewers who inquired about activity levels and self-directed learning and rated the participants on global life satisfaction. Inter-interviewer rating on global satisfaction was found to be positively correlated (.73, $p < .05$); summed interviewer ratings correlated .43 with the SWLS. The LSI correlated .46 to the SWLS (Diener et al., 1985). Overall, the SWLS demonstrates a high level of internal consistency.

6.4.8 Cognitive Quality of University Life

To specifically examine the quality of life at university, Clifton and colleagues (1995) designed the Quality of Life of University Students Scale to determine the degree to which students are integrated into the university. The 17-item scale begins with the phrase "At the University of Edinburgh, I have been challenged to…". Participants indicated agreement with each statement on a 5-point Likert-type scale ranging from "Strongly Agree" to "Strongly Disagree". Each item was scored from 1 to 5, where a higher score indicated a higher cognitive quality of life with scores ranging from 17 to 75. The Cognitive Domain is comprised of a Structural component ("At the University of Edinburgh, I have been challenged to apply theories to new situations") that represents less complex cognitive skills; the Functional component ("At the University of Edinburgh, I have been challenged to recall a significant number of facts.") taps into the more complex cognitive skills. Reliability of the finalized 17 items of the scale found a Cronbach's alpha of .85 for the Functional dimension and .88 for the Structural dimension (Clifton et al., 1995).

6.4.9 Affective Quality of University Life

To assess affective quality of university life, the 31-item Affective Domain of the Quality of Life of University Students Scale (Roberts & Clifton, 1992) was administered. It requires participants to rate their level of agreement on a 5-point Likert-type scale, ranging from "Strongly Agree" to "Strongly Disagree". Roberts and Clifton (1992) assert that the literature suggests a higher education environment that is "intellectually challenging for students while simultaneously preserving their personal integrity and dignity" (Roberts & Clifton, 1992, p.115). The scale measures the affective quality of life along four dimensions: Positive Affect (13 items), Interaction with Students (5 items), Interaction with Professors (9 items), and Negative Affect (4 items). Each response was assigned points from 1 to 5; scores range from 31 to 155. A higher score indicates a higher affective quality of life rating.

The psychometric properties of the scale were determined using a sample of 526 graduate and undergraduate students; construct validity was found to be high with external variables (Positive Affect: .52; Negative Affect: .66; Interaction with

Students: .62; Interaction with Professors: .57). Cronbach's alpha was found to be .93 for Positive Affect, .75 for Interaction with Students, .90 for Interaction with Professors, and .79 for Negative Affect.

6.4.10 Health Behaviours

Health behaviour questions were also included in the questionnaire battery. These measurements were recorded as potential covariates. Health behaviours may influence the salivary hormone assay and are also associated with personality.

6.4.10.1 Smoking

Smoking behaviour was assessed through five questions by asking participants about 1) the number of cigarettes they smoked per day and 2) for how many years they have been a smoker. Additionally, participants were asked 3) if they previously smoked; if so, they were asked 4) for how many years they were a smoker and 5) how many cigarettes did they smoke per day.

6.4.10.2 Alcohol Consumption

Drinking behaviour was assessed through one question by asking participants the average number of alcoholic beverages they consumed per week. Excessive alcohol consumption may influence salivary hormone assays in the first study; in a study by Kokavec and Crowe (2001), seven males were found to have lower salivary cortisol three hours after consuming four units of alcohol.

6.4.10.3 Health/ Illnesses

Participants were asked about the number and severity of illnesses they experience in the past three months. Specifically, participants had to list those illnesses that as requiring hospitalization, those that warranted work or school to be missed, and mild illnesses that still permitted attendance at work or school.

6.4.10.4 Medications

Participants were asked by a single item to list any medications they were taking. Certain medications may confound the salivary hormone assays, particularly those that may impact the HPA axis; this would include any medication that contains hormones. In a university student sample, the most common medication containing steroid hormones are asthma inhalers.

6.4.10.5 Diet

Participants were asked to provide the number of fruit and vegetable servings they consumer per week in two separate questions. Servings were defined as one piece of fruit or a vegetable or approximately ½ cup of food. Furthermore, participants recorded the number of takeaways, candy bars, and bags of crisps that were consumed within one week.

6.4.10.6 Weekly Exercise

Asking participants about their weekly exercise served not only to provide a measure of general activity, but to also account for a potential confound in the salivary markers assay. For example, Chatard and colleagues (2002) found a relationship between salivary cortisol and distance swam in nine elite swimmers who swum an average of 50 km per week. Additionally, there are links between personality and physical activity. In de Bruijn and colleagues (2005) found positive correlations between sports-related physical activity and Extraversion in 980 Dutch adolescents ($r = .105$, $p < .001$). Physical activity was measured through the following question: "How many times do you exercise for at least 20 minutes per week? Exercise includes anything from 20 minutes in the gym to walking to and from university for 20 minutes."

6.4.10.7 Menstrual Cycle

To ensure that the phase of the female's menstrual cycle did not confound analyses for participants in the first study, all females were given a calendar approximately reflecting the past three months. Female participants were instructed to mark with an X those days that they were menstruating. To minimize discomfort, participants were instructed to put their completed calendars in an envelope to be confidentially recorded later.

6.4.11 Demographic Questions

Participants were asked the following demographic questions in addition to their gender and birthdays for identity verification and to test for age cohort effects.

6.4.12 Socioeconomic Status

Socioeconomic status was determined by asking participants to provide work details of each of their heads of household. Participants indicated each head of household's job title and number of hours worked per week. Job titles were then classed to determine the family's socioeconomic status.

6.4.13 Ethnicity

Ethnicity was determined through three questions by asking participants the country they were raised in, the country that they identify with, and the race that they would identify themselves as a part of. There is evidence for racial differences in HPA-axis activity. Recently, Chong and colleagues (2008) examined HPA-axis activity in 98 participants (79 White: 55 males, 24 females; Mage = 22.3 years, SD = 3.03; 19 Black: 7 males, 12 females; Mage = 21.0 years, SD = 2.8). White participants had a 36% greater relative mean cortisol response than blacks (95% CI: 10 – 67%, p = 0.004) and there was a higher HPA-axis response to the Trier Social Stress Test in Whites than in Blacks (Chong et al., 2008).

6.4.14 Academic Performance Outcomes

First-year grades from the end of the first academic year were obtained from the University of Edinburgh Registry for all participants in both studies. Exam marks were averaged in the analyses.

6.5 Procedure

6.5.1 Study 1 (n = 68)

6.5.1.1 Instructions Given to Participants Prior to Lab Visit

Participants were given instructions to limit potential confounds of the salivary hormone assay. In that the HPA-axis is sensitive to excessive alcohol consumption (Kokavec & Crowe, 2001), participants were instructed to avoid having more than one unit of alcohol 24 hours prior to their lab visit. Furthermore, food debris in the mouth or blood contamination due to teeth brushing may confound salivary assay results. Participants were therefore instructed to not eat nor brush their teeth prior to their lab visit.

6.5.1.2 Lab Visit Procedure

At the first phase, participants first completed a consent form upon arrival to the lab. The investigators then assigned an identification number to the participant after completion of the consent form; the completed consent forms were kept securely locked in the lab and the database which connected a participant with his or her identification number was kept securely encrypted on a computer. Participants were then asked if they had any questions before beginning and were told they could withdraw at any point from the study.

For the first two phases, each participant was allowed a private room to complete their questionnaire. Before starting the questionnaire, participants were instructed to rinse their mouths out with bottled water to facilitate the saliva collection after completing the questionnaires. Upon completion of all paper questionnaires, participants notified the investigators who collected the questionnaires and then provided instructions on giving a saliva sample.

For the third and fourth time points of the first study, the entire questionnaire was published on the internet. Participants were emailed invitations to complete the web-based surveys with the same questions as the previous administrations at their convenience; upon completion of the web questionnaire, the investigators received notification of who had finished the inventory. The investigators then emailed the participants to schedule a lab visit time.

6.5.1.3 Saliva Collection

At all phases of the study prior to providing the saliva samples, participants were asked if they met all of the requirements necessary for providing the saliva sample, namely, that they did not eat one hour prior to coming to the lab, that they did not brush their teeth two hours prior to the visit, that they did not consume excessive alcohol within the past 24 hours, and that they did not consume excessive amounts of caffeine 2 hours earlier. If the participant did not meet these requirements, they were asked to return at a later time.

Participants were instructed to provide a saliva sample using a passive drool technique (Hucklebridge, Mellins, Evans, & Clow, 2002). Each participant was given three 65mL vials numbered 1 to 3; participants were told to uncap the vials before starting. Just before providing saliva samples, participants again rinsed their mouths out with bottled water. Participants were also given a countdown timer and were instructed how to use it. When the participant was ready, he or she was told to start the countdown timer while reading through cooking magazines; the literature was provided to encourage salivation and to avoid any confounds originating from a stimulant that is masticated. Participants were told to passively allow saliva to collect in the bottom of their mouths and to spit out the contents of their mouth into the corresponding vial; i.e., after the first minute, saliva was to be spit into the vial marked 1. Participants were told not to try to draw out their saliva nor to move their heads, mouths, or jaws other than when spitting out their saliva in that unnecessary movement of the head can stimulate salivation. Furthermore, participants were told that only 100μL of saliva (0.1mL) were needed for the assay, so there was no pressure to fill the vial. After being asked if they had any questions, the investigator left the participant alone to start the saliva sampling and to signal for the investigator when he or she was finished. Saliva samples were labelled and placed in a freezer at -20°C. After providing the saliva samples, participants were reimbursed according to a scheme set forth earlier in the advertisement of the study; since the study was longitudinal, participants would receive increasing pay for each time point (£3 for the first visit, £4 for the second visit, and £5 for the third and fourth visits) and that successful completion of the entire study would qualify them for a prize draw at the end of the study.

6.5.1.4 Biological Marker Analyses

The biological measures examined the salivary hormones for stress and immune functioning. Specifically, salivary immunoglobulin-A (sIgA) was used as an indicator of immune system functioning due to HPA axis activation.

6.5.1.4.1 Rate of Release Calculations

In keeping with previous studies' procedures (Mackinnon & Hooper, 1994), the total amount of salivary sIgA that covers the mucosal surfaces was determined by determining the rate of release. This was achieved by determining the volume of saliva released and the absolute concentration of sIgA in the saliva.

The volumes of saliva collected at each of the three time points were measured by weighing each vial and subtracting the weight of the vial to obtain the final weight of the saliva; assuming a density of 1 g/ml, the volume of the saliva was calculated from the weight of the saliva.

6.5.1.4.2 Spectrophotometry

Spectrophotometry was used to determine salivary concentrations of sIgA. The enzyme-linked immunosorbant assay (ELISA) technique is the safest, cheapest, and most commonly used method for determining salivary antibody levels; samples were analyzed in duplicate to ensure reliability. As compared to a radiolabelled immunoassay (RIA), the ELISA is the cheaper method and does not require special handling of the reagents in that there are no radioactive solutions as in the RIA.

On the day of the assay, the samples and reagents were brought to room temperature and thawed until liquid. Samples were first vortexed and then centrifuged at 1500g (3000 rpm) for 15 minutes and saliva volumes were measured.

Samples were analyzed using a readily available kit: the ELISA Starter Accessory Package and the Human IgA ELISA Quantitation Kit from Bethyl Laboratories (Montgomery, Texas). A 96-well plate was coated with goat anti-human IgA-affinity purified capture antibodies (Bethyl Laboratories, Montgomery, Texas) by adding 1μl of antibody to 100μl of a coating buffer (0.05 M carbonate-bicarbonate solution, pH 9.6) in each well for one hour. After washing the wells in triplicate with a wash solution (50mM Tris, 0.14M NaCl, 0.05% Tween 20, pH 8.0), the spaces in the wells not covered by the capture antibody were blocked for 30 minutes using a solution of 50mM Tris, 0.14M NaCl, and 1% bovine serum albumin (pH 8.0). After another set of three washes, 100 μl of the standards and diluted samples were added to the plate; samples were diluted by a factor of 4000x in sample diluent (50mM Tris, 0.14M NaCl, 1% bovine serum albumin, 0.05% Tween 20, pH 8.0). After one hour of incubation, the plate was washed three times before adding 100μl of a 1:50,000 dilution of the horseradish peroxidise detection antibody (Goat anti-human IgA-HRP conjugate, Bethyl Laboratories, Montgomery, Texas). After a final series of three washes, 100μl of the tetramethylbenzene enzyme substrate solution was added to each well and allowed to incubate for 15 minutes before 100μl of 2M H_2SO_4 (Fisher Scientific, Loughborough, UK) was added to the plate.

The absorbance of each well was determined at 450nm with 400nm and 520nm as reference wavelengths using the VersaMax microplate reader (Molecular Devices, Sunnyvale, California). Concentration was determined by plotting the known standards' concentrations to their absorbances and determining a 4-parameter logistic curve-fit (SoftMax Pro 5.0.1 data reduction software (Molecular Devices, Sunnyvale, California). The equation of the best-fit curve was then used to calculate the unknown concentrations from their absorbances.

6.5.2 Study 2 (n = 187)

After replying to an initial email with their matriculation numbers for verification, participants were emailed a link to the questionnaire online. The first set of questions comprised the consent form; participants were required to place a check next to all of the statements on the consent form. Participants digitally "signed" the consent form by providing their birthdays and were then only able to access the actual questionnaire battery if they consented to each item on the consent form. All data from this second study was encrypted and password protected on a computer. Participants were informed that any questions would be addressed via email at any point during the study.

Participants were entered in a prize draw upon successful completion of each phase of the study with increasing numbers of prizes at each subsequent phase. Furthermore, participants that completed all four phases of the study qualified for a separate prize draw at the end of the study.

6.5.3 Data Analyses

For both studies, the means and standard deviations for each measured variable were calculated at each time point. Correlations were determined between personality traits, psychosocial factors, academic performance, and salivary sIgA release. Correlations for each variable between time points were also calculated.

In that the psychosocial variables may measure similar constructs, a principal components analysis was performed and potential factors were identified using parallel analysis. A parallel analysis confirms the number of factors using the number of observations and variables in the real data and creates random values from these characteristics; this randomly generated data is then factor analyzed to yield a list of eigenvalues (Horn, 1965). Eigenvalues from the randomly generated data are compared to the actual data's eigenvalues; those factors whose eigenvalues from the actual data are higher than those corresponding factors from the randomly generated data are retained (Hayton, Allen, & Scarpello, 2004). This method is more accurate than examining a scree plot or assuming that eigenvalues greater than 1 indicate a factor (Hayton et al., 2004). SPSS syntax was used (O'Conner, 2000; see Appendix H).

To determine initial predictors of the study's outcomes and the contribution of each variable to the variance of the outcome measures, linear regressions were performed. Growth curve modeling was used to simultaneously consider all time points in predicting exam mark outcome and salivary sIgA release rates. Restricted maximum likelihood (REML) estimation was used in that the variances in the intercepts and slopes are considered random effects and that REML more accurately estimates random variances (Twisk, 2006). Covariance structures were set to be heterogeneous autoregressive in that previous scores may influence future scores. The Bayesian Information Criterion (BIC) was used to indicate conservative model fit.

Chapter 7 - Personality Trait & Psychosocial Factors Descriptive Statistics

7.1 Distribution of the Data

One-sample Kolmogorov-Smirnoff tests were conducted to determine if the data was normally distributed; non-significance of these analyses for all data at all time points indicated that the data can be considered as normally distributed and analysed as such.

7.2 Age

The tables below summarize the characteristics of all participants. Table 7.1 provides age and number of participants at each phase of the study; there were no significant gender differences in age or attrition rates.

Table 7.1 – Age and number of participants at each phase by gender

Age		Mean	SD	SEM	Min	Max	N
	1	**18.78**	**0.675**	**0.042**	**17.09**	**20.74**	**254**
	male	18.81	0.707	0.075	17.09	20.74	89
	female	18.76	0.659	0.051	17.62	20.68	165
	2	**19.13**	**0.649**	**0.055**	**17.45**	**21.05**	**137**
	male	19.13	0.627	0.093	17.45	20.98	46
	female	19.13	0.663	0.069	18.12	21.05	91
	3	**19.43**	**0.682**	**0.068**	**17.67**	**21.4**	**101**
	male	19.51	0.676	0.111	17.67	21.16	37
	female	19.39	0.686	0.086	18.36	21.4	64
	4	**19.8**	**0.691**	**0.069**	**18.05**	**21.67**	**99**
	male	19.85	0.744	0.121	18.05	21.58	38
	female	19.78	0.661	0.085	18.69	21.67	61

SD = standard deviation; SEM = standard error of the mean; Min = minimum; Max = maximum

7.3 Personality Descriptive Statistics

Table 7.2a and 7.2b summarizes each personality trait scores for each time point. In Table 7.2a, descriptive statistics represent NEO-FFI Form S converted *T*-scores; scores were obtained from the NEO-FFI Form S scoring manual (Costa & McCrae, 1994). Table 7.2b depicts raw IPIP scores from the second cohort.

Table 7.2a – Study one descriptives for NEO-FFI Form S trait *T*-scores

		Mean	SD	SEM
Neuroticism	**Time 1**	**54.54**	**10.74**	**1.31**
	male	51.81	10.98	2.11
	female	56.38	10.30	1.63
	Time 2*	**51.79**	**11.42**	**1.46**
	male	48.28	9.97	1.99
	female	54.22	11.86	1.98
	Time 3	**49.50**	**10.69**	**1.61**
	male	49.87	10.67	2.75
	female	49.31	10.88	2.02
	Time 4*	**50.74**	**10.91**	**1.43**
	male	46.73	9.85	2.10
	female	53.19	10.91	1.82
Extraversion	**Time 1**	**53.06**	**11.03**	**1.35**
	male	54.00	11.21	2.16
	female	52.43	11.00	1.74
	Time 2	**55.15**	**11.20**	**1.43**
	male	57.36	11.11	2.22
	female	53.61	11.15	1.86
	Time 3	**55.50**	**10.01**	**1.51**
	male	57.53	10.24	2.64
	female	54.45	9.90	1.84
	Time 4	**55.97**	**9.37**	**1.23**
	male	58.50	7.08	1.51
	female	54.42	10.32	1.72
Openness	**Time 1***	**60.84**	**9.49**	**1.16**
	male	63.85	5.79	1.11
	female	58.80	10.93	1.73
	Time 2* (1)	**58.13**	**9.90**	**1.27**
	male	61.80	6.71	1.34
	female	55.58	11.00	1.83

	Time 3	**59.98**	**9.17**	**1.38**
	male	61.67	7.25	1.87
	female	59.10	10.03	1.86
	Time 4	**60.09**	**9.94**	**1.31**
	male	62.27	6.83	1.46
	female	58.75	11.32	1.89
Agreeableness	**Time 1**	**48.90**	**11.24**	**1.37**
	male	48.78	11.41	2.20
	female	48.98	11.27	1.78
	Time 2	**48.38**	**10.88**	**1.39**
	male	47.92	9.57	1.91
	female	48.69	11.82	1.97
	Time 3	**49.48**	**10.70**	**1.61**
	male	47.47	9.36	2.42
	female	50.52	11.34	2.11
	Time 4	**49.47**	**11.21**	**1.47**
	male	47.41	12.25	2.61
	female	50.72	10.51	1.75
Conscientiousness	**Time 1***	**41.69**	**11.76**	**1.44**
	male	37.85	10.78	2.08
	female	44.28	11.82	1.87
	Time 2	**41.15**	**11.37**	**1.46**
	male	41.92	10.73	2.15
	female	40.61	11.91	1.99
	Time 3 (1)	**45.16**	**11.19**	**1.69**
	male	41.60	10.69	2.76
	female	47.00	11.18	2.08
	Time 4	**42.84**	**11.37**	**1.49**
	male	39.59	9.89	2.11
	female	44.83	11.88	1.98

Significance indicator next to phase number: * = $p < .05$ significant gender difference; phases in brackets next to phase number indicates significantly different phases ($p < .05$); SD = standard deviation; SEM = standard error of the mean

The first cohort's data demonstrated mean-level stability with only the Openness scores between the first and second phases significantly decreasing. Furthermore, only three of the five traits showed any significant gender differences: Neuroticism was lower in males at the second (males: 48.28 $\pm$ 1.99; females: 54.22 $\pm$

1.98) and fourth phases (males: 46.73 $\pm$ 2.10; females: 53.19 $\pm$ 1.82); Openness was higher for males than females at the first (males: 63.85 $\pm$ 1.11; females: 58.80 $\pm$ 1.73) and second phases (males: 61.80 $\pm$ 1.34; females: 55.58 $\pm$ 1.83); and Conscientiousness was lower for males (37.85 $\pm$ 2.08) than females (44.28 $\pm$ 1.87) at the first phase. The only significant mean-level difference between phases of the study was found for Openness between Time 1 (60.84 $\pm$ 1.16) and Time 2 (58.13 $\pm$ 1.27).

Table 7.2b – Study two descriptives for IPIP raw scores

			Mean	SD	SEM
Neuroticism	**Time 1**		**56.96**	**15.57**	**1.14**
		male	53.97	16.12	2.05
		female	58.44	15.14	1.35
	Time 2		**56.93**	**14.98**	**1.75**
		male	57.00	17.02	3.71
		female	56.90	14.26	1.98
	Time 3		**56.64**	**15.42**	**2.01**
		male	56.55	17.69	3.77
		female	56.70	14.16	2.33
	Time 4		**57.29**	**15.41**	**2.41**
		male	54.31	18.59	4.65
		female	59.20	13.04	2.61
Extraversion	**Time 1**		**61.95**	**14.45**	**1.06**
		male	60.58	15.37	1.95
		female	62.63	13.98	1.25
	Time 2		**63.07**	**13.08**	**1.53**
		male	61.24	15.34	3.35
		female	63.81	12.14	1.68
	Time 3		**62.53**	**12.19**	**1.59**
		male	61.18	10.66	2.27
		female	63.32	13.09	2.15
	Time 4		**65.12**	**10.91**	**1.70**
		male	62.44	11.55	2.89
		female	66.84	10.35	2.07
Openness	**Time 1**		**73.08**	**10.90**	**0.80**
		male	74.29	9.59	1.22
		female	72.48	11.48	1.03
	Time 2		**73.49**	**8.92**	**1.04**

	male	73.43	8.34	1.82
	female	73.52	9.22	1.28
	Time 3* (1)	**76.08**	**9.66**	**1.26**
	male	78.55	8.96	1.91
	female	74.62	9.88	1.62
	Time 4	**74.95**	**9.15**	**1.43**
	male	74.75	9.14	2.28
	female	75.08	9.35	1.87
Agreeableness	**Time 1***	**77.44**	**10.88**	**0.80**
	male	73.77	12.32	1.57
	female	79.26	9.63	0.86
	Time 2	**76.68**	**10.70**	**1.25**
	male	72.95	10.92	2.38
	female	78.19	10.33	1.43
	Time 3*	**76.29**	**11.42**	**1.49**
	male	71.45	13.82	2.95
	female	79.16	8.72	1.43
	Time 4	**76.27**	**10.04**	**1.57**
	male	72.75	12.07	3.02
	female	78.52	7.96	1.59
Conscientiousness	**Time 1**	**64.31**	**12.72**	**0.93**
	male	65.10	11.35	1.44
	female	63.92	13.37	1.20
	Time 2	**60.92**	**12.52**	**1.47**
	male	59.52	8.49	1.85
	female	61.48	13.85	1.92
	Time 3 (2)	**66.31**	**13.17**	**1.71**
	male	65.27	12.17	2.60
	female	66.92	13.86	2.28
	Time 4	**66.56**	**14.23**	**2.22**
	male	67.44	13.47	3.37
	female	66.00	14.94	2.99

Significance indicator next to phase number: * = $p < .05$ significant gender difference; phases in brackets next to phase number indicates significantly different phases ($p < .05$); SD = standard deviation; SEM = standard error of the mean

The second cohort showed males scoring lower in Agreeableness than females at the first phase of the study (males: 73.77 ± 1.57; females: 79.29 ± 0.86) and the third phase (males: 71.45 ± 2.95; females: 79.16 ± 1.43). There were no other significant gender differences for any other traits.

There were significant differences between time points for Conscientiousness between the second (60.92 ± 1.47) and third (66.31 ± 1.71) assessments which occurred at the beginning of the second semester and at exam time, respectively. Additionally, Openness at the first time point when the term started (73.08 ± .80) was significantly lower than at the third time point around exam time (76.08 ± 1.26). There were no other significant differences between the phases of the study for the second cohort for any other traits.

In Tables 7.2a and 7.2b, there does not appear to be consistent gender differences in trait levels at any particular phase of the study nor does there appear to be consistency in differences between assessments across the traits. Overall, there were high levels of mean-level trait stability between time points.

Although personality data from the first study was obtained using the NEO-FFI Form S (Costa & McCrae, 1992) while the second study used items from the IPIP (Goldberg et al., 1999), both inventories measured similar constructs and are highly correlated as mentioned in Chapter 6 (see Section 6.4.1 on personality measures). The overall correlation between the IPIP scales and the Big Five was .81 with a .90 correlation corrected for reliability. Therefore, combining trait scores from both cohorts was reasonable in that they are the same constructs measured by both instruments. All other questionnaires were identical between cohorts.

In order to combine the scores from the two different cohorts, *t*-scores were calculated for each cohort with a mean of 0 and a standard deviation of 1. *t*-score standardization was performed by taking each score and subtracting it from the mean of all scores and then dividing the difference by the standard deviation.

To compare gender differences at each of the phases, independent samples t-tests were performed. For Agreeableness, males were lower than females at Time 1 (males: -.238 $\pm$ .117, females: .128 $\pm$ .071, $p < .01$), Time 3 (males: -.328 $\pm$ .177, females: .184 $\pm$ .111, $p < .05$), and Time 4 (males: -.254 $\pm$ .182, females: .158 $\pm$ .112, $p < .05$). For Neuroticism, males were significantly lower than females at the start of each academic year (Time 1: males: -.211 $\pm$ .109, females: .114 $\pm$ .075, $p < .05$; Time 4: males: -.295 $\pm$ .167, females: .184 $\pm$ .120, $p < .05$). Openness was higher in males than females only at Time 1 (males: -.178 $\pm$ .086, females: -.094 $\pm$ .084, $p < .05$). There were no other gender differences for any other traits at any other time points.

When comparing different phases of the study using the combined cohorts' *t*-scores, paired samples t-tests were performed. There was a significant difference between Time 2 at the start of the second semester (.213 $\pm$ .114) and Time 3 during exams (.016 $\pm$ .116; $p = .014$) for Conscientiousness; students had lower ratings for Conscientiousness during exam time than at the start of the second semester. No other traits were significantly different between any other times for the combined data sets demonstrating very little mean-level change over time for all participants.

To examine rank-order stability, correlations between time points were calculated for the combined data set of both cohorts. Personality variables are summarized in Table 7.3.

Table 7.3 – Correlation coefficients for personality traits between phases

	Phase	1	2	3
Neuroticism	**2**	0.80		
	3	0.82	0.84	
	4	0.70	0.71	0.80
Extraversion	**2**	0.77		
	3	0.73	0.73	
	4	0.64	0.67	0.81
Openness	**2**	0.79		
	3	0.74	0.68	
	4	0.63	0.68	0.80
Agreeableness	**2**	0.83		
	3	0.74	0.82	
	4	0.66	0.73	0.87
Conscientiousness	**2**	0.79		
	3	0.77	0.77	
	4	0.78	0.72	0.87
All correlations are significant at the 0.001 level (2-tailed)				

All correlations were found to be significant at the 1% level; in that correlation coefficients ranged from .63 to .87, participants demonstrated moderate to high levels of rank-order stability over the four assessments.

In terms of individual-level change, the differences between phases were divided by the standard error of those differences; those out with the standardized distribution (1.96 standard deviation units from the mean) were considered to have changed. The results from this analysis are presented in Table 7.4.

Table 7.4 – Individual-level change in personality traits for all phases

	1 to 2	1 to 3	1 to 4	2 to 3	2 to 4	3 to 4
Neuroticism						
decreased	**9.59%**	3.39%	**12.20%**	9.38%	3.45%	3.57%
same	**80.82%**	91.53%	**78.05%**	84.38%	86.21%	82.14%
increased	**9.59%**	5.08%	**9.76%**	6.25%	10.34%	14.29%
$\chi^2(2)$	**7.90**	0.25	**7.60**	1.71	2.06	5.63
p-value	**0.02**	0.88	**0.02**	0.43	0.36	0.06
Extraversion						
decreased	**5.48%**	3.39%	4.88%	3.13%	6.90%	3.57%
same	**83.56%**	89.83%	85.37%	96.88%	82.76%	92.86%
increased	**10.96%**	6.78%	9.76%	0.00%	10.34%	3.57%
$\chi^2(2)$	**9.41**	0.74	2.27	0.40	2.37	0.18
p-value	**0.01**	0.69	0.32	0.82	0.31	0.91
Openness						
decreased	5.48%	0.00%	9.76%	3.13%	3.45%	3.57%
same	90.41%	89.83%	85.37%	93.75%	96.55%	96.43%
increased	4.11%	10.17%	4.88%	3.13%	0.00%	0.00%
$\chi^2(2)$	0.14	4.82	2.27	0.40	0.23	0.18
p-value	0.93	0.09	0.32	0.82	0.89	0.91
Agreeableness						
decreased	2.74%	5.08%	12.20%	0.00%	3.45%	0.00%
same	94.52%	88.14%	82.93%	96.88%	96.55%	100.00%
increased	2.74%	6.78%	4.88%	3.13%	0.00%	0.00%
$\chi^2(2)$	1.39	0.55	5.02	0.40	0.23	0.18
p-value	0.50	0.76	0.08	0.82	0.89	0.91
Conscientiousness						
decreased	**12.33%**	**3.39%**	**4.88%**	0.00%	**3.45%**	3.57%
same	**82.19%**	**84.75%**	**75.61%**	96.88%	**79.31%**	92.86%
increased	**5.48%**	**11.86%**	**19.51%**	3.13%	**17.24%**	3.57%
$\chi^2(2)$	**9.41**	**6.70**	**19.74**	0.40	**9.99**	0.18
p-value	**0.01**	**0.04**	**0.00**	0.82	**0.01**	0.91

Those time period comparisons that exhibited significant individual-level change are highlighted in Table 7.4 in bold. Notably, there were a number of comparisons that approached significance whose p-values were under 0.10, such as for Openness between the beginning of the first academic year and exam time ($p = 0.09$; 10.17% increasing, 89.83% not changing), Agreeableness between the beginning of the first year and the beginning of the second year ($p = 0.08$; 12.20% decreasing, 82.93% staying the same, 4.88% increasing), and Neuroticism between exam time and the beginning of the second year ($p = 0.06$; 3.57% decreasing, 82.14% remaining the same, 14.29% increasing).

7.4 General Psychosocial Factor Descriptive Statistics

For each of the general psychosocial factors summarized in Table 7.5, significant gender differences are indicated; significant differences between genders along with differences between assessments for all participants are indicated.

Table 7.5 – Summary of general psychosocial factors by gender

		Mean	SD	SEM
Life Experiences	**Time 1**	**7.19**	**8.81**	**0.55**
	male	7.24	8.76	0.93
	female	7.15	8.86	0.69
	Time 2	**6.91**	**8.09**	**0.70**
	male	6.52	8.16	1.23
	female	7.10	8.10	0.86
	Time 3* (1)	**5.82**	**8.47**	**0.82**
	male	4.30	7.69	1.20
	female	6.75	8.84	1.08
	Time 4* (1,2)	**5.39**	**6.56**	**0.66**
	male	4.75	5.77	0.94
	female	5.79	7.03	0.91
Self-Esteem	**Time 1****	**20.26**	**5.45**	**0.34**
	male	21.75	5.44	0.58
	female	19.46	5.30	0.41
	Time 2 (1)	**21.15**	**4.89**	**0.42**

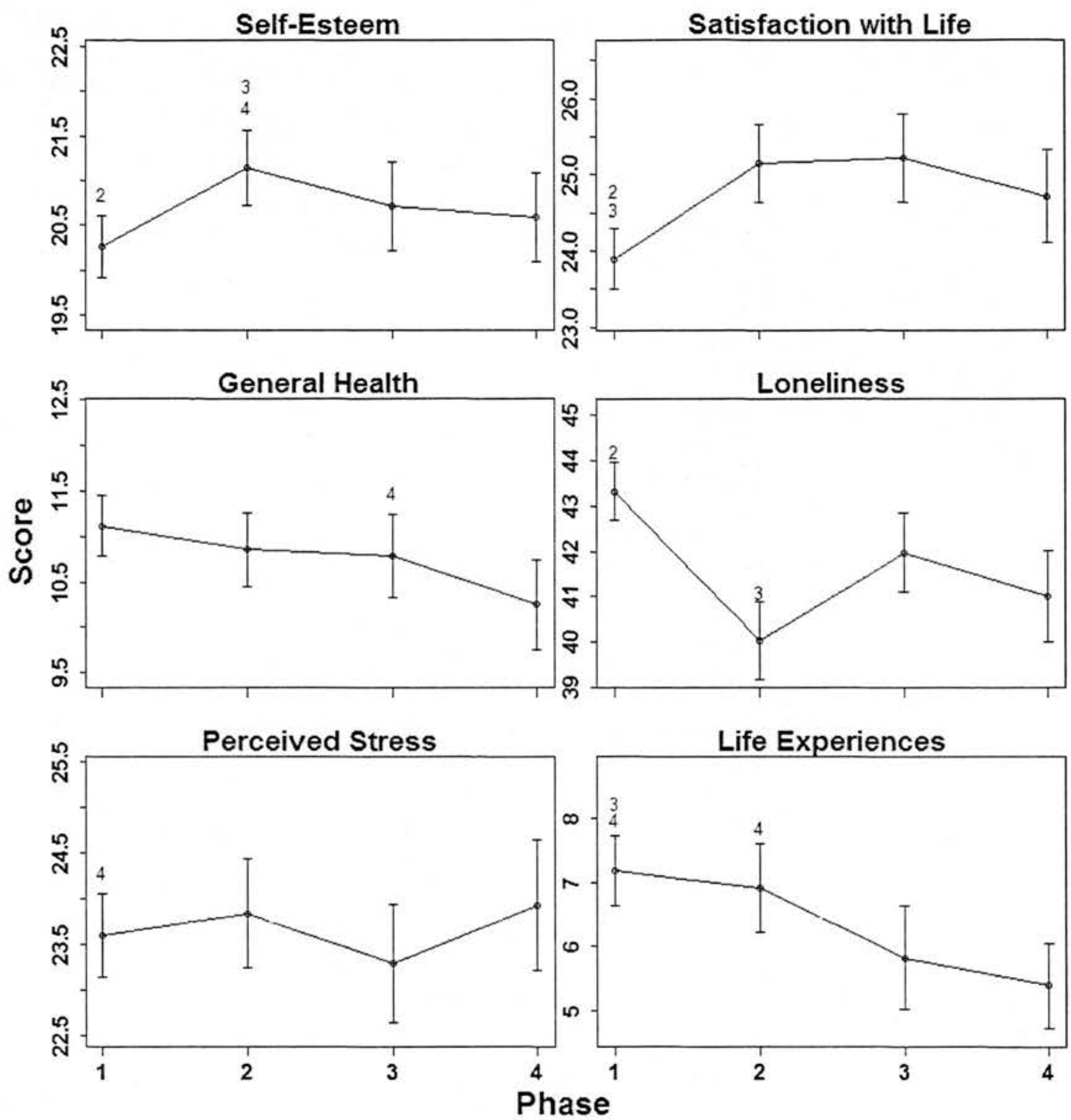
	male	22.80	5.13	0.77
	female	20.34	4.59	0.48
	Time 3 (2)**	**20.72**	**5.29**	**0.50**
	male	21.69	5.57	0.86
	female	20.14	5.08	0.60
	Time 4 (2)**	**20.60**	**4.94**	**0.50**
	male	22.50	4.96	0.80
	female	19.41	4.58	0.59
Satisfaction with Life	**Time 1**	**23.90**	**6.40**	**0.40**
	male	23.58	6.22	0.66
	female	24.07	6.51	0.51
	Time 2* (1)	**25.15**	**5.93**	**0.51**
	male	24.52	5.45	0.80
	female	25.47	6.16	0.65
	Time 3* (1)	**25.22**	**6.15**	**0.58**
	male	24.43	5.64	0.87
	female	25.69	6.42	0.76
	Time 4	**24.71**	**6.08**	**0.61**
	male	25.21	5.74	0.93
	female	24.39	6.31	0.81
General Health	**Time 1***	**11.12**	**5.29**	**0.33**
	male	10.04	4.31	0.46
	female	11.69	5.67	0.44
	Time 2	**10.86**	**4.78**	**0.41**
	male	10.09	4.78	0.71
	female	11.25	4.75	0.50
	Time 3	**10.79**	**4.89**	**0.46**
	male	10.52	4.33	0.67
	female	10.94	5.22	0.62
	Time 4* (3)	**10.25**	**4.89**	**0.49**
	male	9.71	4.83	0.78
	female	10.59	4.93	0.63
Perceived Stress	**Time 1***	**22.22**	**6.53**	**0.66**
	male	22.12	6.71	0.71
	female	24.40	7.57	0.59
	Time 2*	**23.84**	**6.96**	**0.59**
	male	22.13	8.38	1.24
	female	24.71	5.97	0.63
	Time 3	**23.29**	**6.84**	**0.64**
	male	22.76	6.38	0.98
	female	23.61	7.12	0.85
	Time 4* (1)	**23.93**	**7.12**	**0.72**

	male	21.97	7.18	1.17
	female	25.15	6.86	0.88
Loneliness	**Time 1**	**43.34**	**10.32**	**0.65**
	male	42.70	10.79	1.14
	female	43.68	10.07	0.78
	Time 2* (1)	**40.02**	**10.02**	**0.86**
	male	40.33	11.09	1.64
	female	39.86	9.49	1.00
	Time 3* (2)	**41.96**	**9.34**	**0.88**
	male	43.02	9.23	1.42
	female	41.34	9.42	1.12
	Time 4	**41.01**	**10.02**	**1.01**
	male	40.47	10.58	1.72
	Female	41.34	9.74	1.25

Significance indicator next to phase number: * = $p < .05$ & $p < .001$significant gender difference; phases in brackets next to phase number indicates significantly different phases ($p < .05$); SD = standard deviation; SEM = standard error of the mean

Notably, the most number of gender differences existed for Self-Esteem with males scoring higher than females at Time 1 (males: 21.75 $\pm$ .58; females 19.46 $\pm$ .41), Time 3 (males: 21.69 $\pm$ .86; females 20.14 $\pm$ .60), and Time 4 (males: 22.50 $\pm$ .80; females 19.41 $\pm$ .59). Each of these psychosocial factors are represented in Figure 7.1.

Figure 7.1 – Mean general psychosocial factor scores for all participants for each of assessments (bars represent standard error of the mean; numbers atop error bars indicate significantly different phases, $p < .05$)



Examining the mean scores over time from Table 7.5 and Figure 7.1, there exists some evidence of mean-level change in these general psychosocial factors. Most phases differed significantly from the very first phase for most of the factors.

For example, Self-Esteem and Satisfaction with Life both significantly increased between Time 1 and 2 while Loneliness decreased between these assessments. Some degree of mean-level stability was seen; Time points 2, 3, and 4 did not significantly differ for Satisfaction with Life nor for Perceived Stress (See Figure 7.1).

Table 7.6 presents correlations of general psychosocial factor scores between time points to determine rank-order stability over time.

Table 7.6 – Correlations of general psychosocial factors between time points

	Phase	1	2	3
Life Experiences	2	0.45		
	3	0.54	0.58	
	4	0.22*	0.27*	0.29*
Self-Esteem	2	0.78		
	3	0.72	0.79	
	4	0.69	0.73	0.85
Loneliness	2	0.71		
	3	0.57	0.64	
	4	0.52	0.6	0.77
Satisfaction with Life	2	0.63		
	3	0.76	0.74	
	4	0.55	0.56	0.70
General Health	2	0.18*		
	3	0.12x	0.5	
	4	0.14x	0.26*	0.39
Perceived Stress	2	0.50		
	3	0.39	0.59	
	4	0.23*	0.43	0.49

All correlations significant at the 0.01 level (2-tailed) unless noted; *: significant at the 0.05 level (2-tailed); x: not significantly correlated

The general psychosocial factors demonstrated high rank-order stability, although not as stable as seen with the personality traits. Furthermore, the correlation between General Health in the first phase when compared to phase 3 (just before exam time) and phase 4 (the beginning of the second academic year) were not significantly correlated. Overall, the general psychosocial factors seem to demonstrate less rank-order stability than the personality traits over time. Alternatively, the lack of stability may be due to greater measurement error in the psychosocial variables than with the personality traits.

Chapter 8 - University-Specific Psychosocial Factors Descriptive Statistics

Those psychosocial factors relevant to the university experience are presented in Table 8.1 with significant gender and time differences indicated.

Table 8.1 - Summary of university-specific psychosocial factors by gender

		Mean	SD	SEM	
Cognitive Quality of University Life - Functional	**Time 1**	**37.72**	**6.75**	**0.42**	
	male	37.08	6.77		0.72
	female	38.06	6.73		0.52
	Time 2* (1)	**39.82**	**6.03**	**0.52**	
	male	39.65	5.87		0.87
	female	39.91	6.15		0.64
	Time 3* (1)	**40.81**	**6.75**	**0.64**	
	male	41.14	5.78		0.89
	female	40.62	7.30		0.87
	Time 4* (1)	**40.17**	**6.21**	**0.62**	
	male	40.18	5.71		0.93
	female	40.16	6.55		0.84
Cognitive Quality of University Life - Structural	**Time 1**	**20.76**	**4.80**	**0.30**	
	male	20.46	5.40		0.57
	female	20.92	4.45		0.35
	Time 2* (1)	**22.37**	**3.97**	**0.34**	
	male	21.67	4.08		0.60
	female	22.73	3.89		0.41
	Time 3* (1)	**22.69**	**4.27**	**0.40**	
	male	22.98	3.40		0.53
	female	22.52	4.72		0.56
	Time 4* (1,2)	**23.60**	**4.50**	**0.45**	
	male	23.26	4.33		0.70
	female	23.80	4.62		0.59
Affective Quality of University Life - Positive Affect	**Time 1**	**49.92**	**8.31**	**0.52**	
	male	49.33	8.23		0.88
	female	50.23	8.35		0.65
	Time 2* (1)	**47.33**	**7.25**	**0.62**	
	male	45.24	6.95		1.02
	female	48.38	7.21		0.76
	Time 3* (2)	**49.45**	**7.89**	**0.74**	
	male	50.48	6.92		1.07
	female	48.85	8.39		1.00
	Time 4* (2)	**49.80**	**8.00**	**0.80**	

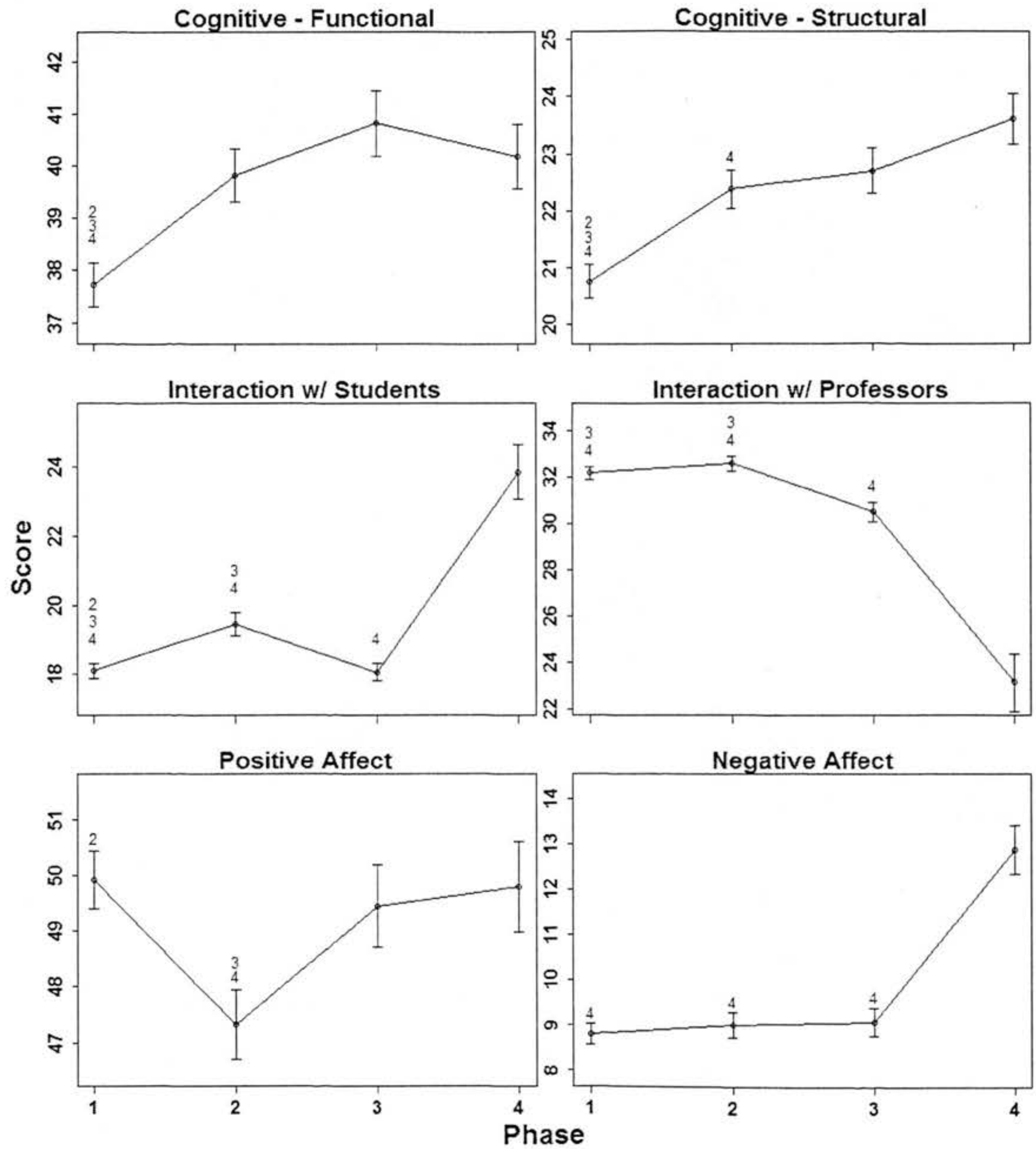
	male	50.18	7.01		1.14
	female	49.56	8.61		1.10
Affective Quality of University Life - Negative Affect	**Time 1****	**8.80**	**3.56**	**0.22**	
	male	7.85	3.35		0.36
	female	9.31	3.57		0.28
	Time 2	**9.00**	**3.22**	**0.28**	
	male	8.72	3.48		0.51
	female	9.15	3.08		0.33
	Time 3	**9.09**	**3.35**	**0.32**	
	male	9.29	3.70		0.57
	female	8.97	3.14		0.37
	Time 4* (1,2,3)	**13.13**	**12.35**	**1.24**	
	male	23.29	12.59		2.04
	female	23.03	12.30		1.58
Affective Quality of University Life - Interaction with Students	**Time 1**	**18.10**	**3.53**	**0.22**	
	male	18.65	3.82		0.41
	female	17.81	3.35		0.26
	Time 2* (1)	**19.45**	**3.76**	**0.32**	
	male	20.20	4.38		0.65
	female	19.08	3.37		0.35
	Time 3* (1,2)	**18.06**	**2.80**	**0.26**	
	male	18.36	2.57		0.40
	female	17.89	2.93		0.35
	Time 4* (1,2,3)	**12.88**	**5.35**	**0.54**	
	male	12.47	5.83		0.95
	female	13.13	5.07		0.65
Affective Quality of University Life - Interaction with Professors	**Time 1**	**32.17**	**4.29**	**0.27**	
	male	32.41	4.59		0.49
	female	32.04	4.13		0.32
	Time 2	**32.56**	**3.92**	**0.34**	
	male	32.65	3.57		0.53
	female	32.51	4.11		0.44
	Time 3* (1,2)	**30.47**	**4.46**	**0.42**	
	male	30.64	4.63		0.72
	female	30.37	4.39		0.52
	Time 4* (1,2,3)	**23.83**	**7.81**	**0.79**	
	male	24.53	7.68		1.25
	female	23.39	7.92		1.01

Significance indicator next to phase number: * = $p < .05$ & $p < .001$ significant gender difference; phases in brackets next to phase number indicates significantly different phases ($p < .05$); SD = standard deviation; SEM = standard error of the mean

Overall, there were few mean-level gender differences for the university-specific psychosocial factors (Positive Affect, Time 2; males: 45.24 $\pm$ 1.02, females: 48.38 $\pm$ 0.76; Negative Affect, Time 1; males: 7.85 $\pm$ 0.36, females: 9.31 $\pm$ 0.28).

Between assessments, there were more significant differences for the university-specific psychosocial factors than for the personality trait findings and general psychosocial factors presented in Chapter 7. In that different demands are placed on students at different times of the academic year, the significant mean-level differences between assessments can be expected. Figure 8.1 graphically depicts the mean-level changes in university-specific psychosocial factors over the four assessments for all participants.

Figure 8.1 – Mean university-specific psychosocial factor scores for all participants for each of assessments (bars represent standard error of the mean; numbers atop error bars indicate significantly different phases, $p < .05$)



Overall, both samples showed marked mean-level change in university-specific psychosocial factors, demonstrating a more dynamic set of factors when compared to the general psychosocial factors. For example, the first time point differed from at least one other assessment point for all six university-specific psychosocial factors. Notably, in terms of Cognitive Quality of Life, participants felt that they acquired both Functional and Structural knowledge in that the first assessment had the lowest rankings for these two constructs (See Figure 8.1, top row). However, between the remaining assessments, only the Structural component differed at the second phase when compared to the fourth phase which may indicate that participants did not feel that they learned anything new or were being challenged academically between these times.

Furthermore, the time of the assessment seemed to influence self-reported scores on the university-specific psychosocial factors whereby the first phase 1) differed from at least one other phase for Positive and Negative Affect, 2) differed between two phases for Interaction with Professors, and 3) had the lowest rankings of all time points for the remaining three university-specific psychosocial factors.

To examine rank-order stability in university-specific psychosocial factors, Table 8.2 presents correlation coefficients between time points.

Table 8.2 – Correlations between university-specific psychosocial factors over time

	Phase	1	2	3
Cognitive Quality of University Life - Functional	**2**	0.55		
	3	0.57	0.70	
	4	0.50	0.62	0.76
Cognitive Quality of University Life - Structural	**2**	0.52		
	3	0.37	0.66	
	4	0.31	0.35	0.46
Affective Quality of University Life - Positive Affect	**2**	0.63		
	3	0.62	0.76	
	4	0.59	0.71	0.85
Affective Quality of University Life - Interaction with Students	**2**	0.57		
	3	0.34	0.47	
	4	-0.08x	-0.28	0.13x
Affective Quality of University Life - Interaction with Professors	**2**	0.53		
	3	0.39	0.45	
	4	0.05x	0.15x	-0.22*
Affective Quality of University Life - Negative Affect	**2**	0.65		
	3	0.48	0.69	
	4	0.02x	0.08x	0.18x

All correlations significant at the 0.01 level (2-tailed) unless noted; *: significant at the 0.05 level (2-tailed); x: not significantly correlated

Overall, there was less rank-order stability than observed in the personality trait and general psychosocial factors data. Seven of the 36 correlations were not significant; those correlations that were significant ranged from .31 to .76. It is particularly interesting to note that despite the mean-level changes seen in Table 8.1 and Figure 8.1, most of the correlations between assessments demonstrated at least some moderate stability; although Time 1 differed from at least 1 other assessment in terms of mean-level comparisons, only 15 of the 18 comparisons demonstrated rank-order stability.

Chapter 9 - Higher Order Analysis & Outcome Measures

9.1 Power Calculation

In order to determine if the sample size had enough power to detect any reliable changes or associations, one can use Monte Carlo simulations to confirm the power with a given sample (Muthén & Muthén, 2002). The sample size needed can depend on the size of the model, variable distribution, missing data, variable reliability, and strength of the relations among the variables. It is critical to ensure that a sample can detect an important effect in the model. Although power tables or online calculators could be used to determine the power, the present study is longitudinal as is the example study in Muthén and Muthén (2002) that employs Monte Carlo techniques.

Monte Carlo techniques methodologically examine the performance of statistical estimates under varying conditions by employing algorithms to mimic statistical computations using defined elements (Muthén & Muthén, 2002). Characteristics of the present study were used to specify elements in the Monte Carlo simulation; a large number of samples are drawn from these characteristics and a model is estimated for each sample. In other words, does randomly generated data under specified calculations that mimic the actual characteristics of the real-life study allow for results to be interpreted with sufficient power?

A Monte Carlo simulation was used to determine if the acquired sample size possessed enough power to detect a given effect size. The effect size refers to the magnitude of the result rather than the likelihood of the result, such as the p value

(Funder, 2001). Effect size is the standardized magnitude of an observed effect. In other words, the effect size reveals how much of one variable is "contained" or explained by another variable. For example, the effect size is the square of the total variance that one variable has on another; an effect size of .3 indicates that 9% of the total variance can be accounted for by that variable (Field, 2005, p.32).

An effect size of .3 has been accepted as possessing a medium effect (Cohen 1988; Cohen 1992). This effect size holds given a power of 0.80. The power of a statistical test indicates the odds of correctly identifying an effect (Field, 2005, p.33). A statistical test with 0.80 power has an 80% chance of correctly identifying an effect at a given size representing a 0.2 probability of failing to detect an effect that really exits (Field, 2005, p.33).

In light of a general consensus that .3 represents a medium effect size, past research was consulted to confirm the expected effect (small, medium, or large) and the actual value of the effect size for personality change across the year in first year students. Key to this analysis is having some idea of the effect size expected. Previous literature was searched to determine the expected effect size sufficient to detect a change in the Big Five personality traits over time and the effect size expected of one covariate on personality change at both one and multiple assessments (Cohen 1992).

Roberts and DelVecchio (2000) reported that rank-order stability could be accounted for by 51% of the variance in the 18-21 age group. In other words, 51% of the variance is due to trait stability (Roberts & DelVecchio, 2000, p. 15); the remaining 49% of the variance can be attributed to personality change which therefore possesses an effect size around .5 (50%). Similarly, Fraley and Roberts (2005) report that 63% (age 18 to 19), 59% (age 18 to 20), and 56% (age 18 to 21) of the variance in Neuroticism measured over time was due to personality stability.

Muthén and Muthén (2002) detail the use of Monte Carlo studies to determine the sample size and power of a study. One example utilizes a sample size of 150 participants and a .2 regression coefficient of the slope growth factor on a covariate with measurements taken at four time points; in other words, there were no missing data in the example and an effect size of .2 is expected. In this scenario, with 10,000 iterations, a power of 0.81 was confirmed (Muthén and Muthén, 2002). In relating this example to the present study, altering the parameters over the four time points in the example to have an effect size of .3, reflecting a medium effect, drastically increased the power to 0.99. Roberts et al. (2006) reported an effect size for an increase in Extraversion to be .41 (95% CI: .13 to .69, $p < .05$) in 18-22 year olds (p. 12) and an increase in Emotional Stability with an effect size of .12 (95% CI: .004 to .24, $p < .05$; p. 13). Openness also increased in this study with an effect size of .37 (95% CI: .18 to .56, $p < .05$; p. 13). These guidelines can be applied to the present study to ascertain the appropriate sample size.

Muthén and Muthén (2002) also provide scenarios with missing data, both with and without a covariate. A growth model with missing data and a regression coefficient of .2 for a covariate influencing data missingness requires 250 participants to obtain a power of 0.80 where the first measurement occasion had

12% missing data, the second had 18% missing data, the third had 27% missing, and the final time point had 50% missing. A similar missing data pattern with no covariate yielded a sample size requirement of 40 to obtain a power of 0.81 after 10,000 imputations of a Monte Carlo simulation (Muthén and Muthén, 2002). In that the present study had at least 40 participants at any one time, applying this example indicates that the present study has a power of at least 0.81.

Knowing the expected effect size with a desired power of 0.80 and the actual sample size, a Monte Carlo simulation was performed on a computer to calculate the power of the present study. Power calculations were repeated 50,000 times to ascertain the most likely power generated in each iteration of the calculation. Specifically, Mplus Version 4.2 (Muthén and Muthén, 1998-2006) was used to run Monte Carlo simulations. The power was calculated repeatedly with randomly generated data to obtain the power with the given parameters from the present study. In the first cohort, 67 participants were in the first phase of the study, 64 were in the second phase, 47 participated in the third phase, and 60 participants returned for the final phase; in the following year, 187 participants completed the first phase, 73 completed the second phase, 59 completed the third phase, and 41 completed the last phase. Taken together, the missing rates were 46%, 60%, and 61% at the second, third, and fourth phases, respectively. These frequencies of missing data were converted to logits to represent the odds that data is missing as specified by the logistic regression procedure outlined by Muthén and Muthén (2002). This procedure uses the logarithm of the odds ratio that data is missing in order to provide a common means of comparison between time points (Muthén and Muthén, 2002; Lao, 1994). Using the models from Muthén and Muthén (2002), a covariate with an effect size of .30, reflecting a medium-sized effect, generated a power of 0.75. Increasing the effect size to .31 resulted in a power of 0.78 and an effect size of .32 was needed to obtain a power of 0.80 given the aforementioned parameters of the simulation. Accounting for the missing data, the present study has sufficient power of 0.80 with an expected effect size of .32 for a covariate.

Without a covariate, 67 participants with data from four time points and an effect size of .3 to represent the effect of time on personality change generated a power calculation of 0.951 after 50,000 iterations. Assuming a covariate with an effect size of .3 with the same data set resulted in a power of 0.803. Modeling missing data will therefore allow the detection of a covariate with an effect size of .3 at a power of at least 0.8 given the 67 participants who attended the first session.

9.2 Missing Data

One of the key questions in examining missing data focuses on the nature of the missing data. In other words, it is crucial to determine if any characteristics of the missing data may contribute to its "missingness"; it is necessary to determine if the data are missing at random or due to some other variable. In the case of the present study, the missing data reflects participants not returning to each phase of the study. There were gaps at each time point whereby participants did not provide personality nor psychosocial data. This has been one of the pitfalls plaguing longitudinal studies in that a sufficient number of participants may attend an initial phase of the study but then subsequently drop out afterwards (Ferrer, Hamagami, & McArdle, 2004; Muthen & Curran, 1997).

Missing data can be attributed to one of three patterns: missing due to a covariate, missing at random (MAR), or missing completely at random (MCAR) (Park & Lee, 1997; Little, 1988). Data missing due to a covariate result from the characteristic of the covariate; something about the covariate causes the participant to be absent. For example, low Conscientiousness participants may not return for subsequent phases of the study and can be attributed to missing data for that participant. One would expect to see participants with low Conscientiousness subsequently not return in further phases of the study. In the present study, none of the variables significantly predicted missingness.

Data that are missing at random are missing in the sense that the missing data does not depend on the observed response but may be dependent on an unobserved response. Data missing due to an unobserved response in the absence of an association of an observed response with the missing data is considered as data missing at random (Park & Lee, 1997). There may be an unmeasured, systematic pattern of association linking participants with missing data.

Data missing completely at random are missing even after accounting for measured and unmeasured variables in the study. None of the measures in the study or another unmeasured factor can significantly account for the pattern of the missing data. The data would not be associated with any measured variables nor would the data reflect some other systematic pattern of association (Park & Lee, 1997; Little, 1988).

There are straightforward means for ascertaining the reason for missing data. In the method outlined by Park and Lee (1997), each missing data pattern is defined into its own indicator variable for modeling. Each outcome of interest is then regressed on to each predictor variable using a regression that only considers those with complete data and then a second regression that incorporates the missing data pattern indicators. If the two regressions are statistically equivalent, then the overall mean indicator values depend on the missing data patterns; then the missing data patterns are not missing completely at random (Park & Lee, 1997). This method allows for multiple missing data patterns to be analyzed simultaneously.

The results of Little's MCAR test (1988) are related to this methodology. Briefly, Little's MCAR test examines each variable with missing data and splits the sample into cases with missing data and cases without missing data. The means of observed values of the other variables between the two groups of missing and non-missing data are then compared using a two-sample t-test; significant differences between the means indicate that the data is not MCAR. Using the Statistical Program for the Social Sciences (SPSS, Chicago, IL), all variables were found to be non-significant for Little's MCAR test; see Table 9.1. Therefore, all missing data were considered to be missing completely at random.

Table 9.1 – Little's MCAR test results to determining missingness

	χ^2	df	Sig
Neuroticism	23.150	16	.110
Extraversion	14.288	16	.577
Openness	19.658	16	.236
Agreeableness	14.808	16	.539
Conscientiousness	17.240	16	.370
Life Experiences	15.043	16	.522
Self Esteem	21.904	16	.146
Satisfaction with Life	25.507	16	.061
General Health	22.281	16	.160
Perceived Stress	21.324	16	.166
Loneliness	18.097	16	.301
Cognitive – Functional	14.064	16	.594
Cognitive – Structural	25.525	16	.061
Affective - Positive Affect	24.674	16	.172
Affective - Interaction with Students	23.411	16	.180
Affective - Interaction with Professors	20.573	16	.211
Affective - Negative Affect	26.058	16	.053
Neuroticism	23.150	16	.110
Extraversion	14.288	16	.577
Openness	19.658	16	.236
Agreeableness	14.808	16	.539
Conscientiousness	17.240	16	.370

In addition to testing baseline characteristics as confounds for participant absenteeism, it is also worth testing differences between those completing all four phases of the study and those who did not participate at each assessment. Costa and McCrae (1992) found significant trait differences between the 61 returnees from the original 158 male military officers twice assessed on the NEO-FFI, effect sizes were modest: those who returned to the study were lower in Neuroticism ($t < -2.05$, $p < .05$, $d = -0.33$) and higher in Conscientiousness ($t = -2.72$, $p < .01$, $d = 0.44$) (Costa & McCrae, 1992). However, Lönnqvist and colleagues (2007) did not find personality differences in participants who did not return for subsequent waves of a longitudinal study. Both personality and psychosocial variables were examined to determine if there were any significant differences between those who attended all phases of the study and those who dropped out. Independent samples t-tests did not find any significant differences between those who completed all phases and those who did not complete all four time points ($p > .05$).

9.3 Variance in Time of Inventory Completion

The number of days that had elapsed between the start of the semester and when each participant completed the questionnaires was recorded. These statistics are presented in Table 9.2.

Table 9.2 – Summary of questionnaire completion time since start of 1st semester

	Mean Days from Start of 1st Semester	**SD**	**SEM**
Phase 1	**28.15**	9.76	0.612
Phase 2	**156.53**	12.54	1.071
Phase 3	**258.04**	26.30	2.463
Phase 4	**391.54**	18.69	1.879

In order to account for individual differences in the time of questionnaire completion, MLwiN (Version 2.10 beta 5, Centre for Multilevel Modeling, Bristol, UK) was used to compare models of individual differences in the dynamics of each psychosocial factor and personality trait. Although multilevel modeling allows for missing data points, the data must be considered to be missing completely at random and not due to another variable; as evidenced in Table 11.1, the data was found to be missing completely at random which allows for this modeling.

The baseline model examined how the total variance was partitioned into two components: between participants and between occasions within participants. This baseline model is used as a comparison model. A -2 log likelihood fit statistic was generated for each model using the Iterative Generalised Least Squares (IGLS) maximum likelihood estimates. The generation and comparison of model fit using the -2 log-likelihood statistic represents the summed fit statistic for all individuals (Coffman & Millsap, 2006). Originally proposed by Lange, Westlake, and Spence (1976), the fit function is generated by comparing an individual's response to a normally distributed probability density function for that response. Aside from generating a goodness of fit statistic, each individual can then be described in terms of an index of the covariance weighted distance between his or her scores and the group average; this results in comparing the -2 log likelihood values for a baseline model and a hypothesized model that includes other variables. The -2 log likelihood statistic follows a chi-square distribution with the degrees of freedom equal to the difference in the number of parameters estimated in the two models. The differences between the -2 log likelihood values for the two models can determine the individual's contribution to the overall model chi-square (Coffman & Millsap, 2006).

Specifically, for each psychosocial factor and each personality trait, a baseline model predicting each participant's score as predicted by a constant was compared to a model that predicted the score as a function of the constant along with the individual's time of inventory completion in relationship to the start of the semester.

-2 log likelihood fit statistics were generated for each model and permitted comparisons to determine the effect of varying dates of questionnaire completion.

Table 9.3 – Comparison of model fit statistics accounting for time variance

	Baseline Model -2 log likelihood	Time Model -2 log likelihood
Neuroticism	1672.344	1672.235
Extraversion	1672.344	1664.537
Openness	1672.344	1670.008
Agreeableness	1672.345	1672.29
Conscientiousness	1672.344	1672.044
General Psychosocial Factors	1664.678	1660.817
University Psychosocial Factors	1660.522	1655.456

Each of the -2 log likelihood statistics for each variable was compared to each other using an independent samples t-test; all -2 log likelihood statistics were found to not be significantly different ($p > .05$). In that the -2 log likelihood fit statistics were similar between baseline models and models accounting for individual differences in time of questionnaire completion, time was permitted to be considered as four discreet phases.

9.4 Psychosocial Factor Data Reduction

In that the psychosocial measures may have had considerable overlap in the constructs that they were measuring and that inclusion of the numerous psychosocial factors measured can complicate higher-order modeling, a principal components analysis was conducted on data from the first phase of each study. Table 9.4 presents the pattern matrix of this principal components analysis and the resulting two factors.

Table 9.4 – Principal components analysis of psychosocial factors

Variable	Component	
	1	2
Life Experiences	**0.515**	0.028
Self-Esteem	**0.800**	0.012
Satisfaction with Life	**0.681**	0.077
General Health Questionnaire	**-0.826**	0.140
Perceived Stress	**-0.899**	0.138
Loneliness	**-0.723**	-0.083
Cognitive Quality of University Life - Functional	-0.012	**0.824**
Cognitive Quality of University Life - Structural	-0.246	**0.768**
Affective Quality of University Life-Positive Affect	0.362	**0.586**
Affective Quality of University Life-Interaction with Students	**0.565**	0.311
Affective Quality of University Life-Interaction with Professors	0.244	**0.606**
Affective Quality of University Life-Negative Affect	**-0.812**	0.065
Principal Component Analysis Component Extraction; Oblimin with Kaiser Normalization Rotation		

Factor 1 appears to relate to general psychosocial factors and incorporates the interaction with students and negative affect components of the university-specific psychosocial factors; this may be deemed as more of a personal, affective component while the second factor that comprises most of the academically based factors and includes how students rate their professors along with positive affect as more of an academic psychosocial factor. To justify the use of Principal Components Analysis component extraction and rotation using oblimin with Kaiser normalization, the correlation between the factors was calculated to be .48 ($p > .01$) which is sufficiently large enough to justify this factor analysis.

To confirm that there truly were two factors, a parallel analysis was performed (Hayton et al., 2004); the results are presented in Table 9.5.

Table 9.5 – Parallel analysis results

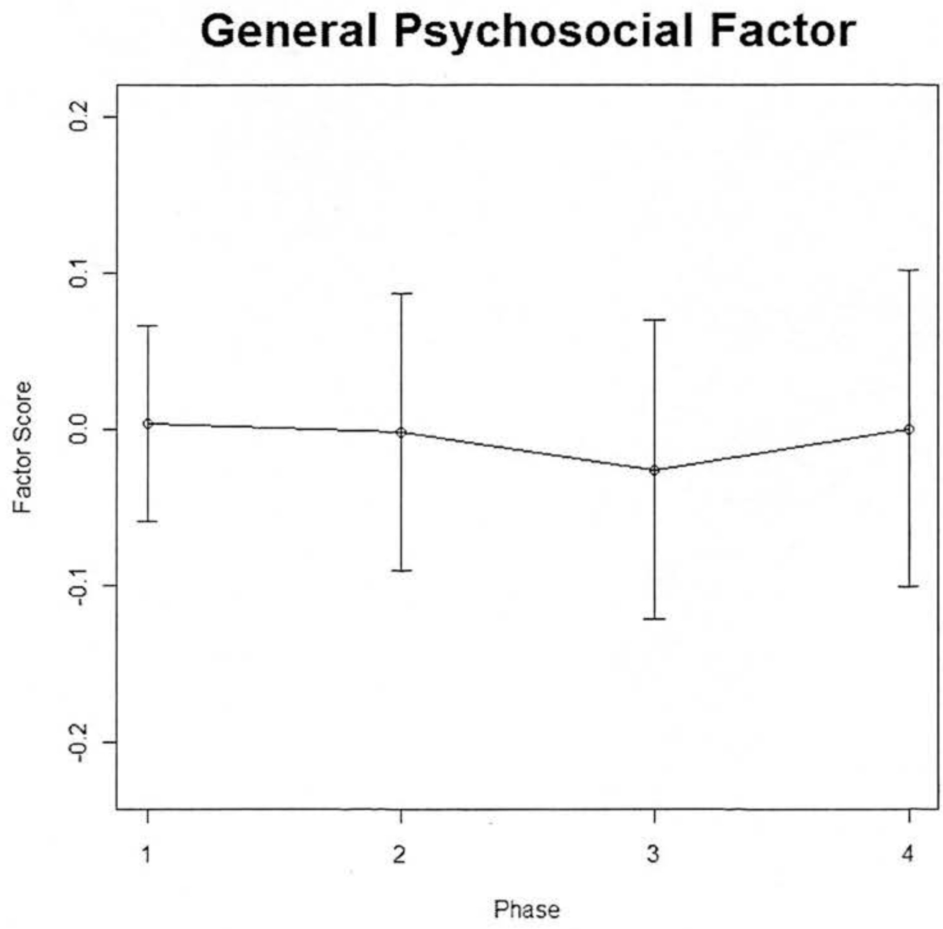
Factor	Raw Data	Means	Percentile
1	4.962819	1.370450	1.459635
2	1.864581	1.270765	1.339002
3	.904209	1.196457	1.249177
4	.811310	1.129917	1.181047
5	.746900	1.070159	1.116324
6	.589275	1.014797	1.055463
7	.498907	.961158	1.001696
8	.438761	.907392	.946454
9	.414859	.856761	.897530
10	.292712	.802454	.846148
11	.266886	.743614	.792431
12	.208783	.676076	.736594

In that the raw data's second factor was the last factor to have a higher eigenvalue than the randomly generated data's eigenvalue, the psychosocial data can be reduced to two factors as presented in Table 11.4. The factor scores from this principal components analysis was then used in further analyses of the psychosocial data. Additionally, confirmation of two factors for the psychosocial measurements was used as guidance for higher-order modeling.

In terms of the mean-level change of each of these factors, Figures 9.1 and 9.2

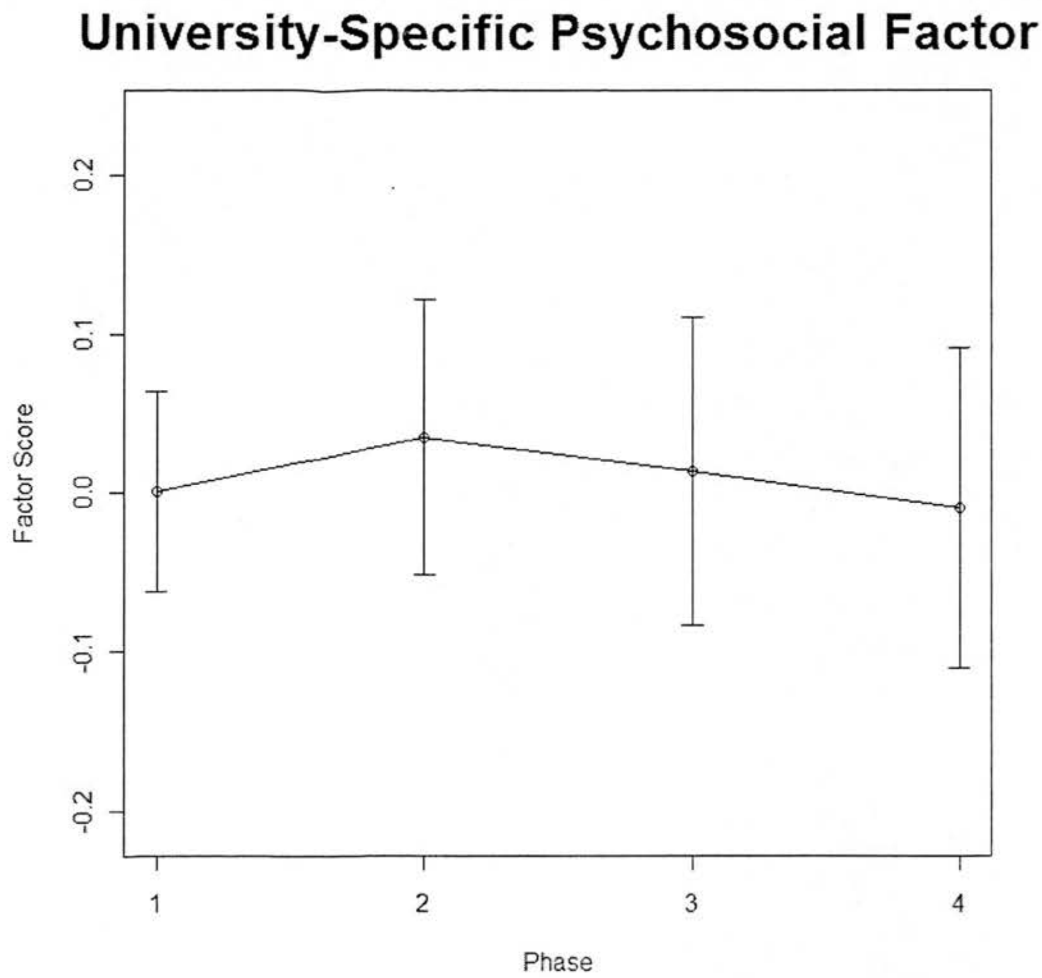
depict the mean level factor scores for the general and university-specific psychosocial factors over the four assessments.

Figure 9.1 – General psychosocial factor mean scores over all assessments (bars represent standard error of the mean)



Overall, there were no significant mean-level changes in the General Psychosocial Factor over time. This indicates that as a whole, both cohorts did not show much change in their psychosocial factor mean scores.

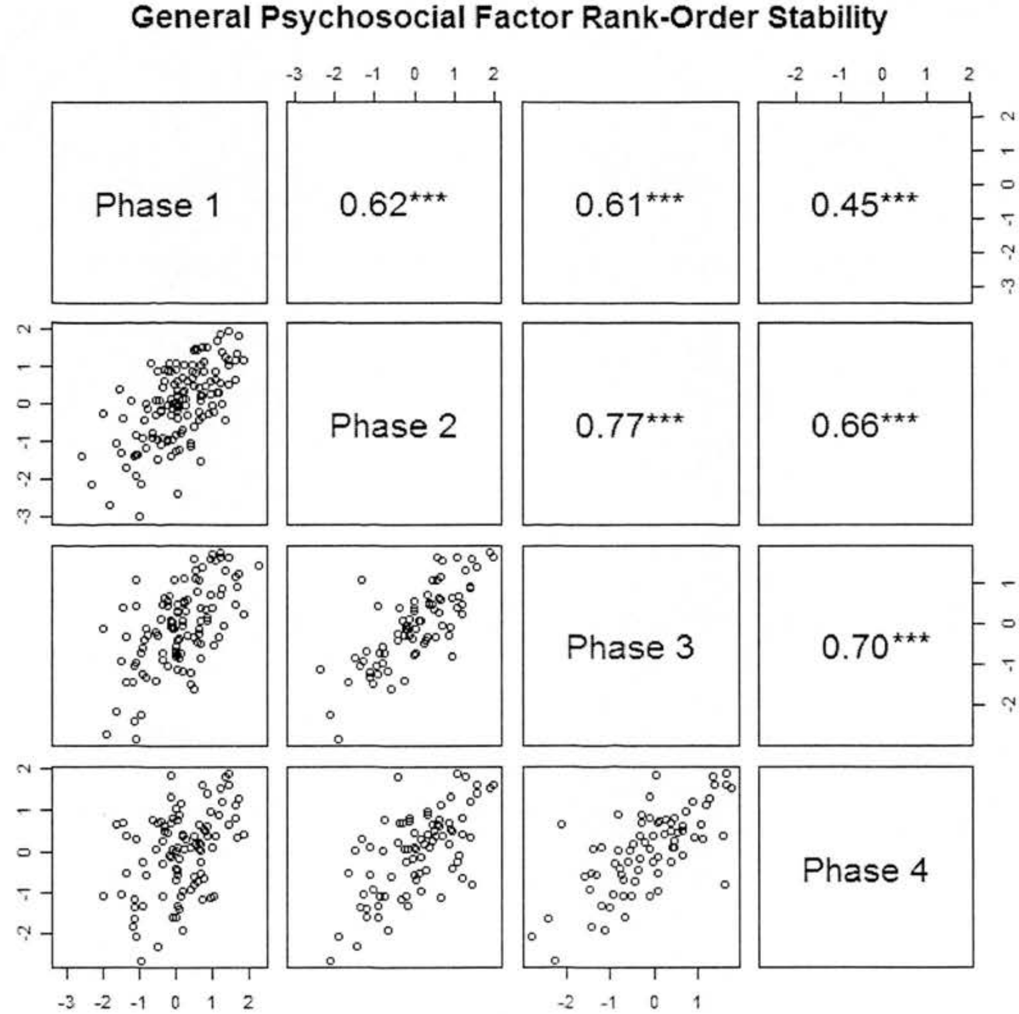
Figure 9.2 – University-specific psychosocial factor mean scores over all assessments (bars represent standard error of the mean)



Examining the University-Specific psychosocial factor, again there were no significant mean-level differences between time points indicating that the group mean remained stable over the course of the study.

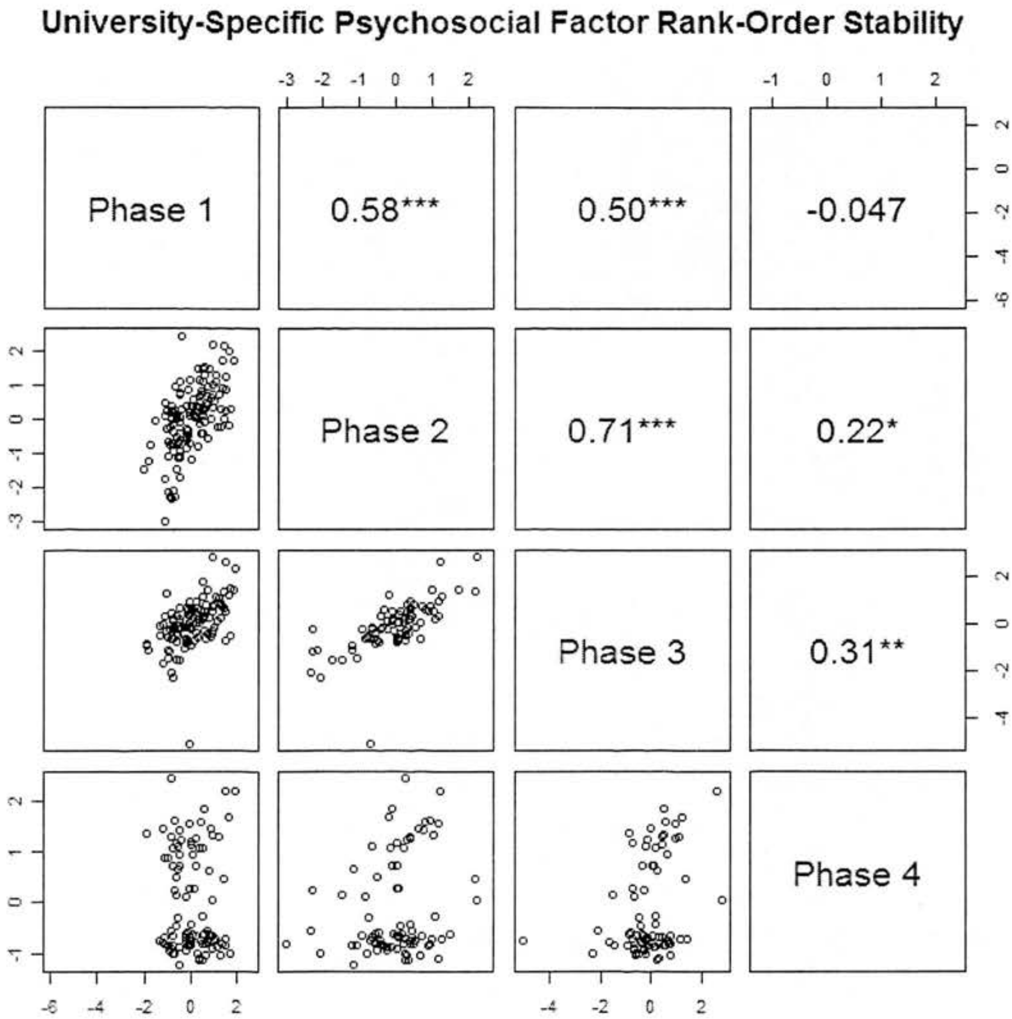
Extending the differing types of analysis to the examination of the extracted psychosocial factors, in turning to rank-order stability, Figure 8.3 presents scatter plots and correlation coefficients for the general psychosocial factor while Figure 9.4 represents the university-specific psychosocial factor data.

Figure 9.3 – Correlations and scatter plots for the general psychosocial factor for all assessments



There was moderately high rank-order stability in the general psychosocial factor between assessments in that correlation coefficients ranged from .45 to .77 and were all significant at the $p < .001$ level. The mean rank-order correlation coefficient was .635. For the general psychosocial factor, the higher levels of rank-order stability correspond to the lack of mean-level change between the time points all participants.

Figure 9.4 – Correlations and scatter plots for the university-specific psychosocial factor for all assessments



There was a greater range of rank-order stability in the university-specific psychosocial factor in that no significant correlation was found between the first and the last assessments; significant rank-order stability correlation coefficients ranged from .22 to .71 and overall demonstrated less rank-order stability than did the general psychosocial factor. Furthermore, the mean rank-order stability coefficient for the university-specific psychosocial factor was .394, notably less than for the general psychosocial factor. Although the moderate levels of rank-order stability between phases for the university-specific psychosocial factor correspond well to the lack of mean-level change for the group over the course of the study, there was less stability in the rankings of participants in relationship to each other. This indicates that despite the overall lack of change in the group means for the university-specific psychosocial factor, the score rankings between people reflect low levels of stability, less than that seen in the general psychosocial factor. Taken together, university-specific psychosocial factors may vary more over the course of a year than general psychosocial factors which suggests that the university setting may serve to destabilize relevant psychosocial factors when compared to those experienced by the general population.

9.5 Correlating Personality and Psychosocial Factors

Having determined the General and University-Specific Psychosocial Factors through data reduction, it is worth examining how well each of the five personality traits correlated with the psychosocial factors. Tables 9.6a-e present the correlations between all psychosocial factors and each of the Big Five traits at each of the four assessments.

Table 9.6a – Spearman's rank-order correlations between Neuroticism and all psychosocial factors

Neuroticism	Phase				
	1	2	3	4	Mean
Life Experiences	-.22***	-.35***	-.16	-.27**	-.25**
Self-Esteem	-.60***	-.65***	-.66***	-.67***	-.65***
Life Satisfaction	-.48***	-.55***	-.56***	-.54***	-.53***
General Health	.55***	.48***	.34***	.37***	.44***
Perceived Stress	.66***	.65***	.56***	.64***	.63***
Loneliness	.49***	.43***	.36***	.33**	.40**
Cognitive - Functional	-.11	-.11	-.14	-.02	-.10
Cognitive - Structural	-.03	.09	-.08	-.08	-.03
Interaction with Students	-.28***	-.31***	-.24**	-.03	-.21**
Interaction with Professors	-.23***	-.33***	-.14	.03	-.17
Positive Affect	-.25***	-.14	-.36***	-.27**	-.25**
Negative Affect	.50***	.57***	.52***	.20	.45***
General Psychosocial	-.66***	-.70***	-.63***	-.63***	-.66***
University Psychosocial	-.11	-.08	-.21*	.07	.24**
Median absolute correlation	.38	.39	.35	.27	.33

* = p < .05; ** = p < .01; *** = p < .001

Neuroticism correlated highly significantly in the expected direction with those negative psychosocial factors. For example, lower self-esteem and life satisfaction was associated with higher Neuroticism at all four time points. Positive correlations between higher scores, indicating poorer outcomes, were found between Neuroticism and General Health Questionnaire scores, perceived stress, and loneliness. Interestingly, Neuroticism did not significantly correlate to Cognitive Quality of University Life scores at any time points indicating that this trait may not necessarily be linked to academic perceptions of the university. Furthermore, it is worth noting that the significant correlations were strongly correlated with most at the 1% level.

Table 9.6b – Spearman's rank-order correlations between Extraversion and all psychosocial factors

Extraversion	Phase				
	1	2	3	4	Total
Life Experiences	.19**	.30***	.31**	.26*	.26*
Self-Esteem	.47***	.41***	.39***	.42***	.42***
Life Satisfaction	.33***	.38***	.20*	.27**	.30**
General Health	-.21***	-.26***	-.25*	-.22*	-.24*
Perceived Stress	-.34***	-.29***	-.23*	-.30**	-.29**
Loneliness	-.64***	-.59***	-.43***	-.44***	-.53***
Cognitive - Functional	.20**	.24**	.06	.12	.16*
Cognitive - Structural	.08	.15	.08	-.01	.07
Interaction with Students	.51***	.51***	.38***	.18	.40***
Interaction with Professors	.14*	.20*	.04	-.09	.02
Positive Affect	.25***	.32***	.20*	.24*	.28*
Negative Affect	-.29***	-.40***	-.25*	.02	-.23*
General Psychosocial	.48***	.51***	.41***	.43***	.46***
University Psychosocial	.23***	.34***	.21*	.17	.24*
Median absolute correlation	.27	.33	.24	.23	.27

* = p < .05; ** = p < .01; *** = p < .001

For Extraversion, there were positive correlations at all four phases with those psychosocial factors having positive characteristics, such as occurring with higher scores for life experiences, self-esteem, and life satisfaction. Furthermore, there were consistent significant correlations at all four time points for those psychosocial factors possessing negative attributes such as general mental health, perceived stress, and loneliness. Again, the university-specific psychosocial factors did not correlate significantly at all four time points suggesting that these psychosocial factors are subject to environmental perceptions that vary during the academic year. Furthermore, these correlations, although significant, did not demonstrate as strong of a relationship to Extraversion as did Neuroticism.

Table 9.6c – Spearman's rank-order correlations between Openness and all psychosocial factors

Openness	Phase				
	1	2	3	4	Total
Life Experiences	.18**	.16	.34***	.21*	.22*
Self-Esteem	.29***	.24**	.18	.03	.18
Life Satisfaction	.18**	.16	.07	.03	.11
General Health	-.19**	-.12	-.08	-.03	-.11
Perceived Stress	-.34***	-.26***	-.14	-.17	-.23*
Loneliness	-.13*	.01	.03	.13	.01
Cognitive - Functional	.10	.29***	.24*	.01	.16
Cognitive - Structural	.02	.06	-.03	-.03	.01
Interaction with Students	.14*	.14	.12	-.09	.08
Interaction with Professors	.20**	.24**	.10	-.06	.12
Positive Affect	.25***	.12	.31**	.11	.20*
Negative Affect	-.22***	-.07	-.26**	-.07	-.16
General Psychosocial	.29***	.18*	.22*	.11	.20*
University Psychosocial	.14*	.16	.21*	-.01	.12
Median absolute correlation	.19	.16	.16	.07	.14

* = p < .05; ** = p < .01; *** = p < .001

Openness did not significantly correlate at every assessment for any psychosocial variable. The first phase had the most significant correlations between the psychosocial factors and Openness; this relationship was not maintained throughout the study. Interestingly, by the fourth phase of the study at the beginning of the second academic year, Openness only significantly correlated with Life Experience scores.

Table 9.6d – Spearman's rank-order correlations between Agreeableness and all psychosocial factors

Agreeableness	Phase				
	1	2	3	4	Total
Life Experiences	.11	.10	.26*	.21*	.17*
Self-Esteem	.22***	.21*	.39***	.28**	.27*
Life Satisfaction	.27***	.24**	.28**	.29**	.27*
General Health	-.09	-.06	-.28**	-.26*	-.17*
Perceived Stress	-.16*	-.09	-.35***	-.36**	-.22*
Loneliness	-.39***	-.29***	-.39***	-.26**	-.38*
Cognitive - Functional	-.19**	.09	.05	.15	.12
Cognitive - Structural	.12*	.12	-.01	.09	.08
Interaction with Students	.33***	.28***	.16	.09	.22*
Interaction with Professors	.14*	.21*	.09	-.02	.11
Positive Affect	.21***	.20*	.15	.20*	.19*
Negative Affect	-.21***	-.24**	-.30**	-.02	-.20*
General Psychosocial	-.27***	.25**	.42***	.41***	.34**
University Psychosocial	-.24***	.21*	.10	.07	.16*
Median absolute correlation	.21	.21	.27	.21	.20

* = p < .05; ** = p < .01; *** = p < .001

Life satisfaction and self-esteem consistently correlated positively with Agreeableness at all four time points; loneliness was negatively correlated with Agreeableness throughout the study. Again, these correlations were moderate at best and not quite as high as the relationship between these factors and Neuroticism. Furthermore, the correlations between Agreeableness and certain psychosocial factors, such as all of the university-specific psychosocial factors, were not always significantly correlated, suggesting that student perception of these psychosocial factors in relationship to Agreeableness changed in accordance with differing perceptions of the university.

Table 9.6e – Spearman's rank-order correlations between Conscientiousness and all psychosocial factors

Conscientiousness	Phase				
	1	2	3	4	Total
Life Experiences	.00	.00	.12	-.06	.02
Self-Esteem	.17*	.08	.32**	.12	.18*
Life Satisfaction	.20***	.19*	.19	.13	.18*
General Health	-.17**	-.05	-.02	.10	-.04
Perceived Stress	-.16*	-.13	-.02	.07	-.06
Loneliness	-.08	-.05	-.17	-.03	-.08
Cognitive - Functional	.29***	.12	.03	.12	.14
Cognitive - Structural	.10	-.01	-.02	.20	.07
Interaction with Students	.07	-.07	.20*	.02	.05
Interaction with Professors	.12*	.12	.20*	.02	.11
Positive Affect	.31***	.11	.23*	.13	.19*
Negative Affect	-.15*	-.10	-.16	.10	-.08
General Psychosocial	.18**	.11	.18	.01	.12
University Psychosocial	.28***	.07	.15	.02	.13
Median absolute correlation	.17	.10	.17	.09	.10

* = p < .05; ** = p < .01; *** = p < .001

The fewest correlations overall between the psychosocial factors and any of the personality traits were found in comparisons to Conscientiousness. This trait may relate the least to any of the measured psychosocial factors in the present study. Furthermore, the first phase reflected the greatest number of significant correlations to Conscientiousness; as the study progressed, fewer significant correlations were found with the final phase at the beginning of the second year as showing no significant correlations between Conscientiousness and any psychosocial factor.

9.6 Outcome Measures

Thus far, the data presented has considered basic changes over time of the measured variables. This study also measured outcomes of academic success in the form of exam marks and immune functioning through salivary levels of sIgA. This section will present the descriptive statistics of these outcome variables along with correlates of these outcomes.

9.6.1 Exam Marks

Table 9.7 presents the descriptive statistics for exam marks at the end of the first academic year. Due to students dropping out of university, the number of exam marks is less than the number of participants who completed the first phase of the study.

Table 9.7 – Summary statistics for final first year exam marks

	Mean	**SD**	**SEM**	**Min**	**Max**	**N**
Exam Mark	**61.31**	**9.781**	**0.655**	**9.5**	**90.43**	**223**
male	60.31	10.696	1.211	29.14	86.33	78
female	61.85	9.246	0.768	9.5	90.43	145

SD = standard deviation; SEM = standard error of the mean; Min = minimum; Max = maximum

Exam marks did not significantly differ by gender.

In order to better understand the relationship between measured variables and outcome measures, correlations were calculated between personality traits and psychosocial variables and the outcome measures. Table 11.8 summarizes the correlations for exam marks; exam marks were found to be normally distributed (Kolmogorov-Smirnoff Z (223) = 1.188, $p = .119$) so Pearson's correlation coefficients (r) were calculated.

Table 9.8 – Pearson's product-moment correlation coefficients and significance values for exam marks with each measured variable; significant correlations are marked with an asterisk

Variable	Phase	Pearson's r	*p*-value
Neuroticism	**1**	0.04	.56
	2	0.08	.37
	3*	0.23	.02
Extraversion	**1**	-0.06	.34
	2	-0.14	.13
	3*	-0.36	<.001
Openness	**1**	-0.04	.59
	2	-0.10	.28
	3	0.01	.94
Agreeableness	**1**	-0.03	.68
	2	-0.04	.63
	3	-0.20	.054
Conscientiousness	**1**	0.00	.99
	2*	0.21	.02
	3	0.11	.31
Self-Esteem	**1**	0.03	.68
	2	-0.04	.63
	3	-013	.18
Loneliness	**1**	-0.03	.61
	2	0.08	.38
	3*	0.22	.03
General Health	**1***	-0.14	.03
	2	-0.01	.88
	3*	0.20	.04
Life Satisfaction	**1**	0.01	.91
	2	-0.01	.95
	3	0.00	.99
Cognitive - Structural	**1***	-0.14	.04
	2	-0.12	.19
	3*	-0.22	.03
Cognitive - Functional	**1**	-0.07	.29
	2	-0.08	.37
	3*	-0.24	.02
Interaction with	**1**	0.01	.85

Students	2	0.07	.41
	3	-0.13	.18
Positive Affect	1*	-0.15	.02
	2	-0.07	.43
	3	-0.08	.40
Negative Affect	1	-0.01	.90
	2	-0.02	.86
	3	0.04	.66
Interaction with Professors	1	-0.08	.23
	2	0.10	.27
	3	-0.00	.99
Perceived Stress	1	-0.06	.40
	2	-0.04	.71
	3	0.10	.34
Life Experiences	1	0.02	.73
	2	-0.06	.55
	3	-0.06	.56
University-Specific Psychosocial Factor	1*	-0.16	.02
	2	-0.08	.39
	3*	-0.23	.02
General Psychosocial Factor	1	0.06	.40
	2	0.01	.88
	3	-0.10	.35

Table 9.8 indicates a significant negative correlation between Extraversion at the third phase around final exam time and mean grades ($r = -0.36, p < .001$); this is probably due to students spending more time studying and less time socializing prior to examinations received higher marks. Interestingly, this correlation was not significant at the two prior time points which indicates that the nature of the Extraversion trait in being associated with exam marks has the potential to demonstrate change during the first-year of university. Additionally, there was a significant positive correlation between Neuroticism and exam marks at this time ($r = 0.23, p < 0.5$); higher levels of Neuroticism during exam time, which may have led

to increased doubt of mastery of the exam material and therefore led to increased studying, correlated with higher exam marks. At the same time point, loneliness was found to significantly correlate with exam marks ($r = 0.22$, $p = .026$); students who had higher academic achievement reported more loneliness in that the higher marks may have required increased studying in solitude during the exam period. Also at the third assessment, general mental health as obtained from self-reported scores from the General Health Questionnaire was found to be positively correlated with exam marks ($r = .20$, $p = .037$); in other words, higher levels of distress correlated with higher grades.

Also at the third assessment near exam time, in examining university-specific psychosocial factors, both the Functional and Structural components of the Cognitive Domain of the Quality of University Student scales negatively correlated with exam marks (Structural: $r = -.219$, $p = .025$; Functional: $r = -.237$, $p = .015$). Students earning higher marks did not feel that the University of Edinburgh was a setting in which they were encouraged and equipped to learn both the facts and the tools necessary to academically excel. Although none of the other university-specific psychosocial factors alone were significantly correlated with exam marks at this assessment, the overall factor negatively correlated with exam marks ($r = -.227$, $p = .023$), indicating that more negative ratings of the university experience were associated with better academic success.

Interestingly, Conscientiousness was only significantly positively correlated with exam marks at the second time point just after winter break ($r = .21$, $p = .02$) and not at the other two time points. Although previous literature has supported a positive link between academic performance and Conscientiousness, this correlation was not found in the present sample. Certain courses have exams just before winter break and marks are released just after the break; this mid-year benchmark may have given enough reason for students to have increased studying in order to obtain better year-end grades.

Finally, at the first assessment, Positive Affect from the Affective Domain of the Quality of University Student Life Scale ($r = -.151$, $p = .024$) correlated negatively with exam score; students who were initially low in positive affect scores performed better on final exams. This may have contributed to feelings of loneliness and worse mental health at a later stage. Furthermore, a significant negative correlation was found between the Structural component of the Cognitive Domain and exam marks ($r = -.138$, $p = .039$) whereby students ranking the University of Edinburgh as not providing a setting for learning new facts at the first assessment were found to have higher grades at the end of the first year. An additional significant correlation was found between the university-specific psychosocial factor at the first assessment and final exam marks ($r = -.155$, $p = .021$) whereby initial negative perceptions of the psychosocial surroundings of the university were found to correlate with higher exam marks. Finally, general mental health at the first assessment was found to negatively correlate with exam marks ($r = -.142$, $p = .034$); these initial measures may have been due to the initial impact of starting university as being somewhat negative and were manifested through these variables which ultimately contributed to better academic achievement over the course of the first academic year.

9.6.2 Salivary Secretory Immunoglobulin-A

Table 9.9 presents descriptive statistics for salivary sIgA secretion rate.

Table 9.9 – Salivary sIgA secretion rate for all time points

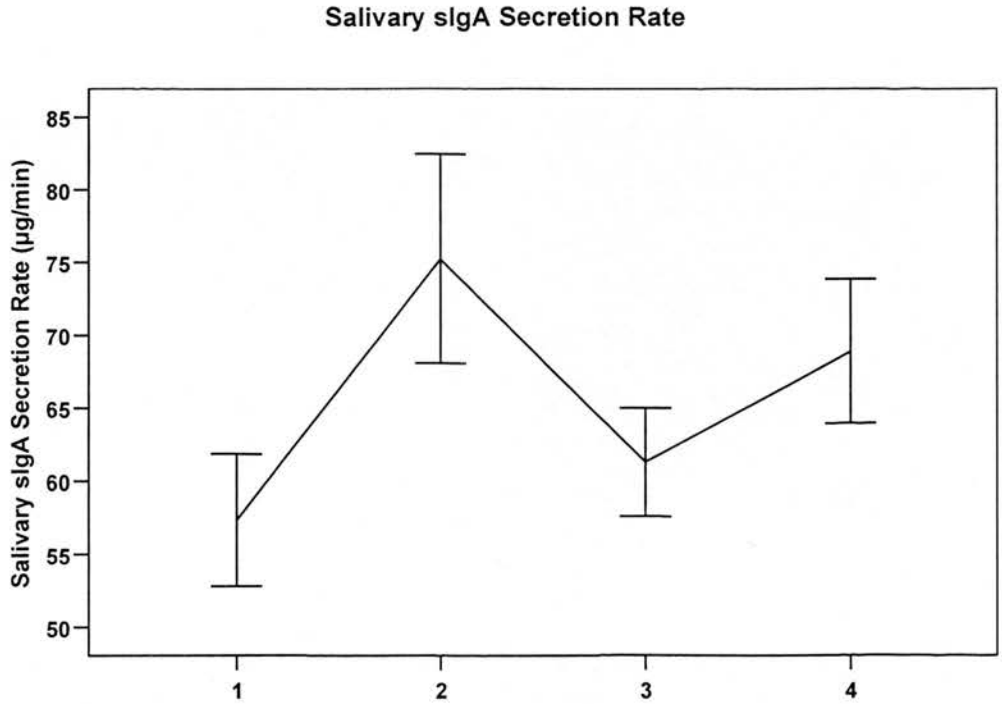
	Mean (μg/min)	SD	SEM	Min	Max	N
Phase 1	**57.34**	**37.09**	**4.53**	**6.80**	**204.93**	**67**
male	59.67	39.87	7.67	15.59	204.93	27
female	55.77	35.52	5.62	6.80	152.66	40
Phase 2 (1)	**75.30**	**56.93**	**7.17**	**11.56**	**418.99**	**63**
male	89.52	76.85	15.69	20.15	418.99	24
female	66.56	38.82	6.22	11.56	191.45	39
Phase 3 (1)	**61.33**	**23.72**	**3.71**	**23.04**	**117.26**	**41**
male	68.55	24.95	6.44	26.79	117.26	15
female	57.16	22.42	4.40	23.04	100.85	26
Phase 4*	**68.95**	**36.54**	**4.97**	**1.41**	**198.94**	**54**
male	86.09	39.78	8.90	24.80	198.94	20
female	58.86	30.83	5.29	1.41	130.44	34

Numbers in brackets after a phase indicate significant different phases; an asterisk indicates significant gender differences at that phase

Independent samples t-tests indicated that there was mean-level change between phase 1 and 2 along with phase 1 and 3 ($p < .025$); no other phases were significantly different from each other. Furthermore, there was a significant gender difference in sIgA secretion rates only at phase 4($p < .025$).

The mean sIgA secretion rates at each time point are presented in Figure 9.5.

Figure 9.5 – Mean sIgA secretion rate (bars represent standard error of the mean)

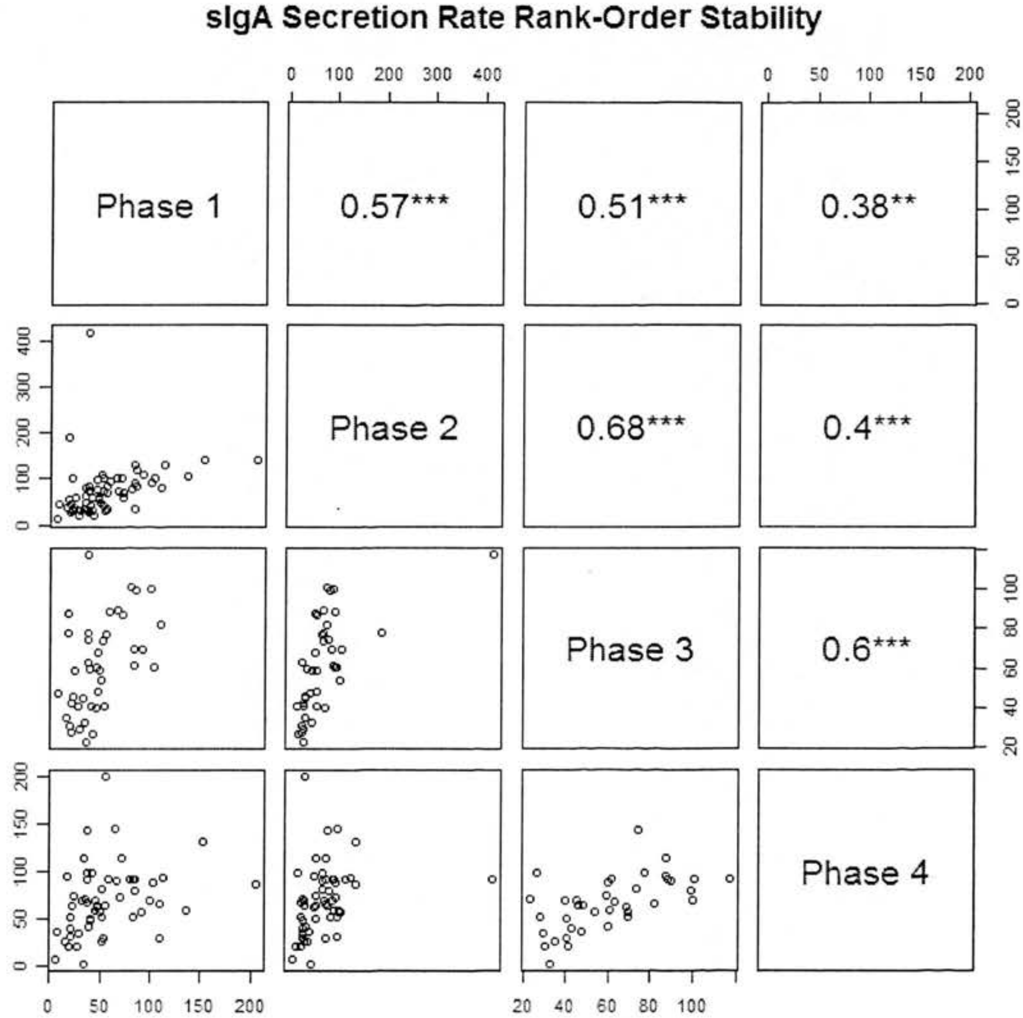


Phase 1 and 2 were significantly different (57.34 µg/min vs. 75.30 µg/min, $p < .05$); Phase 1 and 4 were significantly different (57.34 µg/min vs. 68.95 µg/min, $p < .05$); and Phase 2 and 3 were significantly different (75.30 µg/min vs. 61.33 µg/min, $p < .05$) (See Figure 9.5). These findings indicate that there was mean-level change over time, and that the beginning of the academic year and exam time (Phases 1 and 3) demonstrated decreased salivary sIgA activity, indicating a lower immune response, whereas the time just after winter break and the beginning of the second academic year (Phases 2 and 4) were marked with better oral mucosal immunity through higher salivary sIgA secretion rates.

sIgA secretion rates were not normally distributed in that the Kolmogorov-

Smirnoff tests for normality were significant (Kolmogorov-Smirnoff Z range: .156 - .283, all $p < .05$), so Spearman's correlation coefficients (ϱ) were calculated.

Figure 9.6 – Correlations and scatter plots for the sIgA secretion rates across all assessments (** = $p < .01$, *** = $p < .005$)



There was high rank-order stability in sIgA secretion rates in that all phases were significantly correlated to all other phases as shown in Figure 9.6.

Turning to salivary sIgA secretion rate, Table 9.10 summarizes its correlations to the other measured variables. As mentioned earlier, the salivary sIgA secretion rates were not normally distributed, so Spearman's correlation coefficients are presented.

Table 9.10 – Correlation coefficients between salivary sIgA and other measured variables at each time point

	Phase 1	Phase 2	Phase 3	Phase 4
Neuroticism	-0.170	-0.124	-0.041	-0.185
Extraversion	0.093	0.122	-0.005	0.083
Openness	0.080	**0.330****	0.192	0.201
Agreeableness	**-0.294***	-0.151	-0.207	-0.034
Conscientiousness	0.044	0.041	0.073	-0.084
Self-esteem	0.067	0.119	0.235	0.161
Loneliness	0.075	-0.025	0.151	0.089
General Health	0.061	-0.183	0.102	-0.040
Satisfaction with Life	0.014	-0.040	0.122	0.036
Perceived Stress	-0.079	-0.175	-0.107	-0.262
Life Experiences	-0.108	**0.234+**	0.258	0.157
Cognitive - Structural	-0.005	0.120	0.009	-0.203
Cognitive - Functional	0.069	0.057	-0.095	-0.010
Interaction with Students	-0.149	**0.219+**	0.183	-0.032
Interaction with Professors	0.005	0.210	0.171	-0.083
Positive Affect	**0.214+**	-0.130	0.099	0.027
Negative Affect	0.052	-0.077	0.061	-0.108
University Psychosocial Factor	0.089	0.145	-0.023	-0.129
General Psychosocial Factor	-0.027	0.055	0.118	0.079

+ = $p < .09$; * = $p < .05$, ** = $p < .01$

Salivary sIgA secretion rates were found to negatively correlate with self-reported Agreeableness scores only at the first phase and were found to positively correlate with Openness scores at the second phase. Correlations approached significance between sIgA secretion rates for Positive Affect at the first phase and between sIgA rates and Life Experiences and Interaction with Students scores at the second phase. No other correlations at any individual time points were significant.

Using paired samples t-tests, exam scores were not correlated with any salivary sIgA secretion rates at any time ($p > .05$).

9.7 Regression Analysis

Initially, exam marks were regressed on to each measured variable at each of the preceding three assessments. Those statistically significant regressions are presented in Table 9.11.

Table 9.11 – Linear regression for individual variables predicting exam scores

Phase	Variable	n	B	SE B	β	R^2	p
1	General Health	222	-.258	.121	-.142	.020	.034
	Cognitive - Structural		-.287	.138	-.138	.019	.039
	Affective - Positive Affect		-.188	.083	-.151	.023	.024
	University-Specific Psychosocial Factor		-1.546	.665	-.155	.024	.021
2	Conscientiousness	120	2.047	.822	.223	.050	.014
3	Extraversion	100	-3.312	.927	-.349	.122	.001
	General Health		.347	.176	.204	.042	.037
	Loneliness		.198	.088	.217	.047	.026
	Cognitive - Structural		-.453	.199	-.219	.048	.025
	Cognitive - Functional		-.322	.130	-.237	.056	.015
	University-Specific Psychosocial Factor		-2.008	.869	-.227	.052	.023

As expected, the β weights and p-values matched those values obtained from the correlation analysis presented in Table 9.8. This table indicates that no one trait or psychosocial variable accounted for first-year final exam marks consistently over the four assessments. Interestingly, only Extraversion scores near exam time demonstrated the highest contribution to the variance in exam score (12.2%); none of the other variables were able to account for more than 5.6% of the variance in grades at any time point. Considering each variable independently provides an idea of those factors that may influence exam marks. However, it is worth considering multiple predictors of academic achievement through multiple regression.

9.7.1 Linear Growth Curve Modeling in Predicting Exam Marks

Although individual assessments can be examined in relation to academic performance, using all available time points to determine if trends in personality and psychosocial factors influence exam marks best utilizes how stability and change over time in these measured variables might impact achievement.

Table 9.12 presents the results from growth curve modeling whereby the scores from the first three assessments for each variable were used to predict exam marks. Both slopes and intercepts were considered random effects in the models; restricted maximum likelihood (REML) estimation was employed. Only the first three time points were used in the model in that the fourth assessment occurred after final exams.

Table 9.12a – Growth curve modeling with traits and exam marks

	C	O	E	A	N
χ^2 value	156.671	0.968	0.522	191.421	147.49
χ^2 df	2	2	2	2	2
***p*-value**	0	0.6165	0.7703	0	0
Baseline χ^2 value	48.252	140.564	138.206	61.468	81.324
Baseline χ^2 df	6	6	6	6	6
Baseline *p*-value	0	0	0	0	0

CFI	0	1	1	0	0
TFI	-9.982	1.023	1.034	-9.245	-4.795
H0 loglikelihood	-587.604	-447.838	-450.295	-588.417	-559.221
H1 loglikelihood	-509.268	-447.354	-450.034	-492.706	-485.476
Free parameters	12	12	12	12	12
AIC	1199.208	919.675	924.59	1200.833	1142.442
BIC	1222.623	946.132	951.046	1224.248	1165.857
Sample Size Adj BIC	1184.939	908.348	913.262	1186.564	1128.173
RMSEA estimate	1.22	0	0	1.35	1.183
90% CI	1.026 to 1.385	0 to 0.196	0 to 0.161	1.192 to 1.515	1.025 to 1.348
Prob. RMSEA ≤ .05	0	0.663	0.802	0	0
SRMR	5.292	0.017	0.014	0	4.231
Exam on Intercept	**-0.027**	-3.045	-3.409	**0.017**	**-0.056**
Exam on Slope	0.010	-11.566	-10.232	**0.065**	**-0.054**
Slope with Intercept	7.171	-0.15	-0.227	84.057	11.509
Intercept Mean	0.909	0.061	-0.059	3.537	1.559
Slope Mean	-0.246	**0.006**	**0.087**	-1.388	-0.118
Intercept Variance	-38.323	0.871	1.019	-210.309	-73.223
Slope Variance	8.927	0.131	0.155	-19.741	20.552
R^2 Phase 1	0.000	0.000	0.000	0.000	0.000
R^2 Phase 2	0.000	0.757	0.734	0.000	0.000
R^2 Phase 3	0.000	0.886	0.927	0.000	0.000
R^2 Exam	0.000	0.171	0.139	0.001	0.000

Significant ($p < .05$) values are in bold

Table 9.12a suggests that Openness, Extraversion, and Agreeableness were good predictors of exam marks over time, with the last two assessments' trait variance contributing greatly to the overall variance in final exam scores.

Table 9.12b – Growth curve modeling with psychosocial factors and exam marks

	Life Experiences	Perceived Stress	Satisfaction with Life	GHQ	Loneliness	Self Esteem
χ^2 value	0.599	0.88	6.122	1.069	8.637	6.061
χ^2 df	2	2	2	2	2	2
p-value	0.741	0.6442	0.0468	0.5859	0.0133	0.0483
Baseline χ^2 value	54.490	53.057	134.563	25.632	105.278	164.963
Baseline χ^2 df	6.000	6	6	6	6	6
Baseline p-value	0.000	0.000	0.000	0.003	0.000	0.000
CFI	1.000	1	0.968	1	0.933	0.974
TFI	1.087	1.071	0.904	1.142	0.799	0.923
H0 loglikelihood	-1053.258	1076.238	-987.766	-991.414	-1121.466	-910.747
H1 loglikelihood	-1082.958	-1075.798	-984.705	-990.88	-1117.148	-907.717
Free parameters	12	12	12	12	12	12
AIC	2130.516	2176.475	1999.533	2006.828	2266.932	1845.495
BIC	2158.641	2205.209	2028.266	2035.562	2295.517	1874.079
Sample Size Adj BIC	2120.812	2167.365	1990.422	1997.718	2257.676	1836.239
RMSEA estimate	0.000	0.000	0.16	0.000	0.204	0.159
90% CI	0 to 0.157	0 to 0.173	0.016 to 0.311	0 to 0.183	0.079 to 0.351	0.012 to 0.312
Prob. RMSEA ≤ .05	0.780	0.697	0.077	0.645	0.026	0.079
SRMR	0.016	0.019	0.039	0.027	0.054	0.038
Exam on Intercept	-0.088	0.032	-0.249	-0.837	0.301	-0.373
Exam on Slope	-0.608	0.394	3.752	0.554	0.669	0.764
Slope with Intercept	-4.205	-5.307	0.150	-0.682	-22.857	2.408
Intercept Mean	8.236	22.602	24.052	10.343	41.543	21.233
Slope Mean	-1.061	0.481	0.767	0.531	-0.327	0.066

Intercept Variance	35.067	26.268	20.955	1.730	88.847	11.442
Slope Variance	5.109	8.120	0.670	5.634	18.581	-0.905
R^2 Phase 1	0.471	0.571	0.108	0.085	0	0.606
R^2 Phase 2	0.548	0.5	0.714	0.277	0.621	0.868
R^2 Phase 3	0.693	0.835	0.766	0.994	0.826	0.688
R^2 Exam	0.023	0.015	0.131	0.044	0.089	0.000

Significant ($p < .05$) values are in bold

Table 9.12b indicates that all general psychosocial factors contribute in predicting end-of-year exam marks as demonstrated by SRMR values less than .05.

Table 9.12c – Growth curve modeling with the cognitive quality of university life factors and exam marks

	Structural	**Functional**
χ^2 value	5.43	4.118
χ^2 df	2	2
***p*-value**	0.0662	0.1276
Baseline χ^2 value	75.501	89.395
Baseline χ^2 df	6	6
Baseline *p*-value	0	0
CFI	0.951	0.975
TFI	0.852	0.924
H0 loglikelihood	-916.865	-1031.173
H1 loglikelihood	-914.15	-1029.114
Free parameters	12	12
AIC	1857.731	2086.346
BIC	1886.464	2115.079
Sample Size Adj BIC	1848.62	2077.235

RMSEA estimate	0.146	0.114
90% CI	0 to 0.299	0 to 0.274
Prob. RMSEA ≤ .05	0.104	0.181
SRMR	0.043	0.040
Exam on Intercept	-0.82	-0.342
Exam on Slope	-0.322	-1.083
Slope with Intercept	-1.056	0.833
Intercept Mean	20.992	38.332
Slope Mean	0.576	1.220
Intercept Variance	7.747	18.378
Slope Variance	2.172	2.066
R^2 Phase 1	0.658	0.532
R^2 Phase 2	0.593	0.597
R^2 Phase 3	0.774	0.78
R^2 Exam	0.061	0.065

Significant ($p < .05$) values are in bold

Table 9.12c indicates that both the Functional and Structural components of the quality of university life contribute to a model accounting for exam performance.

Table 9.12d – Growth curve modeling with the affective quality of university life factors and exam marks

	Negative Affect	Positive Affect	Interaction with Professors	Interaction with Students
χ^2 value	0.56	24.661	13.487	21.102
χ^2 df	2	2	2	2
p-value	0.7556	0	0.0012	0
Baseline χ^2 value	106.288	104.228	52.301	49.374

Baseline χ^2 df	6	6	6	6
Baseline p-value	0	0	0	0
CFI	1	0.769	0.752	0.56
TFI	1.043	0.308	0.256	-0.321
H0 loglikelihood	-840.696	-1063.816	-900.009	-895.55
H1 loglikelihood	-840.689	-1051.485	-893.266	-884.999
Free parameters	12	12	12	12
AIC	1705.939	2151.632	1824.018	1815.099
BIC	1734.219	2180.216	1852.299	1843.683
Sample Size Adj BIC	1696.387	2142.376	1814.466	1805.843
RMSEA estimate	0	0.376	0.271	0.346
90% CI	0 to 0.153	0.253 to 0.516	0.147 to 0.417	0.222 to 0.486
Prob. RMSEA ≤ .05	0.794	0	0.003	0
SRMR	0.011	0.102	0.082	0.109
Exam on Intercept	0.068	-0.019	0.392	-1.251
Exam on Slope	0.109	-0.448	1.283	-5.252
Slope with Intercept	-2.658	9.609	-16.08	-2.218
Intercept Mean	8.660	46.961	32.422	19.349
Slope Mean	0.255	0.089	-1.148	-0.499
Intercept Variance	10.550	16.058	8.542	8.166
Slope Variance	2.414	-3.883	1.187	0.975
R^2 Phase 1	0.861	0.277	0.762	0.654
R^2 Phase 2	0.728	0.757	0.466	0.379
R^2 Phase 3	0.916	0.581	0.382	0.394
R^2 Exam	0.000	0.000	0.021	0.132

Significant ($p < .05$) values are in bold

Table 9.12d suggests that only Negative Affect over time impacts exam performance; this relationship is not held up with Positive Affect, Interaction with Students, or Interaction with Professors.

Table 9.12e – Growth curve modeling with the reduced psychosocial factors and exam marks

	General Psychosocial Factor	University Psychosocial Factor
χ^2 value	0.205	0.562
χ^2 df	2	2
p-value	0.9026	0.755
Baseline χ^2 value	101.998	77.457
Baseline χ^2 df	6	6
Baseline p-value	0	0
CFI	1	1
TFI	1.056	1.06
H0 loglikelihood	-492.449	-500.253
H1 loglikelihood	-492.337	-499.972
Free parameters	12	12
AIC	1008.898	1024.505
BIC	1036.218	1051.825
Sample Size Adj BIC	998.41	1014.018
RMSEA estimate	0.000	0.000
90% CI	0 to 0.099	0 to 0.159
Prob. RMSEA ≤ .05	0.918	0.79
SRMR	0.008	0.014
Exam on Intercept	-0.929	-2.684

Exam on Slope	-0.721	-2.313
Slope with Intercept	-0.068	-0.073
Intercept Mean	0.110	0.017
Slope Mean	**-0.05**	**-0.079**
Intercept Variance	0.656	0.504
Slope Variance	0.167	0.148
R^2 Phase 1	0.79	0.764
R^2 Phase 2	0.663	0.65
R^2 Phase 3	1.07	0.812
R^2 Exam	0.007	0.048

Significant ($p < .05$) values are in bold

Overall, from Table 9.12e, both the general and the university specific psychosocial factors serves as good components of a model predicting exam marks.

9.7.1.1 Exam Marks as a Predictor of Personality and Psychosocial Factors

In addition, one can examine the correlation between exam marks, personality traits, and psychosocial factors that were obtained after the third assessment but before the fourth assessment to determine if exam marks subsequently influenced personality or psychosocial variables; this data is presented in Table 9.13.

Table 9.13 –Pearson's product-moment correlation coefficients and significance values for exam marks with each measured variable at the 4th assessment; significant correlations are marked with an asterisk

Variable	Pearson's ϱ	*p*-value
Neuroticism	**0.01**	.96
Extraversion*	**-0.33**	.001
Openness	**0.09**	.38
Agreeableness	**-0.06**	.57
Conscientiousness*	**0.22**	.03
Self-Esteem	**-0.19**	.06
Loneliness*	**0.23**	.03
General Health	**0.12**	.26
Satisfaction with Life	**-0.13**	.20
Cognitive - Structural	**-0.19**	.07
Cognitive - Functional*	**-0.24**	.02
Interaction with Students*	**-0.28**	.007
Positive Affect	**-0.10**	.33
Negative Affect*	**-0.24**	.023
Interaction with Professors*	**0.28**	.007
Perceived Stress	**-0.01**	.95
Life Experiences	**0.08**	.45
University Psychosocial*	**-0.31**	.003
General Psychosocial	**-0.17**	.11

Table 9.13 presents interesting correlations between year-end grades and Phase 4 variables, such as higher exam marks associated with lower Extraversion ($\varrho = -0.33$), higher Conscientiousness ($\varrho = 0.22$), greater loneliness ($\varrho = 0.23$), lower Functional rankings of the Cognitive Domain of University Life ($\varrho = -0.24$), decreased ratings of student interaction ($\varrho = -0.28$), a lower overall University-specific psychosocial factor score ($\varrho = -0.31$); students with higher exam marks reported better Interactions with Professors ($\varrho = 0.28$) at the beginning of the second academic year.

9.7.2 Linear Growth Curve Modeling in Salivary sIgA Secretion Rates

Individual differences in changes over time in personality traits and psychosocial factors in predicting salivary sIgA release rate were examined using growth curve modeling. Both slopes and intercepts were considered random effects in the models; restricted maximum likelihood (REML) estimation was employed.

Table 9.14a - Growth curve modeling with traits and salivary sIgA release rates

	C	A	O	E	N
χ^2 value	147.94	174.61	28.594	165.866	136.894
χ^2 df	24	24	24	24	24
p-value	0	0	0.2358	0	0
Baseline χ^2 value	145.29	152.656	141.432	141.503	125.438
Baseline χ^2 df	28	28	28	28	28
Baseline *p*-value	0	0	0	0	0
CFI	0	0	0.959	0	0
TFI	-0.233	-0.41	0.953	-0.458	-0.352
H0 loglikelihood	-963.179	-975.872	-831.401	-970.569	-975.494
H1 loglikelihood	-889.209	-888.567	-817.104	-887.636	-907.047
Free param	20	20	20	20	20
AIC	1966.358	119.745	1702.802	1981.139	1990.987
BIC	1997.465	2022.852	1733.909	20.12.246	2022.094
Sample Size Adj BIC	1935.015	1960.402	1671.459	1949.796	1959.645
RMSEA estimate	0.384	0.423	0.074	0.411	0.367
90% CI	0.326 to 0.445	0.366 to 0.483	0 to 0.163	0.353 to 0.471	0.308 to 0.427
Prob. RMSEA ≤ .05	0.000	0.000	0.338	0.000	0
SRMR	3.971	5.729	0.124	5.1	2.271

Slope on sIgA Intercept	**0.003**	**0.002**	**-0.008**	**-0.007**	**0.002**
sIgA on Intercept	3.257	1.106	-2.359	-0.852	0.148
sIgA Intercept with Intercept	-9.772	-0.672	5.73	-0.638	-2.462
sIgA Slope with Slope	-0.107	-0.282	1.021	0.459	0.577
Intercept Mean	-0.032	0.243	0.009	0.102	-0.111
sIgA Intercept Mean	50.436	50.639	50.5	50.561	50.581
Intercept Variance	0.677	0.898	0.654	0.558	0.781
sIgA Intercept Variance	444.306	383.453	402.092	387.721	397.608
R^2 Phase 1	0.000	0.000	0.684	0.000	0
R^2 Phase 2	0.741	0.835	0.623	0.65	0.745
R^2 Phase 3	0.802	0.782	0.732	0.85	0.718
R^2 Phase 4	0.898	0.499	0.959	0.702	0.41
sIgA R^2 Phase 1	0.551	0.478	0.508	0.49	0.494
sIgA R^2 Phase 2	0.105	0.103	0.099	0.103	0.106
sIgA R^2 Phase 3	0.801	0.807	0.808	0.828	0.845
sIgA R^2 Phase 4	0.569	0.556	0.554	0.546	0.541
Slope R^2	0.12	0	0.327	0	0
sIgA Slope R^2	0.243	0.07	0.167	0.026	0.001
Significant ($p < .05$) values are in bold					

Table 9.14a demonstrates that none of models incorporating traits and salivary sIgA release rates were significant.

Table 9.14b - Growth curve modeling with general psychosocial factors and salivary sIgA release rates

	Life Experiences	Perceived Stress	Satisfaction with Life	GHQ	Loneliness	Self-Esteem
χ^2 value	36.404	23.017	43.509	50.816	37.764	36.868
χ^2 df	24	24	24	24	24	24
***p*-value**	0.0501	0.5188	0.0087	0.0011	0.0336	0.0451
Baseline χ^2 value	96.763	88.752	131.547	83.768	120.668	166.144
Baseline χ^2 df	28	28	28	28	28	28
Baseline *p*-value	0	0	0	0	0	0
CFI	0.82	1	0.812	0.519	0.851	0.907
TFI	0.79	1.019	0.78	0.439	0.827	0.891
H0 loglikelihood	-1158.094	-1183.781	-1119.229	-1135.167	-1179.469	-1054.1
H1 loglikelihood	-1139.892	-1172.273	-1097.475	-1109.759	-1160.587	-1035.667
Free param	20	20	20	20	20	20
AIC	2356.188	2407.563	2278.459	2310.335	2398.939	2148.201
BIC	2387.858	2439.781	2310.677	2342.553	2430.609	2179.871
Sample Size Adj BIC	2325.378	2377.273	2248.169	2280.045	2368.13	2117.391
RMSEA estimate	0.12	0	0.148	0.174	0.126	0.122
90% CI	0 to 0.195	0 to 0.127	0.074 to 0.217	0.107 to 0.24	0.032 to 0.200	0.019 to 0.197
Prob. RMSEA ≤ .05	0.095	0.636	0.022	0.004	0.073	0.087
SRMR	0.174	0.121	0.129	0.15	0.128	0.149
Slope on sIgA Intercept	**-0.028**	**0.016**	**-0.036**	**0.023**	**0.106**	**-0.011**
sIgA on Intercept	1.03	-0.376	-0.347	-1.46	0.366	0.264
sIgA Intercept with Intercept	17.749	-22.138	24.642	-16.038	-73.747	20.698
sIgA Slope with Slope	-4.125	-0.936	4.581	1.187	-3.299	1.888

Intercept Mean	8.319	22.037	24.886	10.557	37.938	22.136
sIgA Intercept Mean	47.52	48.558	48.544	48.628	49.371	49.464
Intercept Variance	25.133	20.633	15.061	3.579	48.515	10.844
sIgA Intercept Variance	278.768	306.318	327.976	274.924	344.477	332.776
R^2 Phase 1	0.344	0.385	0.665	0.157	0.476	0.637
R^2 Phase 2	0.435	0.475	0.648	0.153	0.493	0.694
R^2 Phase 3	0.371	0.422	0.621	0.076	0.797	0.69
R^2 Phase 4	0.173	0.398	0.454	0.091	0.7	0.97
sIgA R^2 Phase 1	0.4	0.436	0.458	0.39	0.482	0.445
sIgA R^2 Phase 2	0.087	0.091	0.089	0.089	0.084	0.098
sIgA R^2 Phase 3	0.839	0.772	0.757	0.775	0.741	0.872
sIgA R^2 Phase 4	0.511	0.546	0.549	0.542	0.563	0.601
Slope R^2	0.000	0.000	0.000	0.000	0.606	0.036
sIgA Slope R^2	0.000	0.176	0.077	0.77	0.19	0.034
Significant ($p < .05$) values are in bold						

Table 9.14b indicates that taking all assessments of the psychosocial factors together, none were adequate predictors of sIgA release rate over time. Although the SRMR values approached significance, none were below .05.

Table 9.14c - Growth curve modeling with cognitive quality of university life and salivary sIgA release rates

	Structural	**Functional**
χ^2 value	33.15	30.618
χ^2 df	24	24
p-value	0.101	0.1651
Baseline χ^2 value	98.092	137.616

Baseline χ^2 df	28	28
Baseline *p*-value	0	0
CFI	0.869	0.94
TFI	0.848	0.93
H0 loglikelihood	-1108.838	-1150.46
H1 loglikelihood	-1092.263	-1135.151
Free param	20	20
AIC	2257.676	2340.92
BIC	2289.894	2373.138
Sample Size Adj BIC	2227.386	2310.63
RMSEA estimate	0.102	0.086
90% CI	0 to 0.179	0 to 0.168
Prob. RMSEA ≤ .05	0.173	0.259
SRMR	0.12	0.106
Slope on sIgA Intercept	**-0.043**	**-0.044**
sIgA on Intercept	-0.545	0.445
sIgA Intercept with Intercept	34.979	19.761
sIgA Slope with Slope	3.196	-0.825
Intercept Mean	21.078	41.215
sIgA Intercept Mean	48.409	48.552
Intercept Variance	9.453	18.782
sIgA Intercept	340.284	295.596

Variance		
R^2 Phase 1	0.537	0.417
R^2 Phase 2	0.61	0.702
R^2 Phase 3	0.465	0.569
R^2 Phase 4	0.385	0
sIgA R^2 Phase 1	0.512	0.429
sIgA R^2 Phase 2	0.087	0.088
sIgA R^2 Phase 3	0.719	0.754
sIgA R^2 Phase 4	0.561	0.564
Slope R^2	0.624	0.216
sIgA Slope R^2	0.094	0.208
Significant ($p < .05$) values are in bold		

Table 9.14c indicates that neither the structural nor the functional domains of the cognitive quality of university life predicted in that the SRMR values were not below .05.

Table 9.14d - Growth curve modeling with affective quality of university life and salivary sIgA release rates

	Negative Affect	Positive Affect	Interaction with Professors	Interaction with Students
χ^2 value	28.716	54.839	69.591	55.357
χ^2 df	24	24	24	24
p-value	0.231	0.0003	0	0.0003
Baseline χ^2 value	115.548	173.85	120.77	103.165
Baseline χ^2 df	28	28	28	28

Baseline *p*-value	0	0	0	0
CFI	0.946	0.789	0.509	0.583
TFI	0.937	0.753	0.427	0.513
H0 loglikelihood	-1042.584	-1190.957	-1083.883	-1090.417
H1 loglikelihood	-1028.226	-1163.537	-1049.088	-1062.739
Free param	20	20	20	20
AIC	2125.168	2421.914	2207.767	222.834
BIC	2156.838	2454.132	2239.437	2253.052
Sample Size Adj BIC	2094.359	2391.624	2176.958	2190.544
RMSEA estimate	0.074	0.183	0.23	0.188
90% CI	0 to 0.161	0.121 to 0.252	0.168 to 0.294	0.123 to 0.253
Prob. RMSEA ≤ .05	0.336	0.001	0	0.001
SRMR	0.12	0.136	0.257	0.18
Slope on sIgA Intercept	**0.029**	**-0.021**	**-0.054**	**-0.019**
sIgA on Intercept	-0.327	0.34	0.56	3.274
sIgA Intercept with Intercept	-20.528	0.3657	9.866	11.504
sIgA Slope with Slope	-0.795	3.778	3.742	-0.266
Intercept Mean	8.499	47.876	32.333	20.155
sIgA Intercept Mean	49.504	48.517	49.438	48.641
Intercept Variance	7.495	36.611	7.575	2.626
sIgA Intercept Variance	295.77	316.135	291.329	273.422
R^2 Phase 1	0.579	0.567	0.627	0.173
R^2 Phase 2	0.714	0.645	0.626	0.202

R^2 Phase 3	0.561	0.755	0.3	0.416
R^2 Phase 4	0.663	0.913	0.847	0.898
sIgA R^2 Phase 1	0.409	0.457	0.426	0.378
sIgA R^2 Phase 2	0.086	0.09	0.086	0.095
sIgA R^2 Phase 3	0.77	0.761	0.743	0.842
sIgA R^2 Phase 4	0.536	0.548	0.544	0.514
Slope R^2	0.458	0.029	0.499	0.126
sIgA Slope R^2	0.046	0.217	0.123	0
Significant ($p < .05$) values are in bold				

Again, Table 9.14d indicates that none of the affective factors of the quality of university life served as adequate predictors of sIgA release rates over time.

Table 9.14e - Growth curve modeling with reduced psychosocial factors and salivary sIgA release rates

	General Psychosocial Factor	**University Psychosocial Factor**
χ^2 value	32.908	58.726
χ^2 df	24	24
***p*-value**	0.106	0.0001
Baseline χ^2 value	114.568	108.817
Baseline χ^2 df	28	28
Baseline *p*-value	0	0
CFI	0.897	0.57
TFI	0.88	0.499
H0 loglikelihood	-790.078	-780.83
H1 loglikelihood	-773.624	-751.467
Free param	20	20
AIC	1620.156	1601.66

BIC	1650.683	1632.187
Sample Size Adj BIC	1588.265	1569.769
RMSEA estimate	0.104	0.206
90% CI	0 to 0.186	0.14 to 0.274
Prob. RMSEA ≤ .05	0.174	00000
SRMR	0.151	0.165
Slope on sIgA Intercept	**-0.003**	**-0.037**
sIgA on Intercept	3.756	1.906
sIgA Intercept with Intercept	2.565	4.888
sIgA Slope with Slope	0.123	0.001
Intercept Mean	0.300	0.153
sIgA Intercept Mean	49.357	49.797
Intercept Variance	0.393	0.555
sIgA Intercept Variance	272.643	38.796
R^2 Phase 1	0.453	0.85
R^2 Phase 2	0.614	0.332
R^2 Phase 3	0.584	0.065
R^2 Phase 4	0.592	0.00
sIgA R^2 Phase 1	0.388	0.06
sIgA R^2 Phase 2	0.08	0.028
sIgA R^2 Phase 3	0.859	0.655
sIgA R^2 Phase 4	0.588	0.733
Slope R^2	0.52	0.773
sIgA Slope R^2	0.231	0.033
Significant (p < .05) values are in bold		

Table 9.14e indicates that neither of the reduced psychosocial factors predicted sIgA release rates over time in a linear growth curve model.

Chapter 10 - Discussion

This study was the first to measure personality traits, psychosocial factors, and immune functioning over time in first-year university students, thus allowing a better insight into how one's enduring characteristics, perception of the immediate environment, and immune reactivity operate dynamically over time and impact academic outcomes.

10.1 Personality Findings

Examining both samples together, there was very little mean-level change over the course of a calendar year that was comprised of the first full year of university. Agreeableness significantly decreased while Conscientiousness significantly increased between the beginning and end of the second semester (Table 7.2b). Rank-order stability was found to be moderate to high over time, with all correlations between phases being significant ($p < .01$) ranging from .63 to .87 (Table 7.3). Although indicating rank-order stability, these stability coefficients are somewhat higher than in the general population of a similar age (.51 from Figure 1.1) and in previous meta-analyses (.54; Roberts & DelVecchio, 2000). The spacing of the assessments can explain higher levels of rank-order consistency in that typically assessment gaps are measured in years whereas this study was conducted over the course of one year. Shorter time spans show higher consistency of personality than longer spans (Biesanz, West, & Kwok, 2003).

This study hypothesized that these two cohorts of students would show personality change over time rather than high stability. In that the nature of the new university environment which introduces new responsibilities and roles into a young adult's life can be viewed as all-encompassing, it would seem likely that more trait change than stability would be observed; this idea was covered in Chapter 4. However, this was not the case. Instead, more personality stability than trait change was the norm; very little mean-level change was seen between assessments while rank-order stability remained consistent throughout the study.

The present study showed similar findings as Vaidya and colleagues (2002) who measured personality in 392 undergraduates (96 males, 296 females) at two time points separated by 2.5 years using the Big Five Inventory (BFI; John, Donahue, & Kentle, 1991). In this sample, for mean-level change, Extraversion ($\Delta M = 2.1$, d = .33), Openness ($\Delta M = 2.2$, d = .34), Agreeableness ($\Delta M = 0.5$, d = 0.10), and Conscientiousness ($\Delta M = 2.7$, d = .51) significantly increased between the two time points. However, Neuroticism did not show any mean-level change in this sample ($\Delta M = -0.3$, d = .05). In terms of rank-order stability, the 2.5-year interval study found significant rank-order stability ($p < .01$) for Neuroticism (.61), Extraversion (.72), Openness (.65), Agreeableness (.59), and Conscientiousness (.64). Using RCI scores, most participants study did not change on the BFI between time points, although the number of those who did change differed from that found in a normal distribution. Specifically, 83.0% of participants stayed the same for Neuroticism while 9.9% decreased and 7.1% increased (χ^2 (2) = 125.0, $p < .05$). For Extraversion, 79.6% remained at the same level while 2.8% decreased and 17.6% increased (χ^2 (2) = 367.4, $p < .05$). For Openness, 79.3% remained the same while 3.1% decreased and 17.6% increased (χ^2 (2) = 368.3, $p < .05$). Agreeableness was one of the traits that had the most participants at the same level between assessments (84.2%) while 6.4% decreased and 9.4% increased (χ^2 (2) = 103.3 $p < .05$). Finally, Conscientiousness had the most participants not changing (85.7%); only 1.3% decreased and 13.0% increased (χ^2 (2) = 178.7, $p < .05$) (Vaidya et al., 2002).

Similar findings in another study examining individual level trait change in the transition from adolescence to young adulthood twice assessed NEO-FFI personality in 270 university students four years apart (Robins et al., 2001). Specifically, 83% of participants stayed the same on Extraversion with 8% decreasing and 9% increasing. For Agreeableness, 84% remained the same while only 2% decreased and 14% increased. For Conscientiousness, 81% remained the same between assessments, 6% decreased, and 13% increased. Neuroticism had the lowest percentage remain the same between assessments (73%) with 23% decreasing and 4% increasing. Openness had the least individual-level change with 91% staying the same, 2% decreasing, and 7% increasing. All traits' individual-level change was significantly different from the expected frequencies of 2.5% increasing, 95% staying the same, and 2.5% decreasing (χ^2 (df = 2) ranged from 22.6 to 470.1, all $p < .05$) (Robins et al., 2001). As with the previous study by Roberts et al. (2001), young adulthood represents a time of moderate individual level change because of a greater number of participants exhibiting change than if due to chance.

Comparing Vaidya et al.'s (2002) and Robins et al.'s (2001)) individual-level results, the present study demonstrated less individual-level change as seen in Table 7.4. There were more assessments than in both studies, and even the longest span of one calendar year was shorter than the results from previously published work which may account for the lack of individual-level change at all assessments. However, it is noteworthy that even between assessments spanning approximately 3-4 months spanning from the beginning of the first academic year and the beginning of the second semester, three of the five traits demonstrated significant individual-level change. In the present study, most participants demonstrated some trait change rather than remaining the same. Although there was little mean-level change coupled with high levels of rank-order stability in these two cohorts, individual-level change was found to be present between assessments in the present study. Both previous research and the present study indicate that individual-level dynamics can operate independently from group trends.

In that individual-level change was not seen for all traits between all assessments, there may be environmental influences on trait dynamics that differentially act upon traits at particular times of the academic year. For example, the beginning of the first academic year may be seen as quite stressful in that students were in a completely new environment and, when comparing this time to the beginning of the second semester, three of the five traits demonstrated significant individual level change. Although self-reported perceived stress did not change much over the course of a year (Table 8.1), secretory sIgA was lower at the beginning of the first academic year in comparison to the start of the second semester (see Figure 9.5). This objective measure found lowered mucosal immunity at more stressful times, this may be an indication that the environment does present increased demands that may not be detected through self-report measures; these sub-conscious, increased demands may also be the forces that stimulate students to change certain trait levels which may account for the greater number of traits demonstrating individual-level change between the first two assessments.

One of the key themes in this study is that personality dynamics do not occur independently from other factors; psychosocial factors from this study will next be addressed. Aside from discussing their dynamics over time, the following section will also discuss the personality correlates of these psychosocial variables.

10.2 Psychosocial Findings

In that this study sought to determine how other factors relevant to the starting the higher education experience either changed or remained stable over time, psychosocial factors, both general and those specific to the university, were concurrently recorded over time along with personality traits.

10.2.1 General Psychosocial Findings

Table 8.1 and Figure 8.1 indicate a greater level of general psychosocial factor mean-level change between assessments with 12 out of the 36 comparisons for the general factors being significantly different from another phase. This demonstrates that mean-level stability was low; specifically, general health and perceived stress had two pairings of phases that were significantly different, loneliness and life satisfaction each had two significantly different changes in means between phases, and self-esteem and life experiences each had three of the possible six comparisons between phases as significantly differing in mean values.

As for rank-order stability, the general psychosocial factors were less stable than the personality traits, with six of the comparisons not being significantly stable according to rank-order. Of those that were statistically significant, the rank-order stability correlations were considerably lower than for the personality traits, ranging from .18 to .79 (Table 8.2). In that the psychosocial factors may not assessing traits but rather transitory perceptions of the relatively immediate environment, greater mean-level change and less rank-order stability in the study is not surprising.

In relation to personality traits, there were significant relationships between traits and psychosocial factors. For example, there were high correlations between negatively-associated psychosocial factors, such as perceived stress, and Neuroticism (see Tables 8.6a-e). For the most part, these significant associations between personality traits and psychosocial factors were not surprising and did not necessarily challenge previous literature.

10.2.2 University-Specific Psychosocial Findings

Mean-level change was more abundant for the university-specific psychosocial factors with 24 of the 36 comparisons amongst the six psychosocial factors as being significantly different between assessments (Table 9.1 and Figure 9.1). This indicates that the university setting, or at least the perception of the setting, is labile and changes over time. This might be expected in that academic demands may be perceived as much higher during the final exam time than at other points of the school year. It is also worth mentioning that some of the change may be due to measurement error.

There was a moderate level of rank-order stability in the university-specific psychosocial factors. Six of the 36 comparisons were not significant and the remaining only had absolute values from .22 to .76 and were moderate at best. This gives further evidence for the university-related psychosocial factors as being perceived more changeable over time than the general psychosocial factors.

10.2.3 Psychosocial Factor Dynamics Over Time

Considering all psychosocial factors together, an interesting result was noted in the correlations between the psychosocial factors and personality traits over the four assessments as seen in Tables 9.6a-e. Some of the correlations remained significant in the same direction (positive or negative) over all four phases of the study; others remained uncorrelated throughout. However, some were only found to be significant at certain time points, such as Agreeableness correlated positively with Interaction with Students only at the beginning of the first ($r = .23$) and second ($r = .28$, $p < .001$ for both) semesters but not during exam time and not at the very beginning of the second academic year.

10.3 Exam Marks

Exam marks had the most number of significant correlations with personality traits and psychosocial factors at the third time point just before exams. Conscientiousness at the second time point ($r = .22$, $p < .05$) was the only trait to correlate significantly and positively with exam marks at a time before the exam period. Interestingly, the only significantly correlation to exam marks near exam time was Extraversion that was strongly negatively correlated with grades ($r = -.35$, $p < .001$); none of the other traits was correlated with exam marks at the third time period. This finding indicates that participants who were less extraverted only near exam time had greater academic success, indicating that this personality trait may still be labile at this stage in the first academic year. Students may have had to become more introverted and therefore less social in order to devote more time to studying to achieve better marks. Alternatively, students who were most highly extraverted may have had the most difficult time in studying independently or being away from social settings which may have had a negative impact on their exam performance. The psychosocial measures support this in that higher loneliness ($r = .22$) and worse general health ($r = .20$; both $p < .05$) just before exam time was also found in those who then achieve higher grades.

Another interesting correlation between higher grades and the psychosocial factor is that students with better exam marks had an overall poorer rating of the cognitive aspects of their university experience. Both the Structural ($r = -.22$) and the

Functional (r = -.24; both $p < .025$) dimensions of the Cognitive Domain of the Quality of University Life were lower in those students who did well. In other words, students who ranked their university experience as not teaching them the skills and knowledge that they need to succeed ended up with higher exam marks. In that perceived stress, positive affect, or negative affect were not related to exam marks at this phase, and that partialling out these three factor still resulted in a negative correlation between the Structural (r = -.22) and Functional (r = -.23; both $p < .05$) dimensions with exam marks, it was not the stress or general malaise of the exam period that influenced high exam scorers to give negative impressions of what they felt they were learning. Students receiving higher exam marks felt that they were not challenged to learn either simple or complex ideas. This may indicate that those who did well on exams were finding the quality of their education as being too easy; alternatively, they may have felt that their acquired skills were not being utilized in studying for an exam. Alternatively, the difficulty of the course work can vary across subjects; participants who chose to take easier courses may not have had the need to learn new material and skills in order to do well on an exam. Intelligence was not measured in this study; future studies may incorporate previously measured intelligence in order to better illuminate this relationship.

Taken together, these findings on exam marks were not found to be related to personality traits or psychosocial factors as noted in previous work. For example, in the meta-analysis by Poropat (2009), there was a significant positive relationship between academic performance and Agreeableness ($r = .07$, d = .14), Conscientiousness ($r = .19$, d = .46), and Openness ($r = .10$, d = .24; all $p < .001$). The present study did not find these relationships consistently. In that academic performance was solely based on the mean exam grade at the end of the first academic year, the findings in the present study may be limited to drawing the relationship between traits and academic performance to only first-year students. Incorporating other measures of performance may serve as a better means of capturing this construct.

Interestingly, Tables 9.12a-e highlights that Openness, Extraversion, and Agreeableness over time influence end-of-year exam marks. Additionally, all general psychosocial factors appear to influence exam performance. For those university-specific psychosocial factors, Negative Affect affects exam performance along with both the Cognitive and the Functional components of the quality of university life. It is also possible that a one-year span does not provide sufficient variation in trait nor psychosocial factor scores to elicit a real influence on exam marks.

10.4 Immune Functioning

Table 9.9 indicates that salivary sIgA release rates were higher at the second and fourth time points than at the first time point when students first began their university careers and at the third time point during exams. In that salivary sIgA is a marker for immune functioning and that lower sIgA levels is indicative of less immune system activation, these results would indicate that participants had the greatest level of immunity at the beginning of the second semester and at the beginning of the second academic year and had lower immunity at the beginning of starting university and during exams. This finding is in line with other research reporting a decrease in salivary sIgA during exam times; Deinzer and Schuller (1998) obtained daily measures of salivary sIgA in 42 medical students for 7 days prior to and 6 days after examinations and also recorded the amount of study time. Salivary sIgA was found to be progressively suppressed to the time of the exam and this suppression lasted for the 6 days post-exam; time spent studying explained a significant proportion of the sIgA variation (Deinzer & Schuller, 1998). However, no previous research has examined this on such a scale and at these time points during an academic year during the first year of university.

These results provide an objective measure for immune functioning as an indicator of HPA axis activation due to stress; the start of the first academic year and exam time saw lower levels of mucosal immunity, indicative of higher stress. This finding is in line with previous work, such as that by Jemmott and Magloire (1988) who reported lowered salivary sIgA in only 15 healthy undergraduates five days before their exam period. These effects were reversed at less stressful times, such as the beginning of the second semester and at the beginning of the second academic year (Jemmott & Magloire, 1988). The start of the second academic year may not have been as stressful as the start of the first academic year in that students may have been accustomed to the higher education experience by that time.

Interestingly, perceived stress did not correlate with salivary sIgA release rates at any phase; none of the psychosocial variables nor traits consistently correlated with sIgA release rates over time. This finding indicates that objective and subjective measures of stress do differ. This study provides evidence that objective times of stress, such as exam periods, have an objective physiological reaction in a way that perceived stress does not; in other words, subjectively-rated stress perception did not always correlate with times of stress, but objective measurements of mucosal immunity revealed stress to have an immunosuppressant effect.

Interestingly, linear growth curve modeling found that none of the personality or psychosocial variables predicted sIgA (Tables 9.14a-e). In that salivary sIgA demonstrates fluctuations with stress and can be labile, it may not be that surprising that mucosal immunity did not relate to the measures in this study. This is the first study that concurrently measured personality, psychosocial factors, and innate mucosal immunity and employed growth curve modeling in order to determine interrelationships in trends over time.

10.5 Strengths

A strength to this study is the inclusion of those who are new to the university setting which therefore provides a rich understanding of the first-year of higher education. Other studies have found differential relationships between students at different points of their academic careers. The present study's strength in limiting the sample to first year students is clear; a study by Ridgell and Lounsbury (2004) also attributed their findings to the nature of the sample even though their findings differed from those found in the present study. Ridgell and Lounsbury (2004) examined academic performance, Big Five personality traits as measured by the

Personal Style Inventory (PSI, Lounsbury & Gibson, 2002), and work drive in 140 undergraduate students (54% male, 46% female; M_{age} = 19.18 years; 73% freshmen, 20% sophomores, 3% juniors, 4% seniors). Academic success was determined through self-reported GPA and course grade. General intelligence surprisingly significantly negatively correlated with Conscientiousness ($\varrho = -.19$, $p < .05$); the course grade was positively correlated to Emotional Stability ($\varrho = .18$, $p < .05$). No other significant correlations were found between any other personality traits and general intelligence, course grade, or GPA (Ridgell & Lounsbury, 2004). One possible explanation for these seemingly counterintuitive findings is that this sample was comprised mostly of first-year students. "It is possible that course grade for them may be influenced more by other factors than personality traits, such as maturation, study habits, involvement in other activities on campus, and settling into the role of student during the first year or two at college" (Ridgell & Lounsbury, 2004, p. 616). Supporting this contention, Lounsbury, Sundstrom, Loveland, and Gibson (2003) found Openness positively correlated to course grade in a sample of 175 upperclassmen (36% male, 64% female; M_{age} = 22.7 years, SD = 3.44) responding to the PSI. Year of school may serve as a mediator of personality traits predicting academic performance. Further limitations highlighted by Ridgell and Lounsbury (2004) are that the sample was entirely psychology students; including students across disciplines may shed light on those commonalities in personality trait dynamics that predict academic performance.

Other studies have also found that the association between personality traits and academic outcomes can vary by the year of study. For example, correlations between Openness and Agreeableness and year-end exam marks varied depending on the academic year in question in a sample of 432 undergraduates initially given the NEO-FFI upon starting university (Farsides & Woodfield, 2003). Specifically, Conscientiousness only significantly correlated with first-year exam marks from the student's major course of study ($\varrho = .17, p < .01$). Agreeableness was only significantly correlated with third-year exam marks from the major course of study ($\varrho = .15, p < .01$). Openness correlated significantly with year two overall exam marks ($\varrho = .24, p < .01$) along with major course of study marks at year two ($\varrho = .17, p < .01$) and year three ($\varrho = .24, p < .01$) (Farsides & Woodfield, 2003).

The present study adds to the understanding of personality, psychosocial factors, and immune functioning in relationship to the first year of university and academic success. No previous research has measured these variables simultaneously over the course of the first year of a higher education experience. This study adds to the understanding of personality trait dynamics over this time; little mean-level change was seen with high levels of rank-order stability. However, it is important to know that on an individual level, a majority of the participants demonstrated a trait score change over time. In this sense, examining personality on an individual differences level may be more appropriate to capture trait change in this population. Furthermore, this study established how perceptions of the environment through ratings of psychosocial factors appear to be quite mutable over the course of the first academic year. Psychosocial factor ratings also appear to be subject to the demands and pressures of the time of the school year, with stressful times eliciting different psychosocial factor ratings than those marked by decreased demands.

In addition, stressful periods of the academic year may not necessarily be subjectively measured and perceived as stressful; the salivary sIgA measure was incorporated into the present study in order to provide an objective measure of immune functioning and serve as an indirect measure of stress. Acute innate immunosuppression was found to occur during times of stress but did not correlated with measures of perceived stress. This indicates that objective biological measures of can provide a means to indicate times of stress.

Notably, this research does present findings that are relevant to higher education. For example, the incidence of meningococcal meningitis is higher in university students than in other populations. University students, particularly those living in university accommodation, are at the highest risk of developing the disease (Bruce, Rosenstein, Capparella, Shutt, Perkins, & Collins, 2001; Froeschle, 1999; Harrison, Dwyer, Maples, & Billmann, 1999). Clearly there is some element of the higher education setting such as the living arrangements that are part of the university experience that contributes to this higher incidence of illness; the present study has demonstrated the effect of decreasing innate mucosal immunity during stressful times of the academic year. Those characteristics of the higher education setting that contribute to illness warrant further investigation.

10.6 Limitations

This study could have benefitted by examining person-environment fit more directly; none of the psychosocial measures in this study were able to generate alpha or beta fit statistics, for example. Harms, Roberts, and Winter (2006) examined person-environment fit in the higher education environment in a longitudinal study of 191 undergraduate males at Harvard University that were assessed on person-environment fit in their first and fourth years of university. Harms et al. (2004) then correlated change in personality trait levels with the residuals from the regression analyses; these residuals represented change that cannot be attributed to initial person-environment fit or initial personality trait status. Changes in Openness were related to both alpha ($r = .31$, $p < .05$) and beta ($r = .19$, $p < .05$) fit. Correlated change was also seen in the relationship between Extraversion and beta fit ($r = -.14$, $p < .05$). Thus, there was a moderately strong relationship between the changes seen in both openness and person-environment fit (Harms et al., 2004).

Extending the study, the relationship between person-environment fit, academic success, and university environment satisfaction was examined by correlated mean person-environment fit over four years with average overall grade, honors graduations, and overall satisfaction. Mean person-environment fit was significantly related to school performance as measured by students' rankings for each year; honors graduation was related to alpha ($r = 24$) and beta fit ($r = .19$; $p < .05$). To compare the relative contribution of person-environment fit to performance, performance outcomes were regressed on to mean fit and SAT scores in a multiple linear regression. Both alpha and beta fit were related to academic performance (GPA) in the first year while accounting for the effect of intelligence (SAT scores). Only alpha fit significantly predicted academic performance in the following three years (standardized β: .16 to .20); neither alpha nor beta fit significantly related to overall satisfaction (Harms et al., 2004). Taking all results together, person environment fit was moderately consistent without any significant mean-level change over time. Students who felt they fit better in the university environment were more intelligent and had higher levels of Openness. One of the reasons that more participants changed their perceptions of the environment rather than their self-perceptions may relate to the nature of the university itself; Harvard University has an excellent reputation, arguably perceived as one of the most selective and prestigious universities. Harms et al.'s (2004) study may have benefited from questions regarding the perceived status of the university. Overall, Harms et al.'s (2004) study provides evidence for a model that conceptualizes a selection of individuals to first gain membership into this environment and then experience a socialization effect to increase person environment congruence. Additionally, institution selectivity may also explain why there was little relationship between person-environment fit and overall satisfaction with the environment. Students may have wanted to ensure that they fit into the environment in order to earn a prestigious undergraduate degree from a respected university despite the fact that they did not feel satisfied with the university.

Notably, this study may have also benefitted from a direct measure of intelligence. Academic outcomes have been found to be positively related to intelligence in a meta-analysis of 47 samples representing 31,955 participants (r = .23, $p < .001$, d = .52; Poropat, 2009). With such a large effect size, intelligence contributes to academic performance; measuring this construct along with personality traits may better determine the overlap that intelligence and traits have in predicting performance.

Additionally, the present study may have only measured first-year academic outcomes and not necessarily overall academic performance in that it was limited to the mean exam marks at the end of the first year. Future studies may want to examine exam marks obtained at later time points in the participants' academic careers. Further, standardized test scores, such as those used for gradate school admissions, may also be incorporated as a measure of academic performance in tandem with grades.

In terms of the biological measures, the present study was limited to salivary biomarkers. Without having had collected any blood from the participants, this study has limitations as to the depth to which it can mechanistically explain the links between immune functions as shown through salivary sIgA, HPA axis activation, personality, and psychosocial factors. Taking a blood sample would have allowed a greater number of immune factors to have been assessed (Kuby, 1997).

One limitation to this study was that it was purely observational without any experimental intervention. An intervention may have better elucidated the relationships between personality, psychosocial factors, and immune functioning in new university students. For example, Bosch and colleagues (2007) examined depression and rate of wound healing in 193 undergraduates (95 males, 98 females; M_{age} = 20.1 years) who completed the UCLA Loneliness Scale (Russel, Peplau, & Cutrona, 1980) and the Beck Depression Inventory (Beck, Steer, & Garbin, 1988). Each participant received a small 1.5mm deep oral wound under local anesthesia; wound size was measured daily. Logistic regression showed a significant association between depressive symptoms and healing time (OR per SD on the BDI-sf 1.50 (1.10 –2.06); p = .007) which indicated that each standard deviation increase in depressive symptoms increased the likelihood of being a slow healer by 50% (Bosch et al., 2007). Loneliness scores were not related to wound healing status.

10.7 Additional Measures for Future Research

Although the environment may moderate personality and psychosocial dynamics over time, this study did not measure how well participants fit into their environment. Although certain aspects of the study, such as the Quality of Life of University Students Questionnaire, provided some insight as to how students perceived their university environment, the present study did not directly measure person-environment fit (Roberts & Robins, 2004). Directly measuring how participants felt that they fit in with their surroundings and concurrently measuring personality trait dynamics may have potentially illuminated a source of individual differences in trait stability and change.

Furthermore, this study has set the framework for larger studies that may include more measurements. For example, it would be very interesting and would fill another gap in the literature to measure personality, psychosocial factors, and immune functioning throughout the entire university career until a degree is acquired. Extending this design further, multiple universities could be compared to determine those characteristics of the higher education experience that would be optimal to academic success. Additionally, further biological factors such as physiological functioning and metabolic measurements could provide a better picture of how the university may influence its students' health and well-being.

10.8 Conclusions

The first year of university has been shown to be a life-changing experience; this study has demonstrated this idea both objectively and subjectively. Personality traits that are enduring ways of being throughout the life span are more mutable during the transition into young adulthood; this study found high levels of individual-level change in personality traits despite a lack of mean-level change and high levels of rank-order consistency. Psychosocial variables were much more labile over time. Their interaction has been demonstrated to change dynamically over time and in relation to each other. As for academic outcomes, Agreeableness, Openness, and Extraversion are related to exam performance along with the general psychosocial factors; only Negative Affect along with the Cognitive and Functional domains of the university-specific psychosocial factors influenced exam performance. Mucosal immunity did not appear to be related over time to the psychosocial measures in this study. It is through modeling multiple constructs over multiple time points and including both subjective and objective measures in determining academic outcomes can one fully understand a complete picture of starting the higher education experience. Overall, this study indicates that the first year of university can elicit individual-level trait change, affect psychosocial rankings differentially in response to academic demands, influence exam performance through psychosocial factors, and has the potential to moderate innate immunity.

Chapter 11 - References

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Appendices

Appendix A - Summary of Included Studies on Rank-Order Stability

Authors	Measures	N	Mean Baseline Age (Range) in Years	Time between Assessments (years)	Trait	Correl.
Scollon & Diener, 2006	EPI	1130 adults	37.2 (16-70)	2	N	.75
				6	N	.75
				8	N	.68
				2	E	.86
				6	E	.65
				8	E	.62
Viken, Rose, Kaprio, & Koskenvuo, 1994	EPI	6828 male twins	(18-23)	6	N	.48
			(24-29)		N	.56
			(30-35)		N	.59
			(36-41)		N	.63
			(42-47)		N	.62
			(48-53)		N	.67
			(18-23)		E	.58
			(24-29)		E	.68
			(30-35)		E	.72
			(36-41)		E	.72
			(42-47)		E	.71
			(48-53)		E	.69
		8104 female twins	(18-23)	6	N	.60
			(24-29)		N	.57
			(30-35)		N	.62
			(36-41)		N	.63
			(42-47)		N	.65
			(48-53)		N	.65
			(18-23)		E	.60
			(24-29)		E	.69
			(30-35)		E	.70
			(36-41)		E	.74
			(42-47)		E	.70

			(48-53)		E	.74
Morizot & Le Blanc, 2003	JPI; EPI	269 males	(30-40)	10	Disinhibition	.64
			(17-30)	13	Disinhibition	.39
			(17-40)	23	Disinhibition	.40
			(30-40)	10	Neg. Emot.	.37
			(17-30)	13	Neg. Emot.	.33
			(17-40)	23	Neg. Emot.	.71
			(30-40)	10	E	.68
Gustavsson, Weinryb, Goransson, Pedersen, & Asberg, 1997	KSP; EPI	130 twins	(28-52)	9	Somatic Anx.	.56
					Psychic Anx.	.63
					Musc. Tension	.59
					Psychasthema	.57
					Lack of Assert.	.69
					Impulsivity	.64
					Monot. Avoid.	.70
					Detachment	.63
					Socialization	.81
					Soc. Desir.	.59
					Indir. Agg.	.56
					Verbal Agg.	.56
					Irritability	.47
					Suspicion	.54
					Guilt	.44
Costa, McCrae, & Arenberg, 1980	GZTS	460 males	(17-85)	6	Gen. Activity	.83
					Restraint	.71
					Ascendance	.82
					Sociability	.81
					Emot. Stab.	.74
					Objectivity	.71
					Friendliness	.77
					Thoughtfulness	.72
					Personal Rel.	.73
					Masculinity	.75
		203 males	(20-76)	12	Gen. Activity	.77
					Restraint	.72

					Ascendance	.83
					Sociability	.74
					Emot. Stab.	.70
					Objectivity	.69
					Friendliness	.74
					Thoughtfulness	.73
					Personal Rel.	.68
					Masculinity	.72
De Fruyt, Bartels, Van Leeuwen, De Clercq, Decuyper& Mervielde, 2006	HPIC; QBF	682 males & females	(6-7)	3	Emot. Instability	.61
					E	.83
					Imagination	.86
					Benevolence	.77
					C	.76
			(8-9)	3	Emot. Instability	.65
					E	.78
					Imagination	.69
					Benevolence	.71
					C	.82
			(10-11)	3	Emot. Instability	.63
					E	.76
					Imagination	.77
					Benevolence	.79
					C	.77
			(12-13)	3	Emot. Instability	.69
					E	.66
					Imagination	.69
					Benevolence	.75
					C	.74
Pullmann, Raudseppt, & Allik, 2006	NEO-FFI	165 males	(12-14)	2	N	.52
					E	.39
					O	.53
					A	.48
					C	.46
		86 males	(14-16)	2	N	.52
					E	.52

					O	.38
					A	.34
					C	.48
		112 males	(16-18)	2	N	.49
					E	.71
					O	.60
					A	.60
					C	.66
		215 females	(12-14)	2	N	.49
					E	.50
					O	.45
					A	.49
					C	.46
		120 females	(14-16)	2	N	.68
					E	.64
					O	.47
					A	.61
					C	.67
		178 females	(16-18)	2	N	.72
					E	.73
					O	.67
					A	.61
					C	.70
Donnellan, Conger, & Burzette, 2007	MPQ-BF	432 males & females	17.6 (16-19)	7	Positive Emot.	.51
					Neg. Emot.	.48
					Constraint	.58
					Absorption	.48
Stein, Newcomb, & Bentler, 1986	BPI	654 males	(13-15)	4	Ambition	.31
					Attractiveness	.37
					Congeniality	.30
					Deliberateness	.27
					Diligence	.36
					E	.43
					Generosity	.42
					Invulernability	.32

				Law abidance	.41
				Leadership	.39
				Liberalism	.34
				Objectivity	.46
				Orderliness	.37
				Relig. Commit.	.55
				Self-acceptance	.29
	193 males	(17-19)	4	Ambition	.56
				Attractiveness	.60
				Congeniality	.53
				Deliberateness	.44
				Diligence	.46
				E	.63
				Generosity	.44
				Invulernability	.53
				Law abidance	.59
				Leadership	.60
				Liberalism	.44
				Objectivity	.57
				Orderliness	.56
				Relig. Commit.	.71
				Self-acceptance	.40
	461 males	(13-15)	8	Ambition	.24
				Attractiveness	.33
				Congeniality	.33
				Deliberateness	.22
				Diligence	.31
				E	.41
				Generosity	.29
				Invulernability	.25
				Law abidance	.29
				Leadership	.33
				Liberalism	.27
				Objectivity	.40
				Orderliness	.36
				Relig. Commit.	.51

					Self-acceptance	.27
Vaidya, Gray, Haig, & Watson, 2002	BFI	392 male & female undergrads	21.09 (20-32) at second assessment	2.5	N	.61
					E	.72
					O	.65
					A	.59
					C	.64
		260 male & female undergrads	participants completed 1 semester of college at 1st assessment	2 months	N	.82
					E	.72
					O	.82
					A	.81
					C	.80
Robins, Fraley, Roberts, & Trzesniewski, 2001	NEO-FFI	270 male & female undergrads	18	4	N	.53
					E	.63
					O	.70
					A	.60
					C	.59
Roberts, Caspi, & Moffitt, 2001	MPQ	921 males & females	18	8	Constraint	.67
					Neg. Emot.	.60
					Agentic Pos. Emot.	.51
					Comm. Pos. Emot.	.49
Costa & McCrae, 1998	NEO-PI	983 males & females	(21-92)	6	N	.83
					E	.82
					O	.83
					A	.63
					C	.79
Terracciano, Costa, & McCrae, 2006	GZTS	737 males	50.9 (30-87)	16.6	Emot. Stab.	.64
					Ascendance	.78
					Gen. Activity	.75
					Restraint	.68
					Sociability	.73
					Objectivity	.67
					Friendliness	.66
					Thoughtfulness	.65
					Personal Rel.	.67

					Masculinity	.70
		326 females	52.8 (30-82)	10.5	Emot. Stab.	.69
					Ascendance	.78
					Gen. Activity	.76
					Restraint	.70
					Sociability	.78
					Objectivity	.69
					Friendliness	.66
					Thoughtfulness	.71
					Personal Rel.	.68
					Masculinity	.76
	NEO-PI-R	676 males & females	60.6 (30-89)	10	N	.78
					E	.83
					O	.85
					A	.80
					C	.81
Finn, 1986	MMPI	78 males	45 (43-53)	30	N	.56
					Social E	.56
		98 males & females	21.0 (17-25)	30	N	.45
					Social E	.49
Costa, Herbst, McCrae, & Siegler, 2000	NEO-PI	2274 males & females	41.3 (39-45)	9	N	.76
					E	.83
					O	.84
					A	.80
					C	.83
Allemand, Zimprich, & Hertzog, 2007	NEO-FFI	455 males & females	43.7	4	N	.79
					E	.83
					O	.85
					A	.75
					C	.79
		420 males & females	62.4	4	N	.90
					E	.87
					O	.71
					A	.69
					C	.82

Johnson, McGue, & Krueger, 2005	MPQ	833 male & female twins	59.4	5	Pos. Emotion	.83
					Neg. Emotion	.81
					Constraint	.83
Small, Hertzog, Hultsch, & Dixon, 2003	NEO-PI	233 males & females	69.1	6	N	.84
					E	.82
					O	.85
					A	.73
					C	.69
Mroczek & Spiro, 2003	EPI-Q	1663 males	43-91	3	E	.76
				2 subsequent	E	.74
				5 total	E	.71
				3	N	.72
				2 subsequent	N	.68
				5 total	N	.68
Read, Vogler, Pedersen, & Johansson, 2006	EPI	194 males & females	82.3	2	E	.71
					N	.62
Martin, Long, & Poon, 2002	16 PF	67 males & females	64.9	5	Warmth	.45
					Intelligence	.60
					Emot. Stab.	.73
					Dominance	.67
					Enthusiasm	.68
					C	.53
					Boldness	.72
					Sensitivity	.74
					Suspiciousness	.56
					Imagination	.69
					Shrewdness	.53
					Insecurity	.58
					Radicalism	.47
					Self-Sufficiency	.45
					Self-Discipline	.42
					Tension	.77
		57 males & females	82.8	5	Warmth	.47
					Intelligence	.25

					Emot. Stab.	.57
					Dominance	.51
					Enthusiasm	.52
					C	.49
					Boldness	.52
					Sensitivity	.49
					Suspiciousness	.62
					Imagination	.33
					Shrewdness	.07
					Insecurity	.57
					Radicalism	.26
					Self-Sufficiency	.29
					Self-Discipline	.31
					Tension	.61
		55 males & females	100.5	1.5	Warmth	.28
					Intelligence	.02
					Emot. Stab.	.30
					Dominance	.04
					Enthusiasm	.52
					C	.26
					Boldness	.67
					Sensitivity	.36
					Suspiciousness	.31
					Imagination	.09
					Shrewdness	.26
					Insecurity	.34
					Radicalism	.32
					Self-Sufficiency	.41
					Self-Discipline	.21
					Tension	.33

16PF:16PF Personality Questionnaire; BFI: Big Five Inventory; BPI: Bentler Psychological Inventory; EPI: Eysenck Personality Inventory; EPI-Q: Eysenck Personality Inventory – Quick; GZTS: Guilford-Zimmerman Temperament Survey; HPIC: Hierarchical Personality Inventory for Children; JPI: Jesness Personality Inventory; KSP: Karolinska Scales of Personality; MMPI: Minnesota Multiphasic Personality Inventory; MPQ: Multidimensional Personality Questionnaire; MPQ-BF: Multidimensional Personality Questionnaire - Brief Form; NEO-FFI: NEO Five-Factor Inventory; NEO-PI: NEO Personality Inventory; NEO-PI-R: Revised Personality Inventory; QBF: Questionnaire Big Five; N: Neuroticism; E: Extraversion; O: Openness; A: Agreeableness; C: Conscientiousness

Appendix B – Summary of Included Studies Reporting Mean-Level Trait Change

Authors	Measure	N	Age Span (years old)	Time between Assessments (years)	Trait	Mean Change
Scollon & Diener, 2006	EPQ	1130 adults	under 20 - 60+	40	N	-2.5**
				40	E	-2.4***
Morizot & Le Blanc, 2003	JPI; EPQ	269 males	17 - 40	23	Disinhibition	-10.45***
					Neg. Emot.	-16.49***
					E	-1.32***
De Fruyt, Bartels, Van Leeuwen, De Clercq, Decuyper & Mervielde, 2006	HPIC; QBF	682 males & females	6-7 at baseline	3	Emot. Instab.	-.38
			8-9 at baseline			1.28
			10-11 at baseline			1.07**
			12-13 at baseline			1.58**
			6-7 at baseline	3	E	.5
			8-9 at baseline			.7
			10-11 at baseline			1.07
			12-13 at baseline			0.93
			6-7 at baseline	3	Imagination	1.13
			8-9 at baseline			1.22
			10-11 at baseline			1.27
			12-13 at baseline			1.1**
			6-7 at baseline		Benevolence	-0.38
			8-9 at baseline			-0.52
			10-11 at baseline			.-44
			12-13 at baseline			-0.02

			6-7 at baseline		C	0.54
			8-9 at baseline			0.31
			10-11 at baseline			0.22
			12-13 at baseline			.58*
Roberts, Caspi, & Moffitt, 2001	MPQ	921 males & females	18 at baseline	8	Constraint	4.8*
					Neg. Emot.	-15.4*
					Ag. Pos. Emot.	21.6*
					Com. Pos. Em.	0.2
Gustavsson, Weinryb, Goransson, Pedersen, & Asberg, 1997	KSP; EPI	65 twins	17.6 at baseline	9	Somatic Anx.	-0.7
					Psychic Anx.	-0.6
					Musc Tension	-0.5
					Psychasthema	-0.9*
					Lack of Assert.	-1.1*
					Impulsivity	-0.8*
					Monot. Avoid.	-0.4
					Detachment	-0.6
					Socialization	-0.1
					Soc. Desir.	-0.5
					Indir. Agg.	0.5*
					Verbal Agg.	-0.5*
					Irritability	-0.5
					Suspicion	-0.4
					Guilt	0.4
Donnellan, Conger, & Burzette, 2007	MPQ-BF	432 males & females	17.6 at baseline	7	Pos. Emot.	-0.02*
					Neg. Emot.	-0.21*
					Constraint	0.09*
					Absorption	-0.11*
Pullmann, Raudseppt, & Allik, 2006	NEO-FFI	380 adolescents	12-14 at baseline	2	N	-1.3**
					E	2.0***
					O	0.8
					A	-1.5**
					C	0.5
		206 adolescents	14-16 at baseline	2	N	-1.2*
					E	1.3*
					O	2.2***
					A	0.3
					C	-0.3
		290 adolescents	16-18 at baseline	2	N	-0.3
					E	-0.2

					O	2.4***
					A	0.4
					C	0.7
Stein, Newcomb, & Bentler, 1986	BPI	654 males	21.9 at baseline	8	Ambition	-0.01
					Attractiveness	1.73***
					Congeniality	2.03***
					Deliberateness	0.19
					Diligence	1.63***
					E	-0.26
					Generosity	1.47***
					Invulnerability	0.98***
					Law abidance	1.28***
					Leadership	1.18***
					Liberalism	0.08
					Objectivity	0.23
					Orderliness	0.54***
					Relig. Commit.	-0.04
					Self-accept.	0.3
		461 females	21.9 at baseline	8	Ambition	0.13
					Attractiveness	3.36***
					Congeniality	2.00***
					Deliberateness	0.1
					Diligence	1.68***
					E	-0.27
					Generosity	1.5***
					Invulnerability	0.35
					Law abidance	1.5***
					Leadership	1.72***
					Liberalism	-0.59**
					Objectivity	0.33
					Orderliness	1.03***
					Relig. Commit.	0.51
					Self-accept.	0.89***
Robins, Fraley, Roberts, & Trzesniewski, 2001	NEO-FFI	270 male & female undergrads	18	4	N	-0.49*
					E	0.03
					O	0.22*
					A	0.44*
					C	0.27*
Vaidya, Gray, Haig, & Watson, 2002	BFI	392 male & female undergrads	21.09 (20-32) at second assessment	2.5	N	-0.3
					E	2..1**
					O	2.2**
					A	0.5*
					C	2.7**
Johnson, McGue,	MPQ	833 male &	59.4	5	Pos. Emot.	-0.35

& Krueger, 2005		female twins			Neg. Emot.	-0.69*
					Constraint	2.8
Allemand, Zimprich, & Hertzog, 2007	NEO-FFI	455 males & females	43.7	4	N	-1.61*
					E	-0.19
					O	0.10
					A	0.52*
					C	-0.07
		420 males & females	62.4	4	N	-0.65*
					E	-0.32
					O	-0.17
					A	0.30
					C	-0.22
Small, Hertzog, Hultsch, & Dixon, 2003	NEO-PI	233 males & females	69.1	6	N	-1.11
					E	-0.14
					O	-1.67**
					A	0.49
					C	0.01
Read, Vogler, Pedersen, & Johansson, 2006	EPI	194 males & females	82.3	6	E	-0.03
					N	0.01
Martin, Long, & Poon, 2002	16 PF	67 males & females	64.9	5	Warmth	-0.23
					Intelligence	-0.18
					Emot. Stab.	-0.07
					Dominance	0.05
					Enthusiasm	0.15
					C	0.10
					Boldness	-0.01
					Sensitivity	0.30
					Suspiciousness	0.11
					Imagination	-0.10
					Shrewdness	0.30
					Insecurity	0.01
					Radicalism	0.18
					Self-Sufficiency	0.03
					Self-Discipline	-0.32
					Tension	-0.03
		57 males & females	82.8	5	Warmth	0.34
					Intelligence	-0.27
					Emot. Stab.	0.12
					Dominance	0.18
					Enthusiasm	-0.09
					C	0.05
					Boldness	-0.16

					Sensitivity	0.40*
					Suspiciousness	0.48*
					Imagination	-0.34
					Shrewdness	0.25
					Insecurity	-0.03
					Radicalism	0.27
					Self-Sufficiency	0.47
					Self-Discipline	-0.07
					Tension	0.02
		55 males & females	100.5	1.5	Warmth	0.04
					Intelligence	0.16
					Emot. Stab.	-0.24
					Dominance	0.10
					Enthusiasm	-0.25
					C	0.00
					Boldness	-0.08
					Sensitivity	-0.45*
					Suspiciousness	-0.06
					Imagination	0.10
					Shrewdness	0.26
					Insecurity	-0.22
					Radicalism	0.71*
					Self-Sufficiency	0.04
					Self-Discipline	-0.37
					Tension	0.28

16PF:16PF Personality Questionnaire; BFI: Big Five Inventory; BPI: Bentler Psychological Inventory; EPI: Eysenck Personality Inventory; EPI-Q: Eysenck Personality Inventory – Quick; GZTS: Guilford-Zimmerman Temperament Survey; HPIC: Hierarchical Personality Inventory for Children; JPI: Jesness Personality Inventory; KSP: Karolinska Scales of Personality; MMPI: Minnesota Multiphasic Personality Inventory; MPQ: Multidimensional Personality Questionnaire; MPQ-BF: Multidimensional Personality Questionnaire - Brief Form; NEO-FFI: NEO Five-Factor Inventory; NEO-PI: NEO Personality Inventory; NEO-PI-R: Revised Personality Inventory; QBF: Questionnaire Big Five; N: Neuroticism; E: Extraversion; O: Openness; A: Agreeableness; C: Conscientiousness; * = $p < .05$, ** = $p < .01$; *** = $p < .001$

Appendix C – Recruitment Email Text

Thank you for your interest in this study. Attached is a participant information sheet. There are two absolute requirements to this study. Firstly, you must not be on oral contraceptives/birth control pills. Second, this must be your first experience of higher or further education, i.e., you must not have previously studied towards a HNC, HNB, BA, etc. If you fall into one of these categories, you are not eligible for this study at this time. Furthermore, we are now recruiting for participants between the ages of 18 and 21.

You will be required to visit the Psychology Department at four separate times over the next year; the reimbursement scheme is also indicated next to each session:

November/December 2005 - £3
January/February 2006 - £4
March/April 2006 - £5
September/October 2006 - £5

The researchers will make appointments with you at your convenience to accommodate your schedule. Participants completing all four sessions will be entered into a prize draw at the end of the study.

For each visit, you will be required to complete the personality questionnaire which should take no longer than 45 minutes per visit. Furthermore, this study requires you to provide a saliva sample to measure salivary hormones. If you are uncomfortable with either of these requirements, please reply to this email with your regrets.

If you are eligible for this study and would be comfortable completing all stages of this study, please email back with your matriculation number for verification purposes and to arrange your first visit. Please indicate available times to visit the lab.

On the day you provide the saliva sample, there are a few guidelines that you must adhere to; most importantly that you do not eat a large meal 60 minutes beforehand nor brush your teeth 2 hours beforehand.

All responses will be kept strictly confidential.

Thank you for your interest in this study. I look forward to your response.
Regards,
Andrew J. Wawrzyniak

Appendix D – Recruitment Flyer

Ver. 2, 9 September 2005

Are you a first year student between the ages of 18 and 25?
Would you like to earn £17?

If you have answered yes to these questions, you can be selected for a personality study within the Department of Psychology. The study aims to measure personality change and health. It will require four separate visits over the course of 1 year to the Psychology Department located at 7 George Square.

If you are interested, please send an email to s0450459@sms.ed.ac.uk. Thank you!

1st year student personality study s0450459@sms.ed.ac.uk	1st year student personality study s0450459@sms.ed.ac.uk	1st year student personality study s0450459@sms.ed.ac.uk	1st year student personality study s0450459@sms.ed.ac.uk	1st year student personality study s0450459@sms.ed.ac.uk	1st year student personality study s0450459@sms.ed.ac.uk	1st year student personality study s0450459@sms.ed.ac.uk	1st year student personality study s0450459@sms.ed.ac.uk	1st year student personality study s0450459@sms.ed.ac.uk	1st year student personality study s0450459@sms.ed.ac.uk	1st year student personality study s0450459@sms.ed.ac.uk	1st year student personality study s0450459@sms.ed.ac.uk	1st year student personality study s0450459@sms.ed.ac.uk	1st year student personality study s0450459@sms.ed.ac.uk	1st year student personality study s0450459@sms.ed.ac.uk	1st year student personality study s0450459@sms.ed.ac.uk	1st year student personality study s0450459@sms.ed.ac.uk

Appendix E – Job Ad Listing

VACANCY TEMPLATE

For graduate vacancies, placements, internships and voluntary work

Please return to:
SAGE, Careers Service,
The University of Edinburgh, 33 Buccleuch Place, Edinburgh, EH8 9JT.
Tel: (0131) 650 6688 Fax: (0131) 650 4479
Email: SAGE@ed.ac.uk http://www.careers.ed.ac.uk/employers

Date	23 September 2005
Organisation (Name, postal address and brief description of your company)	Department of Psychology 7 George Square
Contact Name	**Andrew Wawrzyniak**
Contact Details	Tel: Fax: Email: s0450459@sms.ed.ac.uk Website:
JOB TITLE (please complete a separate form for each job function)	Participants for Psychology Study
Job Description/Duties (Please give a brief outline)	The study involves completing a questionnaire at the Psychology Department at four separate times over the next year. The questionnaire should take no longer than 40 minutes. Participants will be paid £3 for the first visit in September/October, £4 for the second visit in January/February 2006, £5 for the third visit in March/April 2006, and £5 for the last visit in September/October 2006. Participants completing all 4 sessions will also be entered into a prize draw.
Type of Vacancy (please tick)	Immediate (within next 2 months) X Future (starting next summer/autumn) ☐ Funded (postgraduate opportunity) ☐ Vacation opportunity ☐ Other (please specify)..
Person Specification (skills, experience, personal qualities)	Please state which are essential and which are desirable. You must be a first-year university student who has not previously attended any other higher education institution. You must be between the ages of 18-21 when you begin the study. You cannot be taking oral contraceptives.

Degree Subject(s) (subject and level required)	
Location (main location(s) of job)	Department of Psychology, 7 George Square
Salary (If you cannot provide an exact figure please specify the salary range)	£ 17 over the course of the study
How would you like applicants to apply? (eg. Email, post, phone, Application Form, CV, online etc.)	Please email s0450459@sms.ed.ac.uk for further details.
Closing Date (specifiy a particular date OR 'ASAP' or 'open-ended)	Closing Date*........................... ASAP** ☐ Open-ended*** X
Any other information	

* If you have specified a closing date we will close your vacancy on that date.

** If you have specified 'as soon as possible' your vacancy will remain live on our website for 6 weeks or until we hear otherwise from you. We will contact you in 6 weeks to confirm whether or not you wish to continue advertising.

*** If you have specified 'open-ended' your vacancy will remain live on our website for 3 months or until we hear otherwise from you. We will contact you in 3 months to confirm whether or not you wish to continue advertising.

By completing and returning this vacancy you have read and agreed to our Vacancy Handling Policy (summary attached).

Thanks for choosing to advertise with SAGE@The Careers Service. We hope that it proves successful. If you need any further help, please contact us.

For Office Use Only
Date Received __________
Date input __________

Appendix F – Information Sheet

New University Student Study

Psychology Department

University of Edinburgh

Personality and Stress Markers

You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide if you wish to take part.

What is the purpose of the study?

We are interested in how personality traits and health might be related in new university students. The study will run for one year.

Why have I been chosen?

We are looking for volunteers who are 1st year students at the University of Edinburgh who have not attended a higher education institution or are taking oral contraceptives.

Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason.

What will happen to me if I take part?

If you decide to take part, we will ask you to complete a questionnaire which takes approximately one hour. The questionnaire will be administered at 4 different time periods over the course of a year:

November/December 2005
January/February 2006
March/April 2006
September/October 2006

After each questionnaire, you will be asked to provide a saliva sample. This is accomplished through passive drool for a total of three minutes. The collection vial will be changed after each minute.

The samples will be tested for the IgA, a marker of immune function.

You will be asked to write down any medications you are taking.

Saliva samples will be stored with a security code that prevents anyone from identifying them as yours. At the end of this study, you can decide if we destroy your sample or if we can test other salivary markers in the future. This is explained below.

What do I have to do?

If you decide to take part, there are some restrictions on what you can do on days you provide a saliva sample:

- do not eat a major meal within 60 minutes prior to sample collection
- avoid alcohol consumption 24 hours prior to sample collection
- avoid eating dairy products during the 30 minutes prior to sample collection
- avoid acidic or high sugar foods
- do not brush your teeth within 2 hours prior to sample collection
- wash mouth out with water minutes prior to starting questionnaire

The following are the specific instructions you must follow to provide the sample:

1. Rinse your mouth out with water.
2. Swallow the saliva that is already in your mouth.
3. Allow saliva to collect passively into the bottom of your mouth for the indicated time period.
4. Spit saliva into vial.

What are the possible disadvantages of taking part?
Some people find providing a saliva sample uncomfortable.

What are the possible advantages of taking part?
Compensation will be provided in the form of £3 for the first visit, £4 for the second visit, and £5 for the two subsequent visits.

What if something goes wrong?
If you wish to complain, or have any concerns about any aspect of the way you have been approached or treated during the course of this study, please contact Dr. Martha Whiteman (m.whiteman@sms.ed.ac.uk).

Will my taking part in this study be kept confidential?
All information which is collected about you during the course of the research will be kept strictly confidential. All data collected from you will be separated from all personally identifying information so that you cannot be recognised from it. Personal details will be encrypted and kept securely in a database. Data collected from you will also be kept securely apart from any identifying details. The data will become fully anonymized at the end of the study.

What will happen to the results of the research study?
The results of the study will be written up into reports and publications. We will provide a simplified version of the results written in lay terms in 2007.

Who is organising and funding the research?
The research is funded and organized by the Department of Psychology, The University of Edinburgh.

Who has reviewed the study?
This study was granted approval by the NHS Lothian Regional Ethics Committee for Scotland & the University of Edinburgh's Department of Psychology Ethics Committee.

Contact Information
Andrew J. Wawrzyniak
a.j.wawrzyniak@sms.ed.ac.uk

Dr. Martha Whiteman
m.whiteman@sms.ed.ac.uk

Psychology
The School of Philosophy Psychology and Language Sciences
The University of Edinburgh
7 George Square
Edinburgh EH8 9JZ

Appendix G – Questionnaires

New University Student Study

Questionnaire Book

Psychology Department

University of Edinburgh

General Instructions

Thank you for agreeing to take part in this study. This questionnaire booklet is in several sections, with each questionnaire in a different colour. It should take approximately 40 minutes to complete the entire booklet.

Please read the instructions specific to each questionnaire carefully. Each questionnaire has a different set of instructions and responses. Please answer each question honestly.

All data collected will be kept strictly confidential.
No personal information will be associated with the data you provide here.

Background Information

Date of birth

Day______ Month ______ Year______

Gender

Female ________ Male ________

Do you smoke cigarettes at present? Yes / No

If yes, about how many cigarettes do you smoke each day? ____________

For how many years have you been a smoker? ____________

Have you ever smoked cigarettes? Yes / No

If yes, about how many cigarettes did you smoke each day? ____________

For how many years were you a smoker? ____________

Do you drink alcoholic beverages? Yes / No

If yes, about how many drinks do you consume each week? ____________

Are you working? Yes / No

If yes, how many hours per week do you work? ____________

What is the nature/title of your job? ______________________________

The next set of questions refer to the place you consider home. Furthermore, the questions apply to the head(s) of your household, i.e., mother/father, mother/step-father, step-mother/father, etc.

Is the first head of your household employed? Yes / No

If yes, how many hours per week does s/he work? ____________

What is the nature/title of his/her job? ______________________________

Is your second head of your household employed? Yes / No

If yes, how many hours per week does s/he work? ____________

What is the nature/title of his/her job? ______________________________

How many times do you exercise for at least 20 minutes each week? Exercise includes anything from 20 minutes in the gym to walking to & from university for 20 minutes. ____________

Do you have any medical conditions you are being treated for? Yes / No

If yes, which ones? ______________________

Are you currently taking any medications? Yes / No

If yes, which ones? ______________________

In the past 3 months, have you had any illnesses that required hospitalization?

Yes / No

If yes, which ones? ______________________

In the past 3 months, have you had any illnesses that required you to stay home from school or work?

Yes / No

If yes, which ones? ______________________

In the past 3 months, have you had any illnesses that still allowed you to go to work/school?

Yes / No

If yes, which ones? ______________________

How many times do you eat fast food/takeaway per week? ____________

How many bags of crisps do you eat per week? ____________

How many candy bars do you eat per week? ____________

How many servings of fruit do you eat per week? One serving is one piece of fruit or ½ cup of fruit. ____________

How many servings of vegetables do you eat per week? One serving is one piece of vegetable or ½ cup of vegetables. ____________

Please read all instructions carefully before beginning. The questionnaire on the next two pages contains 60 statements. Please read each statement carefully and tick the one box that best represents your opinion.

Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
SD	D	N	A	SA

Item		SD	D	N	A	SA
1	I am not a worrier.					
2	I like to have a lot of people around me.					
3	I don't like to waste my time daydreaming.					
4	I try to be courteous to everyone I meet					
5	I keep my belongings clean and neat.					
6	I often feel inferior to others.					
7	I laugh easily.					
8	Once I find the right way to do something I stick to it.					
9	I often get into arguments with my family and co-workers.					
10	I'm pretty good at pacing myself so as to get things done on time.					
11	When I'm under a great deal of stress, sometimes I feel like I'm going to pieces.					
12	I don't consider myself especially "light-hearted".					
13	I am intrigued by the patterns I find in art and nature.					
14	Some people think I'm selfish and egotistical.					
15	I am not a very methodical person.					
16	I rarely feel lonely or blue.					
17	I really enjoy talking to people.					
18	I believe letting students hear controversial speakers can only confuse and mislead them.					
19	I would rather co-operate with others than compete with them.					
20	I try to perform all the tasks assigned to me conscientiously.					
21	I often feel tense and jittery.					
22	I like to be where the action is.					
23	Poetry has little or no effect on me.					
24	I tend to be cynical of others' intentions.					
25	I have a clear set of goals and work towards them in an orderly fashion.					
26	Sometimes I feel completely worthless.					
27	I usually prefer to do things alone					
28	I often try new and foreign foods.					
29	I believe that most people will take advantage of you if you let them.					
30	I waste a lot of time before settling down to work.					
31	I rarely feel fearful an anxious.					
32	I often feel as if I am bursting with energy.					
33	I seldom notice the moods or feelings that different environments produce.					
34	Most people I know like me.					
35	I work hard to accomplish my goals.					

		SD	D	N	A	SA
36	I often get angry at the way people treat me.					
37	I am a cheerful, high-spirited person.					
38	I believe we should look to our religious authorities for decisions on moral issues.					
39	Some people think of me as cold and calculating.					
40	When I make a commitment, I can always be counted on to follow through.					
41	Too often, when things go wrong, I get discouraged and feel like giving up.					
42	I am not a cheerful optimist.					
43	Sometimes when I am reading poetry or looking at a work of art, I feel a chill or wave of excitement.					
44	I'm hard-headed and tough-minded in my attitudes.					
45	Sometimes I'm not as dependable or reliable as I should be.					
46	I am seldom sad or depressed.					
47	My life is fast-paced.					
48	I have little interest in speculating on the nature of the universe or the human condition.					
49	I generally try to be thoughtful and considerate.					
50	I am a productive person who always gets the job done.					
51	I often feel hopeless and want someone else to solve my problems.					
52	I am a very active person.					
53	I have a lot of intellectual curiosity.					
54	If I don't like people, I let them know it.					
55	I never seem to be able to get organised.					
56	At times I have been so ashamed I just wanted to hide.					
57	I would rather go my own way than be a leader of others.					
58	I often enjoy playing with theories or abstract ideas.					
59	If necessary, I am willing to manipulate people to get what I want.					
60	I strive for excellence in everything I do.					

Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
SD	D	N	A	SA

Over the past 3 months, do you believe your personality has changed? Yes / No

If yes, how? ______________________________

____

What aspects, if any, of your personality do you desire to change?

____

____

____

____

____

Satisfaction with Life Scale

Below are five statements with which you may agree or disagree. Using a 1 to 7 scale, indicate your agreement with each item by placing the appropriate number on the line next to that item. Please be open and honest in your responses. The 7-point scale is:

1 = strongly disagree
2 = disagree
3 = slightly disagree
4 = neither agree nor disagree
5 = slightly agree
6 = agree
7 = strongly agree

In most ways my life is close to ideal. ________

The conditions of my life are excellent. ________

I am satisfied with my life. ________

So far I have got the important things I want in life. ________

If I could live my life again, I would change almost nothing. ________

Life Events Scale

The following questions ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate how often you felt or thought a certain way.

Although some of the questions are similar, there are differences between them and each one should be treated as a separate question. Your response should reflect a reasonable estimate of how you felt. Please answer each question as quickly and honestly as possible.

		Never	Almost Never	Sometimes	Fairly Often	Very Often
1	In the last month, how often have you been upset because of something that happened unexpectedly?					
2	In the last month, how often have you felt that you were unable to control the important things in your life?					
3	In the last month, how often have you felt nervous and stressed?					
4	In the last month, how often have you dealt with irritating life hassles?					
5	In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?					
6	In the last month, how often have you felt confident about your ability to handle your personal problems?					
7	In the last month, how often have you felt that things were going your way?					
8	In the last month, how often have you found that you could not cope with all the things you had to do?					
9	In the last month, how often have you been able to control irritations in your life?					
10	In the last month, how often have you felt on top of things?					
11	In the last month, how often have you been angered because of things that happened that were outside of your control?					
12	In the last month, how often have you found yourself thinking about things you have to accomplish?					
13	In the last month, how often have you been able to control the way you spend your time?					
14	In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?					
		Never	Almost Never	Sometimes	Fairly Often	Very Often

General Health Questionnaire

We would like to know if you have had any medical complaints and how your health as been in general over the last few weeks. Please answer all the questions simply by circling the answer which you think most nearly applies to you. Remember that we want to know about present and recent complaints, not those that you had in the past

Have you recently...

1	been able to concentrate on whatever you're doing?	Better than usual	Same as usual	Less than usual	Much less than usual
2	lost much sleep over worry?	Not at all	No more than usual	Rather more than usual	Much more than usual
3	felt that you are playing a useful part in things?	More so than usual	Same as usual	Less useful than usual	Much less useful
4	felt capable of making decisions about things?	More so than usual	Same as usual	Less so than usual	Much less than usual
5	felt constantly under strain?	Not at all	No more than usual	Rather more than usual	Much more than usual
6	felt you couldn't overcome your difficulties?	Not at all	No more than usual	Rather more than usual	Much more than usual
7	been able to enjoy your normal day-to day activities?	More so than usual	Same as usual	Less so than usual	Much less than usual
8	been able to face up to your problems?	More so than usual	Same as usual	Less so than usual	Much less able
9	been feeling unhappy and depressed?	Not at all	No more than usual	Rather more than usual	Much more than usual
10	been losing confidence in yourself?	Not at all	No more than usual	Rather more than usual	Much more than usual
11	been thinking of yourself as a worthless person?	Not at all	No more than usual	Rather more than usual	Much more than usual
12	been feeling reasonably happy, all things considered?	More so than usual	About the same as usual	Less so than usual	Much less than usual

Life Experiences Questionnaire

Listed below are a number of events which sometimes bring about change in the lives of those who experience them and which necessitate social readjustment. Please check those events which you have experienced in the recent past and indicate the time period during which you have experienced each event.

Also, for each checked item, please indicate the extent to which you viewed the event as having either a positive or negative impact on your life at the time the event occurred. That is, indicate the type and extent of impact that the event had.

		0 to 6 mo	7 mo to 1 yr	Extremely negative	moderately negative	somewhat negative	no impact	slightly positive	moderately positive	extremely positive
1	Marriage									
2	Detention in jail or comparable institution									
3	Death of spouse									
4	Major change in sleeping habits (much more or much less sleep									
5	Death of close family member:									
	a. mother									
	b. father									
	c. brother									
	d. sister									
	e. grandmother									
	f. grandfather									
	g. other (specify)									
6	Major change in eating habits (much more or much less food intake)									
7	Foreclosure on mortgage or loan									
8	Death of close friend									
9	Outstanding personal achievement									
10	Minor law violations (traffic tickets, disturbing the peace, etc.)									
11	Male: Wife/girlfriends' pregnancy									
12	Female: Pregnancy									
13	Changed work situation (different work responsibility, major change in working conditions, working hours, etc.)									
14	New job									
15	Serious illness or injury of close family member:									
	a. mother									
	b. father									
	c. brother									
	d. sister									
	e. grandmother									
	f. grandfather									
	g. other (specify)									
16	Sexual difficulties									
17	Trouble with employer (in danger of losing job, being suspended, demoted, etc.)									
18	Trouble with in-laws									

		0 to 6 mo	7 mo to 1 yr	Extremely negative	moderately negative	somewhat negative	no impact	slightly positive	moderately positive	extremely positive
19	Major change in financial status (a lot better off or a lot worse off)									
20	Major change in closeness of family member (increased or decreased closeness)									
21	Gaining a new family member (through birth, adoption, family member moving in, etc.)									
22	Change of residence									
23	Marital separation from mate (due to conflict)									
24	Major change in church activities (increased or decreased attendance)									
25	Marital reconciliation with mate									
26	Major change in number of arguments with spouse (a lot more or a lot less arguments)									
27	Married male: Change in wife's work outside the home (beginning work, ceasing work, changing to a new job, etc.)									
28	Married female: Change in husband's work (loss of job, beginning new job, retirement, etc.)									
29	Major change in usual type and/or amount of recreation									
30	Borrowing more than £10,000 (buying home, business, etc)									
31	Borrowing less than £10,000 (buying car, TV, getting school loan, etc.)									
32	Being fired from job									
33	Male: Wife/girlfriend having abortion									
34	Female: Having abortion									
35	Major personal illness or injury									
36	Major change in social activities, e.g., parties, movies, visiting (increased or decreased participation)									
37	Major change in living conditions of family (building new home remodelling, deterioration of home, neighbourhood, etc.)									
38	Divorce									
39	Serious injury or illness of close friend									
40	Retirement from work									
41	Son or daughter leaving home (due to marriage, college, etc.)									
42	Ending of formal schooling									
43	Separation from spouse (due to work, travel, etc.)									
44	Engagement									
45	Breaking up with boyfriend/girlfriend									
46	Leaving home for the first time									
47	Reconciliation with boyfriend/girlfriend									

		0 to 6 mo	7 mo to 1 yr	Extremely negative	moderately negative	somewhat negative	no impact	slightly positive	moderately positive	extremely positive
48	Beginning a new school experience at a higher academic level (college, graduate school, professional school, etc.)									
49	Changing to a new school at same academic level (undergraduate, graduate, etc.)									
50	Academic probation									
51	Being dismissed from dormitory or other residence									
52	Failing an important exam									
53	Changing a course of studies									
54	Failing a course									
55	Dropping a course									
56	Joining a society/club									
57	Financial problems concerning school (in danger of not having sufficient money to continue)									

Here is a list of statements dealing with your general feelings about yourself. Please circle the appropriate response to indicate your agreement with each statement.

		Strongly Agree	Agree	Disagree	Strongly Disagree
1	On the whole, I am satisfied with myself.	SA	A	D	SD
2	At times I think I am no good at all.	SA	A	D	SD
3	I feel that I have a number of good qualities.	SA	A	D	SD
4	I am able to do things as well as most other people.	SA	A	D	SD
5	I feel I do not have much to be proud of.	SA	A	D	SD
6	I certainly feel useless at times.	SA	A	D	SD
7	I feel that I'm a person of worth, at least on an equal pane with others.	SA	A	D	SD
8	I wish I could have more respect for myself.	SA	A	D	SD
9	All in all, I am inclined to feel that I am a failure.	SA	A	D	SD
10	I take a positive attitude towards myself.	SA	A	D	SD

The following statements describe how people sometimes feel. For each statement, please indicate how often you feel the way described by checking the appropriate box.

		Never	Rarely	Sometimes	Always
		1	2	3	4
1	How often do you feel that you are "in tune" with the people around you?				
2	How often do you feel that you lack companionship?				
3	How often do you feel that there is no one you can turn to?				
4	How often do you feel alone?				
5	How often do you feel part of a group of friends?				
6	How often do you feel that you have a lot in common with the people around you?				
7	How often do you feel that you are no longer close to anyone?				
8	How often do you feel that your interests and ideas are not shared by those around you?				
9	How often do you feel outgoing and friendly?				
10	How often do you feel close to people?				
11	How often do you feel left out?				
12	How often do you feel that your relationships with others are not meaningful?				
13	How often do you feel that no one really knows you well?				
14	How often do you feel isolated from others?				
15	How often do you feel you can find companionship when you want it?				
16	How often do you feel that there are people who really understand you?				
17	How often do you feel shy?				
18	How often do you feel that people are around you but not with you?				
19	How often do you feel that there are people you can talk to?				
20	How often do you feel that there are people you can turn to?				
		1	2	3	4
		Never	Rarely	Sometimes	Always

Quality of Life of University Students

Below is a list of items pertaining to your experience thus far at the University of Edinburgh. Please indicate your agreement with each statement by marking the appropriate box.

	Thus far in my academic career at the University of Edinburgh, I have been challenged to...	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	apply theories to new situations.					
2	remember an extensive number of facts					
3	remember complex facts					
4	recall a significant number of facts.					
5	recall a substantial number of new concepts.					
6	organize ideas in new ways.					
7	identify organizing principles in my courses.					
8	analyze complex interrelationships between concepts.					
9	identify the strengths and weaknesses of arguments.					
10	identify bias in written material.					
11	use theories to address practical questions.					
12	demonstrate how theories are useful in real life.					
13	remember an extensive number of new terms.					
14	interpret the meaning of new facts and terms.					
15	make original contributions to classroom discussions.					
16	develop new ideas based on theories.					
17	apply theoretical principles in solving problems.					

Quality of Life of University Students

Below is a list of items pertaining to your experience thus far at the University of Edinburgh. Please indicate your agreement with each statement by marking the appropriate box.

	The University of Edinburgh is a place where...	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	The things I learn are important to me.					
2	People look up to me.					
3	I really get involved in my work.					
4	I like learning.					
5	I enjoy being.					
6	I have acquired skills that will be of use to me.					
7	The things I learn will help me in my life.					
8	I am given the chance to do work that really interests me.					
9	The things I am taught are worthwhile learning.					
10	I really like to go to each day.					
11	The work I do is good preparation for my future.					
12	I have learned to work hard.					
13	I find that learning is a lot of fun.					
14	I find it easy to get to know other people.					
15	Mixing with other people helps me to understand myself.					
16	People think a lot of me.					
17	Other students accept me as I am.					
18	I get on well with other students in my class.					
19	Professors treat me fairly.					
20	Professors give me the marks I deserve.					

	The University of Edinburgh is a place where…	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
21	I achieve a satisfactory standard in my work.					
22	People care about what I think.					
23	Professors take a personal interest in helping me with my work.					
24	I am treated with respect.					
25	Professors help me to do my best.					
26	Professors are fair and just.					
27	Professors listen to what I say.					
28	I feel depressed.					
29	I feel restless.					
30	I get upset.					
31	I feel worried.					

Appendix H – Parallel Analysis SPSS Syntax

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* Parallel Analysis program.
set mxloops=9000 printback=off width=80  seed = 1953125.
matrix.

* enter your specifications here.
compute ncases   = 500.
compute nvars    = 9.
compute ndatsets = 100.
compute percent  = 95.

* Specify the desired kind of parallel analysis, where:
 1 = principal components analysis
 2 = principal axis/common factor analysis.
compute kind = 2 .

****************** End of user specifications. ******************

* principal components analysis.
do if (kind = 1).
compute evals = make(nvars,ndatsets,-9999).
compute nm1 = 1 / (ncases-1).
loop #nds = 1 to ndatsets.
compute x = sqrt(2 * (ln(uniform(ncases,nvars)) * -1) ) &*
        cos(6.283185 * uniform(ncases,nvars) ).
compute vcv = nm1 * (sscp(x) - ((t(csum(x))*csum(x))/ncases)).
compute d = inv(mdiag(sqrt(diag(vcv)))).
compute evals(:,#nds) = eval(d * vcv * d).
end loop.
end if.

* principal axis / common factor analysis with SMCs on the diagonal.
do if (kind = 2).
compute evals = make(nvars,ndatsets,-9999).
compute nm1 = 1 / (ncases-1).
loop #nds = 1 to ndatsets.
compute x = sqrt(2 * (ln(uniform(ncases,nvars)) * -1) ) &*
        cos(6.283185 * uniform(ncases,nvars) ).
compute vcv = nm1 * (sscp(x) - ((t(csum(x))*csum(x))/ncases)).
compute d = inv(mdiag(sqrt(diag(vcv)))).
compute r = d * vcv * d.
compute smc = 1 - (1 &/ diag(inv(r)) ).
call setdiag(r,smc).
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compute evals(:,#nds) = eval(r).
end loop.
end if.

* identifying the eigenvalues corresponding to the desired percentile.
compute num = rnd((percent*ndatsets)/100).
compute results = { t(1:nvars), t(1:nvars), t(1:nvars) }.
loop #root = 1 to nvars.
compute ranks = rnkorder(evals(#root,:)).
loop #col = 1 to ndatsets.
do if (ranks(1,#col) = num).
compute results(#root,3) = evals(#root,#col).
break.
end if.
end loop.
end loop.
compute results(:,2) = rsum(evals) / ndatsets.

print /title="PARALLEL ANALYSIS:".
do if  (kind = 1).
print /title="Principal Components".
else if (kind = 2).
print /title="Principal Axis / Common Factor Analysis".
end if.
compute specifs = {ncases; nvars; ndatsets; percent}.
print specifs /title="Specifications for this Run:"
 /rlabels="Ncases" "Nvars" "Ndatsets" "Percent".
print results /title="Random Data Eigenvalues"
 /clabels="Root" "Means" "Prcntyle"  /format "f12.6".

do if  (kind = 2).
print / space = 1.
print /title="Compare the random data eigenvalues to the".
print /title="real-data eigenvalues that are obtained from a".
print /title="Common Factor Analysis in which the # of factors".
print /title="extracted equals the # of variables/items, and the".
print /title="number of iterations is fixed at zero;".
print /title="To obtain these real-data values using SPSS, see the".
print /title="sample commands at the end of the parallel.sps program,".
print /title="or use the rawpar.sps program.".
print / space = 1.
print /title="Warning: Parallel analyses of adjusted correlation matrices".
print /title="eg, with SMCs on the diagonal, tend to indicate more factors".
print /title="than warranted (Buja, A., & Eyuboglu, N., 1992, Remarks on parallel".
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print /title="analysis. Multivariate Behavioral Research, 27, 509-540.).".
print /title="The eigenvalues for trivial, negligible factors in the real".
print /title="data commonly surpass corresponding random data eigenvalues".
print /title="for the same roots. The eigenvalues from parallel analyses".
print /title="can be used to determine the real data eigenvalues that are".
print /title="beyond chance, but additional procedures should then be used".
print /title="to trim trivial factors.".
print / space = 1.
print /title="Principal components eigenvalues are often used to determine".
print /title="the number of common factors. This is the default in most".
print /title="statistical software packages, and it is the primary practice".
print /title="in the literature. It is also the method used by many factor".
print /title="analysis experts, including Cattell, who often examined".
print /title="principal components eigenvalues in his scree plots to determine".
print /title="the number of common factors. But others believe this common".
print /title="practice is wrong. Principal components eigenvalues are based".
print /title="on all of the variance in correlation matrices, including both".
print /title="the variance that is shared among variables and the variances".
print /title="that are unique to the variables. In contrast, principal".
print /title="axis eigenvalues are based solely on the shared variance".
print /title="among the variables. The two procedures are qualitatively".
print /title="different. Some therefore claim that the eigenvalues from one".
print /title="extraction method should not be used to determine".
print /title="the number of factors for the other extraction method.".
print /title="The issue remains neglected and unsettled.".

end if.

end matrix.

* Commands for obtaining the necessary real-data eigenvalues for
  principal axis / common factor analysis using SPSS;
  make sure to insert valid filenames/locations, and
  remove the '*' from the first columns.
* corr var1 to var20 / matrix out ('filename') / missing = listwise.
* matrix.
* MGET /type= corr /file='filename' .
* compute smc = 1 - (1 &/ diag(inv(cr)) ).
* call setdiag(cr,smc).
* compute evals = eval(cr).
* print { t(1:nrow(cr)) , evals }
 /title="Raw Data Eigenvalues"
 /clabels="Root" "Eigen." /format "f12.6".
* end matrix.
```