EVALUATING THE CAUSAL PRIMACY OF THE FIVE-FACTOR MODEL OF PERSONALITY IN RELATION TO HEALTH STATUS, PHYSICIAN UTILIZATION, RESTRICTION OF ACTIVITIES, HEALTH BEHAVIOURS, AND NEGATIVE LIFE EVENTS

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Evaluating the Causal Primacy of the Five-Factor Model of Personality in Relation to Health Status, Physician Utilization, Restriction of Activities, Health Behaviours, and Negative Life Events

By

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Abstract

Two questions were posed in this dissertation: first, to what extent is the Five-Factor Model of Personality related to health status, illness behaviour, and sick-role behaviour? And second, how are the five factors connected to these variables, through stress moderation, mediation, both moderation and mediation, or neither? To answer these questions, eight non-process and process models were developed. For each of the four non-process models, two of the models included statistical controls and personality by personality interaction terms. The process or path models were similarly constructed: two models were constructed with controls and personality by life stress product-terms while the remaining two omitted the latter variables. Questionnaire data were gathered from 706 adults (Mean Age = 37 years) in a two-wave prospective study. The participants were administered a 79-item trait adjective checklist to measure the five factors, a measure of negative life stress, the Alameda Country Health Practices Index, a demographics questionnaire, and 10 measures of health status, illness behaviour, and sick-role behaviour. Principle Components Analyses at waves one and two reduced the health and health-related measures to three interpretable components: General Health, Physician Utilization, and Restriction of Activities. Multiple regression and observed variable path analyses (i.e., structural equation modelling: EQS) were used to analyze the models. The multiple regression analyses suggested that (1) despite some redundancy, the five factors were found to be related to health status independently as opposed to interactively, (2) the relationships found between the five factors and health status were found more often with the subjective or well-being measures of health status,

and (3) these latter relationships were attenuated when the wave one controls, specifically the autoregressive variables, were implemented. However, the five factors (e.g., openness to experience, neuroticism, extraversion) were still variously related to a number of well-being measures (e.g., general health). The regression analyses highlight the importance of accounting for other variables when interpreting correlational data.

The results from the path analyses indicated that the five-factors had little effect on the mediators and health status variables when the outcome was objective (e.g., number of chronic conditions) and when the controls were implemented. However, neuroticism was consistently related to greater levels of life stress and general health despite the controls. When the models were evaluated without the controls, four of the five factors had an additive effect on health status (i.e., general health); no personality by life events interactions were observed save for an openness to experience by stress interaction; however, this interaction disappeared when the controls were taken into account. The control variable stress/health behaviour mediator model was found to be the most parsimonious model.

Based on the results from the path analyses, two new models were constructed from the control variable stress/health behaviour mediator model and the no control variable stress/health behaviour mediator model. In general, the results suggested that neuroticism may directly and indirectly impact on health status, illness behaviour, and sick-role behaviour, depending on whether control variables are incorporated into the models. The findings support Stone and Costa, Jr.'s (1990) notion of the distress-prone personality. Little support was found for Booth-Kewley and Friedman's (1987) disease-prone personality model.

While the present study replicated several past researches, it also shed new light on the complexities associated with the use of a multivariate model of personality set within a biopsychosocial context. Future research will need to further the usefulness of the five-factor model of personality in stress-health research programs.

Acknowledgements

I would like to thank several individuals who helped to make this dissertation possible. First of all. I would like to thank Dr. Ted Hannah for his supervision over the past few years and his encouragement for getting me through some difficult times. Ted. its still hard to believe that it is all over. What ever will I do?

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Thanks are also extended to the many people and organizations who were kind enough to lend their time in helping me to complete this undertaking.

Dedications

This dissertation is dedicated to a few special people who have had an enormous impact on my life:

To my Mother who made me realize that I could and should make something of my life. You pushed me out of apathy and propelled me upwards. This one is for you! Love you always!

To my brother Bill for picking up where no father could.

To John for your supervision and ways of looking at the world.

To Eli for being there for so long. Thanks for not giving up on our friendship.

To Todd and Kathy for the laughs.

To Evan for fighting the fight.

To Irma, my godmother for the coffee and sandwiches, your dreams of winning the lottery, your waves good-bye and your hugs and kisses. Love you forever!

To Kimberly for everything! You have made a boring existence fun, the lonely times full, the happy times even happier, and the painful times less painful. You have been my best friend and a source of reason when blackness and uncertainty tried to prevail. Thanks Duck for sticking with me through everything!

Dave

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List of Symbols and Abbreviations

M	=	Mean/Average
SD	=	Standard Deviation
h^2	=	Communality
r	=	Correlation Coefficient
E	=	Error Term
R^2	=	Multiple R-Squared
β	=	Standardized Regression/Path Coefficient
η	=	Endogenous/Dependent/Criterion Variable
γ	=	Weight expressed in conjuntion with ξ
ξ	=	Exogenous/Predictor/Independent Variable
p	=	Probability Level (Alpha)
ns	=	Not Statistically Significant
SEM	=	Structural Equation Modelling
ECVI	=	Expected Cross-Validation Index
GFI	=	Goodness of Fit Index
IFI	=	Incremental Fit Index
CFI	=	Comparative Fit Index
RCFI	=	Robust Comparative Fit Index
RMSEA	=	Root Mean Square Error of Approximation
N	=	Number of Subjects in Total Data Set

List of Symbols and Abbreviations Continued

n	=	Subset of Subjects in Total Data Set
df	=	Degrees of Freedom
Alpha	=	Cronbach's Alpha Reliability Coefficient
T1	=	Time/Wave 1
T2	=	Time/Wave 2
F	=	F-test comparing R^2s from two different models
t	=	t-test
W	=	W-test (Generalized R^2)
χ2	=	Chi-square
S-Bχ2	=	Satorra-Bentler Chi-Square
Hoχ2	=	Independence Model Chi-Square
CI	=	Confidence Interval
q	=	Number of Parameters

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Evaluating the Causal Primacy of the Five-Factor Model of Personality in Relation to Health Status, Physician Utilization, Restriction of Activities, Health Behaviours, and Negative Life Events

...our belief in disease as a direct reflection of mental state is largely folklore (Angel, 1985)

We wanted to highlight the following bright spots in personality research: the growing agreement among differential psychologists concerning the number, character, and stability of personality dimensions; the extent to which heritability of personality is being understood and thereby illuminating the important contributions made by environmental factors to individual differences in personality; the growing sophistication of research which aims to elucidate the biological and social bases of trait dimensions; and the extent to which personality differences predict outcomes or act as moderators, in cognitive and health settings (Deary & Matthews, 1993).

The belief that personality is linked to health status has a long and rich, though checkered history (Watson & Hubbard, 1996).[1] One of the earliest views reported to have linked personality to health was developed by the ancient Greek physician, Galen of Pergamum, who argued that the four bodily humours of blood, phlegm, black bile, and yellow bile, could form the basis of temperament. Galen labelled these temperaments, the *melancholic* (black bile), the *choleric* (yellow bile), the *phlegmatic* (phlegm), and the *sanguine* (blood). According to Galen, when the four humours are blended into a balanced state, optimal personal functioning results. An imbalance of the humours leads to both physical and mental disturbance (Deary & Matthews, 1998).

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[1] Portions of this dissertation were presented at the 1996 Canadian Psychological Association Convention in Prince Edward Island, Canada.

A more recent and distinct view was developed during the first half of the twentieth century when many came to believe that chronic psychic conflicts were associated with physical disorder. To many, this period represented the great promise of psychosomatic medicine (Seeman, 1989). One figure who would have a significant impact on this movement was Sigmund Freud. Freud, whose work on conversion hysteria helped to renew interest in personality, emotions, and health, believed that repressed psychic impulses produce a variety of physical and mental symptoms (Phares & Chaplin, 1997). For example, in conversion hysteria it was believed that a conflict (e.g., ego versus id) was converted into a symptom through various mental mechanisms. By using hypnosis and other analytic techniques (e.g., free association), Freud was often able to cure or provide relief to the psychic problem.

A further development occurred in the 1930s and 1940s when both Flanders Dunbar and Franz Alexander, early proponents of the psychosomatic movement, argued for a psychoanalytic interpretation for several health problems that included ulcers, high blood pressure, asthma, migraine headaches, as well as rheumatoid arthritis (Sarafino, 1994). Unfortunately, because of several theoretical and methodological (e.g., retrospective data) problems underlying their work, and that of others, a *moratorium* was placed on the psychosomatic movement (Suls & Rittenhouse, 1990).

During the past 30 years, there has been a renewed interest in the field of personality and health (Watson & Hubbard, 1996). This reemergence was due in large part to the growing status of health psychology and behavioural medicine as separate disciplines. Advances in methodology (e.g., Structural Equation Modelling: see e.g., Hoyle, 1995), findings that traditional risk factors do not fully account for the variance in disease outcome, and developments in theory and research on the *Type A Behaviour Pattern* (TABP) and *Personality Hardiness*, also contributed (Amelang, 1997; Denollet, 1997; Sanderman & Ranchor, 1997; Van Heck, 1997; Wiebe & Smith, 1997). According to Suls and Rittenhouse (1990), the moratorium has since been lifted.

<u>Causal Primacy and the Personality to Health Status Connection</u>

The metatheory underlying the view that personality is linked to health status is based on the *Causal Primacy Hypothesis*, the assumption that personality causes or influences behaviour (e.g., health: see Deary & Matthews, 1998).[2] Raymond Cattell's (1957) distinction between source and surface traits, Gordon Allport's (1966) belief that personality lies within the individual and influences personal activity, and Henry Murray's (1938) view that personality resides within the brain, all partly reflects such an assumption (see Suls & Rittenhouse, 1990; Wiebe & Smith, 1997).

At its simplest level of explanation, the causal primacy hypothesis holds that personality has a direct influence on the development of disease or health problems (e.g., Amelang, 1997; Diener, Suh, Lucas, & Smith, 1999; Krantz & Hedges, 1987; Smith & Williams, 1992; see Figure 1a). One line of research that exemplifies this view focuses on the link between the Type A Behaviour Pattern and coronary heart disease (Amelang, 1997; Bartlett,

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[2] While behaviour may influence personality, this effect is assumed to be weaker than the personality to behaviour relationship (Deary & Matthews, 1998).

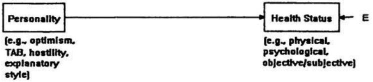

Figure 1a: Direct Effects Model

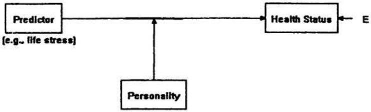

Figure 1b: Moderator Model

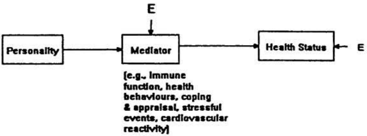

Figure 1c: Mediator Model

Figure 1: Personality and health models based on the Causal Primacy Hypothesis

1998).[3] In the late 1950s, two cardiologists, Meyer Friedman and Ray Rosenman, observed that younger patients who suffered from a variety of cardiac problems tended to display several types of behavioural excesses including a heightened sense of competitive achievement striving, a sense of time urgency, and aggressiveness. Wright (1988) later extended this view and proposed that the basic ingredients underlying the construct include, a sense of time urgency, a chronic activation level, and a multiphasic behavioural component (i.e., engages in multiple tasks). Type A Behaviour Pattern research had been so fruitful that by the late 1970s, it was considered to be a significant contributor to the development of coronary heart disease as well as a host of other physical and psychological problems.

Largely influenced by Type A Behaviour Pattern research, scholars began to focus their attention on other person variables. Much of this early research had been summarized in a seminal meta-analytic review by Friedman and Booth-Kewley (1987; see also Booth-Kewley & Friedman, 1987; Matthews, 1988), who found that anxiety, depression, anger/hostility/aggression, anger/hostility, and extraversion were all variously related to a variety of psychosomatic conditions including coronary heart disease, asthma, ulcers, arthritis, and headaches. Researchers have since linked other personality variables to health status, including repressive coping style (Davidson, 1993), dispositional optimism (Scheier

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[3] During the past decade, scholars have also focused their research energies on the Type-C or the Cancer-Prone Personality (i.e., repression of emotions, lack of expression; see Sanderman & Ranchor, 1997 for a literature review). According to Sanderman and Ranchor (1997), there is little data available demonstrating the impact of this construct on cancer progression or survival.

& Carver. 1987). anger (Suls. Wan. Costa Jr.. 1995). the Type D or Distress-Prone Personality (Denollet. Sys. Stroobant. Rombouts. Gillebert. & Brutsaert. 1996). attributional style (Hull & Mendolia. 1991). power and affiliation motives (Jemmott III. 1987). sense of coherence (Antonovsky. 1987: Korotkov. 1998). hardiness (Kobasa. 1979). self-efficacy (e.g.. Bandura. 1997). neuroticism/negative affectivity (Costa. Jr.. & McCrae. 1987a). and hostility (Denollet. 1997: Miller. Smith. Turner. Guijarro. & Hallet. 1996).[4]

A second. more explanatory view of the primacy hypothesis holds that personality is linked to health status through a variety of biopsychosocial conditions and mechanisms (see Figures 1b and 1c: Krantz & Hedges. 1987: Smith & Williams. 1992: Suls & Rittenhouse. 1990: Taylor. 1991). To help explain these processes. two meta-models have guided researchers. the *stress moderator model*. and the *mediator model*.

In general. the stress moderator model assumes that an internal or external antecedent variable interacts with stress to influence both the magnitude and direction of the relationship between stress and health outcome (see Figure 1b).[5] Moderator variables can

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[4] Interestingly. Costa. Jr.. McCrae. and Dembroski (1989). and others (e.g.. Adams & John. 1997: Felsten. 1996) have speculated that because hostility is moderately correlated with agreeableness. a dimension of the five-factor model of personality. and also the model under discussion. the later may be linked to coronary heart disease.

[5] Contemporary influences of the moderator model can in part be traced to Henry Murray and Walter Mischel. Murray (1938). whose work would influence generations of psychologists. played a significant role in furthering our understanding of personal motivation and health. In general. Murray believed that in order to understand personality and behaviour. one must consider both the person and the situation. Of paramount importance in Murray's theorizing and research. were his expositions on the constructs of *Needs* and *Presses*. According to Murray. a need simply reflects a tendency or desire to achieve a specific end-state. while an environmental press is an aspect of the environment that could affect the health. behaviour. and well-being of the individual. The combination or

take many forms. In general, these include biologic or genetic variables (e.g., sex), personality traits (e.g., humour), and interpersonal factors (e.g., actual support). The stress moderator model has been referred to as the *Moderator Model* (Baron & Kenny, 1986; Cohen & Edwards, 1989; Wheeler, 1988), the *Vulnerability Hypothesis* (Dohrenwend & Dohrenwend, 1984), the *Stress Buffering Model* (Barrera, Jr., 1988; Cohen, 1988), and the *Interactive Effects Buffering Model* (Wheaton, 1983). Stress moderation is typically tested by way of analysis of variance or multiple regression. In both statistical models, a stress by resource (e.g., personality) product-term interaction variable is included to assess for moderation. In general, a significant interaction term suggests that stress is being influenced by the resource in question. Theoretically, a stress resource can either prevent a cognitive stress appraisal or facilitate coping during reappraisal (see Cohen & Edwards, 1989).

An early example of this research focused on the trait variable of personality hardiness, a dispositional construct comprised of three related components, commitment, control, and challenge (Kobasa, 1979). According to Kobasa, individuals who score high on all three variables are believed to be resilient to the deleterious consequences of stress. In an often

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interaction of a particular need with a press, results in a constellation of behaviours termed a *Thema*. For example, an individual who has a high need for achievement but who is consistently turned down for a promotion, may become depressed as well as passive within the context of his or her job.

A significant event occurred in the late 1960s when Walter Mischel (1968) published a paper that, ironically, helped to propel trait psychology as well as personality and health research back into the spotlight. In a stinging attack on trait psychology, Mischel presented what appeared to be compelling evidence that traits lacked cross-situational consistency and predictive validity. One response to Mischel's critique was a subsequent focus on interactionism (Bartlett, 1998). For example, in the late 1970s researchers began to explore the possibility that demographic, social, and personality variables could mediate, buffer or moderate, the effects of life stress on illness.

cited study. Kobasa (1979) split a sample of high stress male executives into high and low illness groups. When the two groups were compared, Kobasa found individuals in the high stress-low illness group to be more *hardy* than those in the high stress-high illness group. While some controversy remains surrounding the proposed stress-buffering effects of hardiness (see e.g., Allred & Smith, 1989; Funk & Houston, 1987), Kobasa's research has influenced a generation of researchers interested in the personal variations that underlie the stress response.

More recent researches have identified sense of coherence (Korotkov, 1998), neuroticism (Aldwin, Levenson, Spiro, & Bosse, 1989), extraversion (Duckitt & Broll, 1982; Miller & Cooley, 1981), locus of control (Cohen & Edwards, 1989), potency (Ben-Sira, 1985), pet ownership (Siegel, 1990), humour (Martin & Lefcourt, 1983; Nezu, Nezu, & Blissett, 1988), telic-paratelic dominance (Martin, Kuiper, Olinger, & Dobbin, 1987), and ego resiliency (Block & Block, 1980) as moderators. As in the case of hardiness, individuals with high scores on the positive end of the moderator variable measure (e.g., emotionally stable, extraverted, internally controlled), tend to report fewer psychological and physical problems under high stress than those who score at the low end of the moderator variable.

A second elaboration of the original causal primacy hypothesis focuses on those variables that mediate, as opposed to moderate, the relation between personality and behaviour (e.g., health status; see Figure 1c).[6] The mediator model assumes that personality

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[6] Some researchers such as Wiebe and Smith (1997), view the mediator model as a *transactional* extension of the moderator model given the belief that some individuals are active in selecting the situation they enter into (Diener, Suh, Lucas, & Smith, 1999; Snyder,

(e.g., the big five) has an indirect impact on health (see Figure 1c: see Suls, David, & Harvey, 1996). In general, the mediator model emphasizes the mediator as a mechanism that transmits the effects of a predictor (e.g., personality) to a criterion (e.g., health status). While the moderator hypothesis speaks to the conditions under which personality impacts on behaviour (e.g., health status), the mediator model emphasizes process, or how disease develops. In this vein, the mediator model is more theoretically based than the moderator model (Kline, 1991). The mediator model has been given several names including the *Suppressant Effect Model* (Revicki & May, 1985), the *Top-Down Model* (Feist, Bodner, Jacobs, Miles, & Tan, 1995), the *Resource Intervention Model* (Hobfoll & Lilly, 1993), the *Stress Prevention Model* (Barrera, Jr., 1988), and the *Stress Deterrent Model* (Wheaton, 1983). In order to be classified as a mediator, the variable must be related to both the predictor and outcome variable and the predictor must be linked to the outcome (Baron & Kenny, 1986). When the mediator is partialled out from both variables, the personality to health status relationship should be statistically nonsignificant. [7]

1985). This contrasts with the mechanistic view of moderation: that is, moderation in the form of an A by B product-term interaction.

[7] In this writer's view, this reflects a legitimate though potentially overly prescribed to assumption given that sample size may impact on the significance level of the beta weight or partial correlation. Jackson (1995) has suggested a different though possibly complementary option whereby the degree of reduction based on the *Rule of Thirds* is used. That is, if a relationship between the predictor and outcome disappears by a third as a result of partialling out the mediator, this may be construed as possible mediation. However, given the somewhat arbitrary nature of the rule, it would perhaps be more fruitful to consider both statistical viewpoints, possibly in terms of necessity and sufficiency. This latter view was adopted for the purposes of this research.

Theory and research have suggested several variables that may help to explain the link between personality and health including but not limited to, life events (Wiebe & McCallum, 1986), daily hassles (Aldwin, Levenson, Spiro, & Bosse, 1989), immune function, cardiovascular reactivity (Cohen & Herbert, 1996; Sanderman & Ranchor, 1997), self-regulatory processes, goals (Bandura, 1997), coping, appraisal, and health behaviours (Suls, David, & Harvey, 1996; Suls & Rittenhouse, 1990).

In general, all three views of the primacy hypothesis are complementary in nature. That is, to assess for moderation, it is ideal *though not necessary*, that the predictor and moderator not be related to health status, and each other. For example, personality may interact with stress, *disordinally*, as well as *ordinally* (see e.g., Feldman, Cohen, Doyle, Skoner, & Gwaltney, Jr., 1999; Martin & Lefcourt, 1983). The following will present a critique of personality-health research. This will be followed by a discussion on the five-factor model of personality, a set of constructs that may help to resolve the concerns that will now be described.

Theoretical and Methodological Concerns

Despite the renewed interest in personality and health, the field remains plagued by several theoretical and methodological problems. In general, the concerns are centered around single trait models, process, issues surrounding the measurement and definition of health, the population of study, statistical control/overcontrol, statistical developments in structural equation technology, as well as the nature of the research design. It will be argued that the theoretical concerns can in part be resolved by use of the five-factor model of personality, a broad dispositional typology comprised of five broad factors that include, *Openness to Experience, Conscientiousness, Extraversion, Agreeableness*, and *Neuroticism*. The methodological and statistical issues represent other significant concerns that preclude adequate interpretation of personality-health findings: therefore, these latter concerns will also be addressed.[8]

(1) **Focus on Single Trait Models**. One concern is that researchers have tended to rely on single trait variable models in conceptualizing personality and its impact on health (Suls, David, & Harvey, 1996).[9] Theoretically, this research ignores claims and findings by several writers that trait variables in the personality sphere are interconnected (e.g., Allport, 1966; Marshall, Wortman, Vickers, Jr., Kusulas, & Hervig, 1994). For example, according to Allport (1966), *personality is comprised of a network of overlapping traits only relatively independent from one another*. Marshall, Wortman, Vickers, Jr. Kusulas, and Hervig (1994) add that, in relation to personality-health research, ... *much research in the area can be characterized as having led to isolated pockets of knowledge pertaining to narrowly defined constructs of unknown relationships to one another*. Conversely, researchers have yet to synthesize the vast array of personality constructs as they relate to health status.

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[8] See Cohen and Edwards (1989) for a specific critique on moderator variable research.

[9] For a discussion and examples of the closely related *Specificity Issue* whereby single traits and broad factors are compared in terms of prediction, see Ashton, Jackson, Paunonen, Helmes, and Rothstein (1995), Axelrod, Widiger, Trull, and Corbitt (1997), Dunkley, Blankstein, and Flett (1997), Lay (1997), Saucier and Ostendorf (1999), and Velting and Liebert (1997).

Statistically, data analysts have typically failed to consider the potential impact or confounding of other trait variables on the personality variable under examination. Because many personality variables are interrelated, it is difficult to determine if the variables in question act *independently*, *interactively*, or are *redundant* with each other: therefore, researchers need to consider these factors when planning their research (Ahadi & Diener, 1989; Denollett, 1997; Friedman & Booth-Kewley, 1987). For example, in a study that assessed the extent to which the Life Orientation Test, a measure of dispositional optimism, was related to measures of symptoms and coping, the Life Orientation Test failed to reach significance when the effects of neuroticism were controlled for (Smith, Pope, Rhodewalt, & Poulton, 1989).[10] These findings suggest that incidental to single trait variable research, effect sizes tend to be small (Friedman & Booth-Kewley, 1987). However, by increasing the number of predictors in a trait model, the variance explained by a given set should increase (Mershon & Gorsuch, 1988).

One strategy that may help to resolve each of these concerns is to use a multivariate personality model that is systematically linked to those traits associated with health status. One candidate that may satisfy this condition is the five-factor model of personality. As will be discussed, the five factors have been linked to several health related traits that include, optimism, personal meaning (Marshall, Wortman, Vickers, Jr., Kusulas, & Hervig, 1994), as well as several health status variables including affect (McCrae & Costa, Jr., 1991a), and

[10] See also Denollett (1997) for an example of Type-D or Distress-Prone Personality Type research in which emotional distress is multiplicatively combined with inhibited sociality to effect health status (e.g., coronary heart disease).

adjustment (Carp, 1985). Therefore, one purpose of this study will be to examine the direct effects of personality, specifically the five-factor model, on health status. In keeping with Ahadi and Diener (1989) and Marshall, Wortman, Vickers, Jr., Kusulas, and Hervig's (1994) recommendations, both main effect and personality by personality interactions will also be modelled. Few interactions are hypothesized given the lack of concrete research and theorizing in this area. For example, while McCrae and Costa, Jr. (1991a) found 10 out of 100 five-factor by five-factor interactions to be significant in predicting well-being (e.g., positive and negative affect), the findings could not be replicated across two time periods for the same measure. McCrae and Costa, Jr. (1991a) suggested that personality appears to affect well-being independently. They further argued that with respect to personality-environment fit interactions, if the latter do occur, they are relatively rare in community dwelling individuals. However, based on research by Denollett (1997: Type D Personality), emotional distress (e.g., neuroticism) may be multiplicatively combined with inhibited sociality (e.g., extraversion, agreeableness) such that individuals who tend to be more prone to distress than those less prone and who are less social, may experience poorer health. Although no other personality by personality interactions appear to have been researched (i.e., the five factors), the present study will assess for any further personality by personality contributions to health outcome. Personality by situation (i.e., life stress) interactions will be assessed in a separate model testing (i.e., path analysis) section because of concerns with statistical power and interpretation.

(2) **Lack of Process Models**. According to Suls and Rittenhouse (1990), researchers have also tended to focus more on the direct relationship between personality and health than on the mechanisms or conditions that link the two variables. While it is important to highlight the bivariate or multivariate associations between personality and illness, it is perhaps more important to understand the conditions and mechanisms that link personality to health (i.e., moderators, mediators: Friedman & Booth-Kewley, 1987; see Eysenck, 1997 and Stelmack, 1997 for discussions linking types of nomological networks to scientific methodology). This concern has been echoed by several writers who argue that there has been little theoretical advancement in personality and health research (Krantz & Hedges, 1987; Sanderman & Ranchor, 1997; Smith & Williams, 1992; Suls, David, & Harvey, 1996; Wiebe & Smith, 1997). In addition, while several mechanisms have been correlated with personality and health status (e.g., health practices), few attempts have been made to link the proposed mediator to personality and health status (Krantz & Hedges, 1987; Wiebe & Smith, 1997), and even less so with a multivariate model of personality.

This study will attempt to rectify these concerns by testing a variety of process and moderator models that may help to explain the link between personality and health. To determine if personality is connected to health status, the five-factor model will first be related to health status (i.e., non-process models) and subsequently assessed for any stress moderation and mediation effects. Because several researchers have implicated life events and health practices as potential mediators in the personality to health status relationship (e.g., Wiebe & McCallum, 1986), both variables will be incorporated into each of the models to be discussed. In a related vein, a subsequent section will discuss the methodological issues inherent in testing for process as well as moderation.[11]

(3) **Variance Accounted For Versus Theory Development: Opposing Views on the Necessity of Statistical Control.** It is commonly believed that within the context of a prospective or longitudinal research design, the best predictor of time n + 1 of a given variable, is the same variable assessed at a previous wave of data collection (i.e., autoregression). This has been shown with such criteria as personality (Stones & Kozma, 1986; McCrae & Costa, Jr., 1989), life stress (Headey & Wearing, 1989), well-being (McCrae & Costa, Jr., 1991a), health habits (Rakowski, 1987), and physical symptoms (Korotkov & Hannah, 1994). According to Aiken and West (1991), Gollob and Reichardt (1987), and Cohen and Wills (1985), it is important to control for autoregressive effects because it helps to: (1) rule out any confound or nuisance variable(s); (2) attain less biased and more efficient (i.e., small standard errors) parameter estimates; and (3) reduce the error variance. However, what is not clear, is the extent to which autoregression impacts on the relationship between the predictor or personality variables, and the criterion. In some cases, inclusion of an autoregressive predictor has eliminated the effects of the remaining predictors (Smith, Pope, Rhodewalt, & Poulton, 1989). This partly results because of high

[11] Interestingly, estimates from the Lalonde Report (Lalonde, 1975) and the Center for Disease Control (1989; cited in Stroebe & Stroebe, 1995; reference not available) indicate that a large proportion of mortality can be attributed to individual lifestyle factors. However, it has only been within the past few years that researchers have seriously studied the impact of health behaviours on personal health (Rosolack & Hapson, 1990). Suls and Rittenhouse (1990) and Wiebe and Smith (1997) echo this by stating that there has been little systematic research linking personality to health behaviours.

intercorrelations amongst the predictors as they relate to the criterion (i.e., health status). In other cases, the effects have remained, though attenuated (see Korotkov, 1998 for an example related to the sense of coherence personality construct). This latter point raises a key issue in personality-health research. Specifically, disposition may or may not be related to health status to the extent that personality related autoregressive controls (i.e., health status) are utilized.

Therefore, this view argues that conceptually, a criterion can be effected by an autoregressive variable. As Gollob and Reichardt (1987) point out, (1) *values of a variable are caused only by values of prior variables*, (2) *values of a variable can be caused by prior values of the same variable*, and (3) *effect sizes can vary as a function of the length of the time lag between a cause and the time for which it is assessed*. As (2) indicates, incorporation of an autoregressive variable is permissible and desired within the context of a model, or more specifically, a causal model. Thus, this view suggests that the autoregressive variable is a conceptually and statistically important ingredient in determining if personality is linked to health status (see e.g., Cole, Peeke, Dolezal, Murray, & Canzoniero, 1999; Dormann & Zapf, 1999; Holahan, Moos, Holahan, & Cronkite, 1999; Redmond, Spoth, Shin, & Lepper, 1999). From this standpoint, personality may have little or no effect on health status.

An alternative approach adopts a more liberal view by arguing that mindless use of autoregression makes little conceptual sense and that priority should be accorded to the role of theory with no necessary emphasis on autoregression. In the first case, it has been argued that simply regressing behaviour on behaviour is a questionnable practice because behaviour is not a cause of itself (Bandura. 1997). According to Bandura (1997). both past and future behaviour correlations reflect not causal relations but rather the influence of common determinants and/or stability within a situation. Therefore. extrapolating from Bandura. health cannot cause itself.

The second point is that model development and selection should be theory driven and not data driven (e.g.. Hoyle. 1995). That is. according to some scholars. when constructing a theory. the goal is not to maximize the variance as when. for example. an autoregressive variable is included in a research model. but to develop and test a model based on past theory and research (e.g.. Kenny. 1979). Several examples testifying to the importance of theory without autoregression are available in the literature (e.g.. Aspinwall & Taylor. 1992: Gowan. Riordan. & Gatewood. 1999: Newcomb & Harlow. 1986: Rini. Dunkel-Schetter. Wadhwa. & Sandman. 1999: Schmeelk. Granger. Susman. & Chrousos. 1999: Wiebe & McCallum. 1986: see also Levin. 1999: Martin. Kelley. & Eklund. 1999: Wanberg. Kanfer. & Rotundo. 1999: Whitbeck. Hoyt. & Yoder. 1999 for cross-sectional examples).

Given these split views. separate analyses. with and without any autoregressive variables and other controls (i.e.. sex. age. marital status. income. education. occupation). will be run and subsequently compared. Differences between analyses would provide support to both views. Support for the first view (i.e.. autoregression) would be found to the extent that the autoregressive variable maximizes the explained variance.

In addition, the autoregressive variable(s) may also minimize the effects of personality on health status. Support for the second view (i.e., theoretical stance) would be found to the extent that the theorized personality-health relationships are statistically significant. While the camps appear divided on this view, the present study will illustrate the complexities of this debate.

(4) **Structural Equation Modelling (SEM) Issues.** The past two decades have witnessed an increased interest in covariance structure or structural equation modelling (see e.g., Hoyle, 1995; Judd, Jessor, & Donovan, 1986). Conceptually, structural modelling is a two-phase process, comprised of first, model specification, and second, parameter estimation (Pedhazur, 1997). The following will discuss a number of concerns related to the practice of structural equation modelling. In presenting these issues, a brief foray into the nature of structural equation modelling will first be presented.

In general, structural equation modelling is a blended approach of two statistical traditions, multiple regression and factor analysis, to analyzing structural or causal relations with experimental and nonexperimental data. The structural equation modelling approach, originally developed by Joreskog (see Joreskog & Sorbom, 1986), is comprised of two components, the confirmatory or measurement model, and the structural model (Anderson & Gerbing, 1988; Pedhazur & Pedhazur-Schmelkin, 1991). The purpose of the measurement model is to ascertain the extent to which one's measures refer to the construct of interest. Confirmatory factor analysis is used to assess an hypothesized underlying or latent structure of the construct. Each latent factor can be comprised of either single- or multi-item observed variables. With single indicator latent variables, the researcher estimates the amount of error variance through a *sensitivity analysis* (i.e., a series of best personal estimates of measurement error are tested) for each observed variable that comprises the latent or unobserved variable (Anderson & Gerbing, 1988; Hayduk, 1987). When multiple measures are used, measurement error is automatically accounted for by the program (e.g., LISREL, EQS).

Once an adequate fit of the measurement model has been achieved, the researcher procedes in estimating the theorized structural model or the regression paths that link the exogenous variables (i.e., independent/predictor) with the endogenous variables (i.e., dependent/criterion). Like the measurement model, the structural model is evaluated for *goodness or badness of fit* (i.e., Data = Model + Residual: Byrne, 1994). Model fit is generally evaluated according to three criteria, *absolute or overall measures* (e.g., chi-square, Goodness of Fit Index), *incremental measures of fit* (e.g., Non-Normed Fit Index, Comparative Fit Index), and *parameter assessments* (i.e., variances, covariances, path coefficients). A fourth criterion, *conceptual and statistical parsimony*, may also be used.

Structural equation modelling can be used to assess simple regression models as well as observed variable path analytic and latent variable analytic models. Both measurement and structural models (i.e., model specification) are constructed based on theory and research (e.g., Suyapa, Silvia, & MacCallum, 1988), as well as practical considerations (e.g., number of parameters: see Bentler & Chou, 1987).

Unlike past approaches to path analysis, all of the major software programs provide for a simultaneous assessment of the model in question. In the past, causal models were assessed on an equation by equation basis with standard multiple regression programs, thereby omitting tests of overall model assessment, corrected parameter estimates, and other multivariate statistics. Because of these past limitations, the present research will analyze each model using the observed variable path analytic method with current structural equation modelling technology (Kline, 1991).[12] Excellent reviews on latent variable path analysis and observed variable path analysis can be found in Bentler and Dudgeon (1996), Biddle and Martin (1987), Hoyle (1995), and Kline (1991).

A second issue focuses on how both measurement and structural models are constructed or specified. In constructing and developing a model, Joreskog & Sorbom (1993) point out that there are three basic approaches to model construction and development (Joreskog & Sorbom, 1993), the *Strictly Confirmatory Approach, the Model Generation Strategy, and the Model Comparison Strategy*, the last one of which was adopted for the purposes of this research. The method that is used least is the strictly confirmatory approach. In general, this approach requires the researcher to first present the model of interest, and then compare it to the data in order to assess model fit. If the model accurately describes the data, the results are taken to support the model. If the data fails to support the model, no other steps are

[12] Given the complexity of the models presented herein, the latent variable approach was not used, although the method was initially implemented. Because several problems occurred when estimating the error variances for the product-term interactions, the latent variable approach was abandoned in favour of the more conservative observed variable strategy. The main limitation of the latter approach is that one assumes zero measurement error in the indicators, a questionnable assumption at best. The benefit is that the former provides a first-approximation of the parameter estimates.

taken. This approach not only lacks flexibility, it also fails to address any negative outcomes that may arise from the data analysis. As a result, this strategy is not very often used.

The most common approach used to address causal relations is the model generation strategy (a.k.a., theory trimming: see McPherson, 1976). When using this approach, the researcher first compares the model to the data. Given a less than desirable fit, the researcher procedes by adding to or removing a parameter from the model. By adding or removing the parameter(s), one is trying to improve model fit. While useful for exploratory purposes, few researchers have attempted to validate the reparameterized model. When changes are made to the initial model, one is no longer engaging in confirmatory assessment, but exploratory analysis (Cliff, 1983; MacCallum, 1995). According to MacCallum, Roznowski, and Necowitz (1992), because the model is now being *driven by the data*, there is a greater probability that the modifications are significant, based on chance alone. As MacCallum, Roznowski, and Necowitz (1992) argue, model modifications made in one sample have a low probability of being replicated in a second sample, except when the sample is very large.

A third, more defensible strategy is the model comparison approach (MacCallum, Roznowski, & Necowitz, 1992). The model comparison approach requires the researcher to develop a number of models a priori, which are then compared within the same data set. The different models are developed based on different theoretical positions or on the basis of discrepant research findings. In some cases, the models may reflect the uncertain patterns of relations in the areas of interest and may therefore be deemed exploratory. In these instances, a number of models, ranging from simple to complex are constructed. Unfortunately, many researchers have tended to focus on one favourite model to the exclusion of other, good fitting models. In many cases, it is incorrectly assumed that all is known about the phenomenon or process in question (MacCallum, Wegener, Uchino, & Fabrigar, 1993).[13]

Given past analytic concerns (i.e., single equation and data driven analyses, single model assessment), the present research will (1) use a structural equation modelling software program (i.e., EQS: Bentler, 1995) to assess for overall fit and to generate separate and corrected parameter estimates, and (2) adopt the model comparison approach by developing and assessing several structural models. Using the standard regression strategy, the model comparison approach will also extend to the non-process models: that is, several alternative process and non-process models will be constructed.

(5) **Health Status Issues**. A fifth issue is concerned with the definition and measurement of health status. While it is generally accepted that health is a multidimensional construct, there is little agreement as to how it should be defined and measured (e.g., Larson, 1991). For instance, Larson (1991) points out that there are five general approaches to understanding health. The first and most widely accepted model of

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[13] A related concern focuses on how process is evaluated. When path analysis is undertaken, it is important for the researcher to consider any alternative models that may also explain the data (Cliff, 1983). As Cliff (1983) and Kerlinger and Pedhazur (1974) point out, the mere fact that a model cannot be confirmed, only disconfirmed, suggests that others models may fit the data equally well (e.g., moderator versus mediator: see e.g., James & Brett, 1984).

health today, is the *Medical Model*. In general, the medical model views health as the absence of disease and morbidity. However, as many have argued, while optimal physical functioning is a necessary condition, it is not sufficient. For example, a person may be healthy even though he or she may not be disease free.

The second model, which focuses on the health of the whole person and includes physical, mental, and social components, is the *Holistic Model*. The holistic model focuses on the positive aspects of health and well-being as well as the negative aspects (i.e., medical model). While criticized by some as utopian, the holistic model is the most popular alternative to the medical model. The holistic model has also been compared to the World Health Organization definition of health, although the former may include components of health not considered by the World Health Organization model (e.g., spiritual health). The World Health Organization views the health concept as including social, mental, and physical components. Health is not merely the absence of disease.

The third model, whose origins are far from clear, is somewhat of a spin-off of the World Health Organization definition.[14] Though narrow in scope, the *Wellness Model* views health as a way of feeling, a subjective sense of comfort, energy, and ability. The wellness model includes such variables as happiness and quality of life.

The fourth model, the *Environmental Model*, is perhaps the most difficult to operationalize. The environmental model focuses on the individual's adaptation to the environment or more generally, the person-environment relationship. While not a

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[14] According to Diener, Suh, Lucas, and Smith (1999), the study of well-being developed in part as a reaction to the extreme focus in psychology on negative states.

systems theory model, the environmental model appears to be one of its by-products.

The last model of health, the *Eclectic Model*, is a *catchall* model for any unusual definition of health. For example, according to the Marxist view, health is defined as productivity, where the employers or capitalists benefit from the labours of the employee.

Because different traits may be linked to different health status variables, health status will be assessed in several ways. With respect to the five factor model, little research has been conducted with other health and illness behaviour measures such as physician utilization, disability, general health, and chronic illness.[15]

The present study will adopt a quasi-holistic approach to health status measurement, save social health (i.e., given past operational concerns; see e.g., Ware, Jr., 1986). Measures of well-being, negative affect, and physical symptoms will also be assessed.

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[15] To distinguish between the related concepts of health behaviour, illness behaviour, and sick-role behaviour, it is useful to consider the definitions proposed by Kasl and Cobb (1966). According to these authors, health behaviour refers to,

> *any activity undertaken by a person believing himself to be healthy, for the purpose of preventing disease or detecting it in an asymptomatic stage. Illness behaviour is any activity, undertaken by a person who feels ill, to define the state of his health and to discover a suitable remedy. The principle activities here are complaining and seeking consultation from relatives, friends, and from those trained in matters of health. Sick-role behaviour is the activity undertaken by those who consider themselves ill for the purpose of getting well. It includes receiving treatment from appropriate therapists, generally involves a whole range of dependent behaviours and leads to some degree of neglect of ones usual duties.*

The present study makes use of these distinctions. To simplify the discussion, the term health status will refer to health, illness-, and sick-role behaviours, save health behaviours or practices.

A related issue focuses on the subjective and objective aspects of health status measurement. With few exceptions, the majority of researches (e.g., Allred & Smith, 1989; Contrada, 1989) have focused on the subjective side of health status (e.g., mood, symptoms: Nezu, Nezu, & Blissett, 1988; Flannery & Flannery, 1990). While useful, the major problem associated with such measures is their apparent confound with neuroticism or negative dysphoria, as well as other measures of personality, and life events (Costa, Jr., & McCrae, 1987a; Holroyd & Coyne, 1987). In other words, subjective measures of illness may be confounded with neurotic like symptoms that inflate the personality-stress and outcome relationship. The question is, does personality and stress influence health status or is health status a proxy for these independent variables? To reduce the impact of this problem, this research will take four precautionary measures. *First*, this research will include both objective (e.g., chronic conditions, days of restricted activity) and subjective measures of health (e.g., positive and negative affect). *Second*, prior distress (i.e., time one = T1 of a two-wave study) will be controlled for in order to clearly assess the effects of the predictors on the criterion(a). *Third*, and closely related to the previous strategy, the measures will be administered twice over a period of six months in order to reduce the impact of having subjects justify their responses on one questionnaire (e.g., health status) by their responses on a previous one (e.g., life events) as is the case with single wave research (see Brown, 1972). The *last* strategy is incidental to the model building process. That is, when a model has at least two intervening variables, the isomorphic or one to one nature of the relationship(s) becomes compromised, relative to a single process theory.

thereby enhancing predictive power (Reynolds, 1971; Underwood, 1975). In other words, by including multiple predicted paths, prediction is less likely to be affected by confounding or explanatory fiction, but more by the theory.

Overall, this study will also advance five-factor model-health research by its focus on objective as well as subjective health. Because little data is available that links the five factor model to objective health status, several objective and subjective measures will be included in the study for analysis. Principal components analysis will be used to assess the construct validity of the health status measures. In general, it is hypothesized that physician utilization and disability variables will form two separate though related components. The component structure of the remaining variables (i.e., positive and negative affect, physical symptoms, chronic conditions, and general health) is less clear as both positive and negative affect have been shown to be both *bipolar* (see e.g., Russell & Caroll, 1999) and *independent* (e.g., Diener & Emmons, 1984; Watson & Anna Clark, 1997; Zautra, Potter, & Reich, 1997) in nature.

(6) **Cross-Validation**. Susser (1973) has argued that in order to demonstrate a clear basis for inferring causation in the health sciences, it is important for the findings to generate a degree of order and pattern among the variables. While this *criterion of consistency* does not rule out all confounding variables, it does suggest that in order for a finding to be useful, it should, at the very least, be consistent. To this end, several approaches, which can be classified as either external or internal, will be used to assess the degree of cross-validation or expected cross-validation (see Thompson, 1994).

The external approach involves collecting data on a separate sample. While costly and time consuming, it is perhaps the best method. Internal approaches are of three kinds, the split sample technique, the jackknife, and the bootstrap (Thompson, 1994). The split sample technique involves randomly splitting a sample in half. When using the jackknife, separate analyses are conducted with usually N-1 dropped from each of the analyses until the set number of replications, usually based on sample size, is complete. With the bootstrap method, the data set is typically copied over and over again into a large data file and separate resamplings with replacement (size of N determined by researcher), are conducted. Upon completion of all the resamplings, the results are averaged across replications (Bentler, 1997; Stine, 1989; Thompson, 1994).

While not classified by Thompson (1994) as an internal approach to cross-validation, several researchers also recommend calculating a single-sample expected cross-validation coefficient when conducting structural equation modelling research (Browne, 1999; Browne & Cudeck, 1992). In general, this allows the researcher to estimate the probability that a given research finding will cross-validate in a new sample. To assess the degree of expected cross-validation, Browne and Cudeck's (1992) Expected Cross-Validation Index (ECVI) will be employed (see also Browne, 1999). This coefficient is helpful when comparing models; specifically, the model with the smallest expected cross-validation index is chosen.[16]

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[16] As will be discussed in more detail, interpretation of the Expected Cross-Validation Index must take into account sample size bias as well as the number of parameters for a given model and its confidence intervals (CIs).

Of the internal approaches, excluding the expected cross-validation coefficient, the bootstrap is the preferred method of choice (Thompson, 1994). One strength of the bootstrap is that it can be used to assess the stability of one's findings over several data configurations. This is typically done by examining the mean in relation to the standard deviation of the parameter estimates (e.g., fit measures). Therefore, to assess the stability of the findings, the present study will use two methods to cross-validate the data, the Expected Cross-Validation Index, and the bootstrap simulation procedure.

Because of funding and time considerations, an external approach to cross-validation was inappropriate. The split sampling technique was not chosen due to concerns with statistical power. This issue will be discussed in the Method and Results sections as well.[17]

(7) **Population of Study.** In order to increase the generalizability of the findings, it is useful to sample from a broad range of subject populations. Unfortunately, research suggests that this is the exception and not the rule. Research from a number of sources suggests that student populations continue to be used as the primary subject pool (Endler & Speer, 1998; Mallon, Kingsley, Affleck, & Tennen, 1998). According to this data, the general conclusion is that while use of undergraduate samples is down from the past two to

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[17] The split sampling technique was initially the method of choice. However, to reduce the size of the standard errors and therefore enhance the stability of the statistical solution(s) and power, the data were not split into subgroups. Interestingly, according to Browne (1999), single-sample and two-sample cross-validation indexes tend to yield similar though not necessarily equivalent results, suggesting that it may be preferrable to analyze the whole sample. The method section will outline the computations for the split sample power estimates. These estimates provided an initial preestimate of the required sample size needed to test the hypotheses.

three decades, this decrease is not statistically significant. The data also suggests a rise in the use of adult samples from 1968 (7%) to 1986-1988 (26%) and to 1993-1995 (29%). Despite this increase, undergraduate populations continue to be used at a higher rate than that of adults (Endler & Speer, 1998). To maximize the degree of external validity, data will be collected from an adult population using the *Deliberate Sampling for Heterogeneity* method (Cook & Campbell, 1979). In general, the deliberate sampling for heterogeneity approach refers to a nonrandom sampling process whereby various groups of individuals are targeted for inclusion into a study in order to capture a variable population.

(8) **Retrospective versus Prospective-Longitudinal Designs**. In an review of longitudinal and prospective methods in health psychology, Kobasa (1985) had argued that the majority of researchers in health psychology typically reject the longitudinal or prospective method as problematic methodologically (e.g., attrition), and too demanding in terms of time and effort. In corroborating this, in a recent review of close to thirty years of articles in the Journal of Personality, Mallon, Kingsley, Affleck, and Tennen (1998) found that the cross-sectional study remained the most popular research methodology over this time period, while longitudinal (passive-observational) studies slightly increased from six percent (1980s) to 12% (1990s). In a more encompassing review of five major personality journals for the years 1993-1995, Endler and Speer (1998) found a greater emphasis on cross-sectional as opposed to longitudinal methodology.

This is particularly relevant to the present study. As is well known amongst researchers (e.g.. Susser. 1973). in order to assess causality. cause must preceed effect. In nonexperimental research this is vitally important. An added benefit of the prospective research design is that the methodology allows researchers to control for autoregressive effects. Given these issues and concerns. the present study will be conducted using a two-wave prospective research design.

Summary. Research linking personality to health status has been plagued by several theoretical and methodological/statistical limitations that include a focus on single traits. issues centered around process. issues related to the definition of health status. the population of study. statistical control. path analysis. and research design. The present study will focus on two closely related questions. First. to what extent is the five-factor model related to health status? More research needs to be done with a wider range of health related variables such as chronic conditions. And second. how are the five-factors related to health status. through moderation. mediation. both. or neither? It was proposed that personality influences health status through various mechanisms and under specific conditions (i.e.. life stress and health practices). While some research supports these routes. few researchers have incorporated a multidimensional model of personality in their researches. To answer these questions. this research will make use of current structural equation modelling technology. subjective and objective indicators of health status and health-related variables (illness behaviour and sick-role behaviour). an adult population. and a prospective research design.

As Krantz and Hedges (1987) have pointed out,

> *We would suggest that the research programs in this area with the best chance of having lasting influence will: (a) utilize reliable and objective measures of both personality and health, (b) focus on mechanisms relating behaviour to disease, rather than just correlating traits with measures of disease, and (c) be sufficiently physiologically grounded so that the conceptual approach is biologically plausible, and so that important confounding variables and risk factors are controlled.*

The present study was designed with these considerations in mind. The five-factor model will now be discussed, followed by an expanded literature review on how the factors are linked to stress, health behaviours, and health status.

The Five-Factor Model (FFM) of Personality

> *There has been quite some commotion recently about the so-called Five Factor Model of Personality. This model forms the most important and well-known result of an international enterprise that strives for an economic description of all relevant personality characteristics. That this would appear to succeed up to a certain level is no less than a miracle. What stands out in this research is not that specifics of a culture primarily determine the contents of the national trait structures; no doubt there are cultural specifics. Striking is what is in fact common to the different national trait structures* (De Raad, 1998).

As many psychologists have pointed out, the five-factor model of personality (a.k.a., *the Big Five*) represents a fundamental discovery for researchers interested in the phenotypic/genotypic variations underlying personality (Goldberg, 1993; McCrae & John, 1992; Saucier & Goldberg, 1996; Vassend & Skrondal, 1997). As McAdams (1992) insightfully put it, *After decades of doubt and defensiveness, traits are back on top. One major reason for the revival of traits is the emergence and development of the big five model.* Indeed, in a review of personality research trends for the years 1993-1995 inclusive, Endler and Speer (1998) found that, overall, the five-factor model was the dominant model used in trait research during this time.[18]

Originally discovered by Fiske (1949), the five-factor model has been used as a framework for *housing* other personality structures including the *Personality Research Form* (i.e., Murray's needs: Ashton, Jackson, Helmes, & Paunonen, 1998; Costa, Jr., & McCrae, 1988a; Craig, Loheidi, Rudolph, Leiter, & Rubin, 1998), the *Jackson Personality Inventory* (Ashton, Jackson, Helmes, & Paunonen, 1998), the *California Q-Set* (McCrae, Costa, Jr., & Busch, 1986), *the Personal Attributes Questionnaire, the Masculine Behaviour Scale* (Smith & Snell, Jr., 1996), the *Myers-Briggs Type Indicator questionnaire* (McCrae & Costa, Jr., 1989), the *Comrey* and *Howarth* personality measures (Shafer, 1999), the *Inventory of Personal Characteristics* (McCrae & Costa, Jr., 1995a), the *16 Personality Factor* questionnaire (i.e., 16PF: e.g., Gerbing & Tuley, 1991; Hofer, Horn, & Eber, 1997; Noller, Law, & Comrey, 1987), Eysenck's *Psychoticism-Extraversion-Neuroticism (PEN) Model* (Avia, Sanz, Sanchez-Bernardos, Martinez-Arias, Silva, & Grana, 1995; Smith & Snell, Jr., 1996), temperament (Angleitner & Ostendorf, 1994), and the *California Psychological Inventory* (McCrae, Costa, Jr., & Piedmont, 1993).

It has also been linked to as several intrapersonal, interpersonal, and health related variables such as *assertiveness, compliance, procrastination* (Schouwenburg & Lay, 1995),

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[18] This is not to suggest that the model is without its detractors. Several researchers have pointed to a number of limitations of the model (e.g., Ashton, Jackson, Helmes, & Paunonen, 1998; Block, 1995; Caprara, Barbaranelli, & Comrey, 1995; Caruso & Cliff, 1997; Eysenck, 1997; Paunonen, 1998; Schinka, Kinder, & Kremer, 1997; Scandell & Wlazelek, 1999; Shafer, 1999; Vassend & Scrondal, 1997, 1995).

marital conflict (Buss. 1991a). *job performance* (Barrick & Mount. 1991). *wisdom* (Staudinger. Maciel. Smith. & Baltes. 1998). *academic achievement* (Dwight. Cummings. & Glenar. 1998: John. Caspi. Robins. Moffitt. & Stouthamer-Loeber. 1994). *visual* and *auditory ability* (Coren & Harland. 1995). *development* (Bradley & Marcia. 1998: Dollinger. 1995: Einstein & Lanning. 1998: Fleeson & Baltes. 1998). *self-esteem. adjustment* (Graziano. Jensen-Campbell. & Finch. 1997; Lippa. 1995). *prototypicality* (Borkenau. 1988). *implicit personality* (Borkenau. 1992). *cognitive schemas* (Smith & Kihlstrom. 1987). *constructive thinking* (Caruso & Spirrison. 1994). *and positive* and *negative affect* (Bradley & Marcia. 1998). In addition. the five factor structure has been replicated or extended across several nationalities including *Italian. Dutch* (Caprara & Perugini. 1994: De Raad. Perugini. Hrebickova. Szarota. 1998: De Raad. Perugini. & Szirmak. 1997). *Estonian. Finish* (Pulver. Allik. Pulkkinen. & Hamalainen. 1995). *Hungarian* (Szirmak & De Raad. 1994). *Chinese. Japanese. American English* (McCrae. Zonderman. Costa. Jr.. Bond. & Paunonen. 1996: Trull & Geary. 1997). *Hispanic-Spanish* (Benett-Martinez & John. 1998). *Filipino* (Guanzon-Lapena. Church. Carlota. & Katigbak. 1998). *Polish. Dutch. Czechoslavokian* (De Raad. Perugini. Hrebickova. & Szarota. 1998). *German* (Hendriks. Hofstee. & De Raad. 1999). *Greek* (Tsaousis. 1999). *Norwegian* (Vassend & Skrondal. 1997). *English* (Saucier & Goldberg. 1996). and *Hebrew* (Montag & Levin. 1994) languages[19 20]

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[19] Note that in many of these studies (e.g.. Montag & Levin. 1994) an established five-factor measure such as the NEO-PI-R (see McCrae. Costa. Jr.. Del Pilar. Rolland. & Parker. 1998) has been translated into a language prior to testing and subsequent components or factor analysis. This *Imposed Etic* approach. while useful in validating the original five

The five factor model may also be useful in communicating research findings, in facilitating the accumulation of research (John, 1990; Botwin & Buss, 1989), in providing a sound framework for selecting variables (e.g., achievement, competance; Botwin & Buss, 1989), to pointing out gaps in current research, in allowing for a comprehensive evaluation of individual differences (i.e., to compare and contrast individual difference

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factors within the culture, may be limited in not tapping into a more expansive range of trait terms in a language (Hofstee, Keiers, De Raad, , Goldberg, & Ostendorf, 1997). In such studies, it may be easier to recover the five factors because of their link to such fundamental human life themes such as power, work, affect, culture, and love (Blas & Forzi, 1998). While biased, the imposed etic approach allows researchers to see what domains and/or facets generalize and which do not (Pulver, Allik, Pulkkinen, & Hamalainen, 1995). To counter these limitations, an *Emic* approach to sampling trait terms has been used (e.g., Guanzon-Lapena, Church, Carlota, & Katigbak, 1998; Narayanan, Menon, & Levine, 1995). With the emic approach, indigenous or local trait terms are sampled in order to capture the unique characteristics of the population. While useful, the emic approach may not always validate the five-factors (Blas & Forzi, 1998; Yang & Bond, 1990). However, some researchers have pointed out that the lack of one-to-one correspondence across cultures may be due to poor test translation, lack of item relevance, lack of item relevance, trait-level differences, trait-structure differences, differential causal links, response-style involvement issues, test-format problems, different analytic methods, emic criteria, and the nature of the emic constructs (Paunonen & Ashton, 1998).

[26] In general, Fiske (1949), who would borrow Raymond Cattell's scales for his own research, was unable to reproduce the 16 factors Cattell had found. Instead, after having several clinical psychology trainees and trainers, as well as several nonclinical students rate a number of subjects on the scales, a factor analysis suggested that a *five-factor* model best described the data. A number of other individuals, though some years later, were able to replicate his findings. For instance, when Tupes and Christal (1961) examined data from eight heterogeneous samples (two from Cattell's data base), they found that the data could be described by a *five-factor* model, similar to Fiskes'. These findings have since been replicated by a number of authors using not only Cattell's original 35 scales (e.g., Borgatta, 1964; Digman & Takemoto-Chock, 1981; Norman, 1963), *but* also more representative, non-Cattellian measures (e.g., Deary, 1996). For example, in an interesting reanalysis of personality trait rating data collected by Webb in 1915, Deary (1996) found that the data could be explained and understood by reference to both *five-* and six-factor solutions.

variables: Briggs, 1992; Digman, 1990; Digman & Inouye, 1986; McCrae & John, 1992; McCrae, Costa, Jr., & Busch, 1986; McCrae & Costa, Jr., 1989b; Miller, 1991), for increasing the clarity and precision of classification (Miller, 1991), in providing a parsimonious representation of phenotypic variations in personality descriptors (Saucier & Ostendorf, 1999; Watson & Hubbard, 1996), and in ensuring that no two traits are given a similar sounding name (e.g., optimism and generalized expectancies for success: Rodin & Salovey, 1989; Sanderman & Ranchor, 1997; Van Heck, 1997), the last of which is a concern in much of personality research (Ackerman & Heggestad, 1997; Borkenau, 1992; Costa, Jr., & McCrae, 1988a; Deary, Clyde, & Frier, 1997; Marshall, Wortman, Vickers, Jr., Kusulas, & Hervig, 1994; Nicholls, Licht, & Pearl, 1982).

In general, the five-factor model is a superordinate typology comprised of five stable (Bagby, Costa, Jr., McCrae, Livesly, Kennedy, Levitan, Levitt, Joffe, & Young, 1999; Costa, Jr., & McCrae, 1992; McCrae, 1993) and relatively orthogonal bandwidth factors, variously labelled *Openness to Experience Culture Intellect* (e.g., Botwin & Buss, 1989; McCrae & Costa, Jr., 1996), *Conscientiousness Will to Achieve* (e.g., McCrae & Costa, Jr., 1992; Digman, 1989), *Extraversion Surgency* (e.g., Costa, Jr., & McCrae, 1992; Tupes & Cristal, 1961), *Agreeableness Likeability* (Costa, Jr., & McCrae, 1992; Norman, 1963), *and Neuroticism Emotional Stability* (e.g., Conley, 1985; Goldberg, 1992).[21 22]

[21] An ongoing debate has centered on which personality model (i.e., the five-factor model, Eysenck's Psychoticism-Extraversion-Neuroticism model) is the most basic trait model. Research by Digman (1997) and Becker (1999; see Britt, 1993 for a related discussion on the topic of metatraits) suggests that while both models are useful at their point of abstraction (i.e., level of analysis; see Watson and Hubbard, 1996 for an interesting discussion relating the big five and the Eysenck's model to coping), the five factor model

Table 1 illustrates the range of factor labels used to classify and define each of the factors (see Appendix A for a partial listing of the variables found to define each of the labels or factor domains). To measure the five factors, various methodologies have been employed, ranging from *questionnaire approaches* (e.g., Benet-Martinez & John, 1998; Caprara, Barbaranelli, Borgogni, & Perugini, 1993; Costa, Jr., & McCrae, 1997, 1992a; Costa, Jr., McCrae, & Dye, 1991; Hendriks, Hofstee, & De Raad, 1999; Hogan, 1989; Tsaousis, 1999), to *act-report measures* (Botwin & Buss, 1989; Buss, 1985), to both *uni- and bipolar trait adjective checklists* (John, 1990; see Widiger and Trull, 1997 for a review), and in both *self-report* (McCrae & Costa, Jr., 1997) and *observer rating* formats (Mount, Barrick, & Strauss, 1994; Costa, Jr. & McCrae, 1988b).

While some variation exists among domain content, each of the five factors, save openness to experience (vs. culture vs. intellect: see Saucier, 1992 who counters that found differences may be *much ado about nothing*), have been relatively easy to define when based on findings from factor analytic research (e.g., see Deary, 1996). Although several similar, though somewhat distinct models exist (e.g., Costa, Jr., & McCrae, 1992; John, 1990; Peabody, 1987), Costa, Jr., and McCrae's (1997) Five-Factor model, as assessed by

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can be reduced further to two factors or metatraits. For example, after factor analyzing 14 data sets using various populations (i.e., children, adolescents, adults: see Parker & Stumpf, 1998 for an application of the model to youth), Digman (1997) found that openness to experience and extraversion consistently loaded on one factor called β (beta), and conscientiousness, agreeableness, and neuroticism loaded on a second factor called α (alpha).

[22] Interestingly, in a preview of things to come, Allport (1961) had speculated that the number of dispositions a person has may vary between five and ten.

Table 1

Labels often used to classify each of the five-factors

Factor (Label Adopted)/
Previous Labels

Factor I (Extraversion: Interpersonal style)

assertiveness (Borgatta, 1964), **extraversion** (Digman & Takemoto-Chock, 1981), **activity** (Buss & Plomin, 1984), **positive emotionality** (Tellegan, 1985), **sociability** (Zuckerman, Kuhlman, Thornquist, & Kiers, 1991)

Factor II (Agreeableness: Interpersonal style)

agreeableness (McCrae & Costa, Jr., 1992:), **likeability** (Hogan, 1989), **agreeable stable** (Botwin & Buss, 1989), **love** (Peabody & Goldberg, 1989), **cortertia** (Cattell, 1957), **aggression-hostility** (Zuckerman, Kuhlman, Thornquist, & Kiers, 1991)

Factor III (Conscientiousness: Motivational style)

conscientiousness (McCrae & Costa, Jr., 1992), **impulse control** (Conley, 1985), **work** (Peabody & Goldberg, 1989), **superego strength** (Cattell, 1957), **constraint** (Tellegan, 1985), **impulsive-unsocialized-sensation seeking** (Zuckerman, Kulman, Thornquist, & Kiers, 1991)

Factor IV (Neuroticism: Emotional style)

emotionality (Buss & Plomin, 1984), **anxiety** (Digman & Takemoto-Chock, 1981), **neuroticism** (Eysenck, 1997), **affect** (Peabody & Goldberg, 1989), **anxiety** (Cattell, 1957), **adjustment** (Hogan, 1989), **neuroticism-anxiety** (Zuckerman, Kuhlman, Thornquist, & Kiers, 1991)

Factor V (Openness to Experience: Experiential style)

culture (Tupes & Christal, 1961), **intellect** (Peabody & Goldberg, 1989), **openness to experience** (McCrae & Costa, Jr., 1992), **intellectance-culture** (Botwin & Buss, 1989)

Note: The factor names in parentheses are based on Costa, Jr., & McCrae's (1992a) conceptualization. The names appear to be generally accepted within the psychological community.

the NEO-PI-R. appears to be the most widely used and developed (questionnaire) framework (see Table 2). Because of the quality and quantity of their work with respect to the structure. function (e.g.. the big five and well-being). and methodology. Costa. Jr. and McCrae's (1997) model will be adopted for the purposes of this research (see Avia. Sanz. Sanchez-Bernardos. Martinez-Arias. Silva. & Grana. 1995). Where appropriate. references will be made to other five-factor contributors. Costa. Jr. and McCrae's (1997) model will now be presented (see Table 2: see also Costa. Jr.. & McCrae. 1992a. Digman. 1990. and John. 1990 for a more indepth discussion of those constructs). This will be followed by a discussion that focuses on the usefulness of the five-factor model in health related research.

Costa, Jr. and McCrae's (1997, 1992a) Five-Factor Model

(1) **Openness to Experience**. Individuals who are open to experience tend to have an active imagination. are aesthetically sensitive. moved by art and beauty. sensitive. novelty seeking. analytical. tolerant. more attentive to their inner feelings. and are intellectually curious. In general. individuals who are open tend to be more curious about both inner and outer worlds. They also tend to experience both positive and negative feelings more keenly than less open. or closed persons. Conversely. individuals who score low on a measure of openness are more practical. insensitive to beauty. experience a narrow range of emotions. are pragmatic. more dogmatic. conventional. and conservative. Such individuals prefer the familiar to the unfamiliar. and their affects tend to be muted.

Table 2

Costa, Jr. and McCrae's (1992) Five-Factor Model with domain and facet content

Factor (Domain) / Facet	
Extraversion	
Warmth. Gregariousness. Assertiveness. Activity. Excitement Seeking. Positive Emotions	
Conscientiousness	
Competance. Order. Dutifulness. Achievement Striving. Self-Discipline. Deliberation	
Agreeableness	
Trust. Straight-forwardness. Altruism. Compliance. Modesty. Tender-Mindedness	
Neuroticism	
Anxiety. Anger-Hostility. Depression. Self-Consciousness. Impulsiveness. Vulnerability	
Openness to Experience	
Fantasy. Aesthetics. Feelings. Actions. Ideas. Values	

Note. In their conceptualization of a factor. Costa. Jr. and McCrae (1992a) use the term *domain*. The variables that comprise the domain are called *facets* (i.e.. traits). It is important to point out that Costa. Jr. and McCrae (1995b. 1998) make no claim regarding the comprehensiveness of these facets. See also Saucier and Ostendorf (1999). Perugini and Gallucci (1997). Schinka. Dye. and Curtiss (1997) for discussions regarding the big five and facet development using the lexical approach. In addition. Saucier and Goldberg (1998) provide suggestions for expanding the five-factor model for those traits not captured by it.

(2) **Conscientiousness**. Individuals who are conscientious are purposeful and goal driven. strong-willed. hardworking. ambitious. persevering. self-directed. reliable. scrupulous. neat. punctual. practical. ambitious. businesslike. organized. playful. and determined. High scores on a measure of conscientiousness have been associated with academic and occupational achievement. but when the scores are in the extreme. such individuals may engage in compulsive and workaholic behaviour. Individuals who are not as conscientious tend to be more lackadaisical in terms of goal directed behaviour. Low scores on this dimension suggests that the less than conscientious tend to be negligent. careless. undependable. lazy. disorganized. sloppy. and aimless.

(3) **Extraversion**. According to Costa. Jr. and McCrae (1992a. 1995a). extraverts are active. assertive. warm-hearted. talkative. and like to be with people. They also tend to be dominant. cheerful. fast-paced. high spirited. upbeat. and optimistic. Conversely. introverts tend to be reserved. independent. retiring. serious. cautious. solitary. and even-paced. Introverts are not pessimistic or unhappy. even though they lack the high spiritedness of an extravert.

(4) **Agreeableness**. As Costa. Jr. and McCrae (1995a) contend. individuals who are agreeable tend to be altruistic. good-natured. courteous. selfless. helpful. trusting. lenient. forgiving. gullible. straightforward. flexible. and sympathetic. Conversely. a person who is disagreeable or antagonistic tends to be egocentric. irritable. rude. selfish. uncooperative. stingy. critical. stubborn. proud. manipulative. skeptical. and competitive. The agreeableness construct represents something of a double-edge sword. In one sense.

agreeable individuals tend to be psychologically healthier and more popular than less agreeable individuals. However, there are times when it is advantagious to be skeptical and critical (e.g., protect one's interests).

(5) **Neuroticism**. Individuals who score high on a measure of neuroticism or emotionality, tend to experience more negative affect such as disgust or embarassment than those who score lower on a measure of neuroticism. Such individuals tend to worry alot, are tense, easily frustrated, down-hearted, and have difficulty in dealing with stress. Individuals who are highly emotional are also prone to engage in irrational thinking and have low impulse control. Emotionally stable individuals are calm, relaxed, even-tempered, secure in themselves, able to resist temptation, and are cool-headed.

The Five-Factor Model as a Health-Related Typology

During the past decade, several researchers have suggested that the five-factor model may be of some importance in forwarding our understanding of the stress-illness process (Smith & Williams, 1992). As Smith and Willliams (1992) point out, several stress-related personality variables, including the Type A Behaviour Pattern, hardiness, optimism, and inhibited power motivation may be linked to each of the five-factors. Marshall, Wortman, Vickers, Kusulas, and Hervig (1994) have corroborated these assertions in a study that examined the extent to which the five-factor model was related to several personality-health variables (e.g., optimism, locus of control, purpose in life). According to Marshall, Wortman, Vickers, Jr., Kusulas, and Hervig (1994), much of the variation in these specific measures was explained by the five-factor model.

Overall, the results from these and other researches (e.g., Friedman & Booth-Kewley, 1987; McCrae & Costa, Jr., 1991a) suggest that the five-factor model may have a place in person-health research. The following review will extend this hypothesis by presenting both data and theory linking the big five to stress, health behaviours, and health. Several theoretical perspectives will first be presented. This will be followed by a discussion on the relationship between the five-factor model to personal stress resources and coping styles, defences, health practices, and the genetic markers of the big five. The discussion will then focus on each of the process and non-process models.

(1) **The Five-Factor Model and Theory**. In general, there are three classes of theoretical explanation that to some extent, may help to account for the health promoting and damaging effects of the five-factors. The first class focuses on three metatheoretical accounts, namely the *Evolutionary Model, Socioanalytic Theory*, and the *Interactional viewpoint*. The second class is more diverse and reflects various theories that to some extent, incorporate several elements of the five-factor model into their frameworks. The third class refers more specifically to those models that in the strictest sense, have been evaluated in past personality-stress-illness research (e.g., moderator and mediator models). While these latter models have just been discussed, they will also be documented in the model generation section that follows.

From an evolutionary personality perspective, the adaptive functions of personality have been cast in two basic ways (Buss. 1991b. 1996: see also Budaev. 1999. MacDonald. 1995. 1998). from the standpoint of the individual. and secondly. from the group. In the first sense. personality is viewed as a problem-solving mechanism that aids or facilitates adaptation. As Buss (1991b) argues. humans have evolved various psychological mechanisms that allow them to perceive. attend to. and act upon the differences in others and the environment that are necessary for adaptive purposes (i.e.. for survival and reproduction). For example. it is often to the person's advantage to comply (i.e.. agreeable) with an environmental condition that may threaten or inflict harm on him or her. Similar functions could be attributed to the remaining four factors.

At the group level. Buss (1991b) suggests that people also evaluate their social environment to determine if other individuals. based on their characteristics. can facilitate adaptation or satisfy evolutionary relevant goals for the group. Such goals include negotiation of dominance in their social hierarchy or group (e.g.. surgency). cooperation (agreeableness). commitment and work reliability (conscientiousness). dealing with stress (emotional stability). and innovation (openness to experience).

Socioanalytic theory (Hogan. 1996. 1983: see also De Raad & Doddema-Winsemius. 1999 for a historical discussion relating instincts to evolution). which draws heavily on evolutionary theory. depth psychology. and symbolic interactionism. has also been invoked to explain the health enhancing and limiting effects associated with the big five model. According to socioanalytic theory. one defines personality from two perspectives. First. personality needs to be considered from the viewpoint of the actor. From the actor's perspective, there are three major components to personality, self-images that guide self-presentation (which later become habitual, automatic, unconscious), images reflecting the expectations of significant others, and self-presentation or stylized role performances. In the latter case, the individual adopts various presentational strategies to aid in goal attainment.

For example, Hogan (1991b) argues that such individuals as the *trait neurotic* may use their own symptoms (e.g. dysphoria) as a self-presentation strategy to achieve their end goal. Delinquency can also be explained in socioanalytic terms. In the case of the drug user, drug use is a way to express the user's uniqueness and unconventionality. In this case, the similarity to the openness construct is obvious though not explicitly stated by Hogan (1991b). Therefore, elements of the five-factor model may be reflected in the self-presentation strategies that individuals use to survive in the world (see also Avia, Sanchez-Bernardos, Carillo, & Rojo, 1998; Avia, Sanz, Sanchez-Bernardos, Martinez-Aria, Silva, & Grana, 1995; Scandell & Wlazelek, 1999).

From a different, though complementary perspective, personality can also be examined from the viewpoint of the observer. Hogan (1991b) first makes two assumptions pertinent to his discourse. First, people always live within a group and secondly, that a status hierarchy exists within every group. Hogan adds that in order for a group to survive, certain trait terms had to be encoded within the language of the group to identify those individuals that could aid in group survival or adaptation. Within this context, trait terms serve three specific functions: as a tool for communicating information about a person, to explicate such psychological structures as motives, needs, goals, and interests, and as a tool for evaluating others as it bears on the welfare of the group. For example (this writer's view), a person seen as agreeable or trustworthy may be viewed by the group as supportive of their need to prosper and survive. The same case may be made for the remaining factors.

A third theory or model, that to some extent is embedded within the previous two theories, is the Dyadic Interactional Model (Wiggins & Trapnell, 1996). The interpersonal view has a long history, spanning over 50 years, and developed independently of the five-factor model. The interactional system grew out of earlier research that attempted to translate a number of concepts from the writings of Harry Stack Sullivan, into measurable constructs. It was extended by incorporating several concepts from social exchange theory, and was maintained through a number of developments in the field of cognitive psychology.

The dyadic interactional model is a structural system for classifying interpersonal traits into a two-dimensional circumplex. The variables are empirically or mathematically located in a circular order in close or distant correspondence to the two bipolar and orthogonal coordinates of *Communion* (e.g., agreeableness) and *Agency* (e.g., extraversion).[23]

According to Wiggins (1991), both agency and communion are considered essential for psychological fulfilment, and most if not all scholars view them both as good or virtuous. For example, Sigmund Freud, Alfred Adler, Karen Horney, and Erik Erickson have all

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[23] The circumplex approach has been expanded to include all five factors. See De Raad and Doddema-Winsemius (1999), De Raad, Hendriks, and Hofstee (1992), Hofstee, De Raad, & Goldberg (1992)John, Angleitner, and Ostendorf (1988), Saucier and Ostendorf (1999), and Saucier and Goldberg (1996) for research and discussions on this expanded model. Because of its history, the dyadic model is highlighted.

made reference to both concepts. The mechanisms that provide for the well-being of the individual may in part be explained by both evolutionary and socioanalytic theory. As Buss (1991b) and Hogan (1983) allude to, the most important trait terms for survival and communication purposes were in all likelihood encoded in language (see also Saucier & Goldberg, 1996).

The five-factor model or components of it, have also been tied to several psychological theories, and personality models. Table 3 illustrates the range of correspondence between each of these models and the big five. As can be seen from Table 3 the five-factor model can be linked to several *psychodynamic* (e.g., Alfred Adler, Sigmund Freud, Karen Horney), *phenomenological* (e.g., Abraham Maslow, Carl Rogers), and *trait* models (e.g., Raymond Cattell, Hans Eysenck). While in no way complete or accurate in the sense that any one theory can explain the relationship between the five-factors and behaviour or health, Table 3 suggests that, (1) several, if not most typologies, theories, and variables can be isomorphically classified (i.e., one to one) in terms of the five-factor model; and (2) each theory is in some way helpful in understanding the mechanisms that link personality to health.

(2) **The Relationship of the Five-Factor Model to Personality Resources and Coping Strategies/Defences/Health Practices**. The five factors have also been linked to several stress resources or personality characteristics. For example, sense of coherence (Korotkov, 1998; Margalit & Eysenck, 1990), self-efficacy (Thoms, Moor, & Scott, 1996), optimism and sense of humour (Korotkov & Hannah, 1994), have all been linked to

Table 3

Examples of Theorists and their theoretical concepts as related to components of the Five-Factor Model

Theorist	**Theorist's Concept**	**Five-Factor Concept**
Rogers (1961)	Openness to Experience	Openness to Experience
	Creativity	Openness to Experience
Maslow (1971)	Mystical or peak experiences	Openness to Experience
	Metaneeds:	
	Simplicity	Conscientiousness
	Planfulness	Conscientiousness
Fromm (1941)	Relatedness	Agreeableness
	Hoarding Orientation	Conscientiousness
	Rootedness	Extraversion
Adler (1939)	Inferiority	Neuroticism
	Social Interest	Agreeableness/Extraversion
Cattell (1973)	Exvia vs. Invia	Extraversion
	Pathemia vs. Cortertia	Agreeableness
	Superego Strength	Conscientiousness
	Adjustment vs. Anxiety	Neuroticism
	Independence vs. Subduedness	Openness/Intelletance
Angell (1918)	Will (volition)	Conscientiousness
	Anger, jealousy, envy, moral indignation	Neuroticism
	Tender feelings (e.g., love, affection)	Agreeableness
	Intellectual/aesthetic impulses	Openness to Experience

Note. See DeNeve & Cooper (1998) for a comprehensive list of 137 personality characteristics classified under the five-factor model as well as De Raad and Doddema-Winsemius (1999) for a comparison with personality relevant instincts.

both extraversion and neuroticism, while telic/paratelic dominance (Martin, Kuiper, Olinger, & Dobbin, 1987), inhibited power motivation (Smith & Williams, 1992), social anxiety (Realo & Allik, 1998), hopelessness, self-esteem, optimism, life purpose, locus of control, curiosity, anger out and affect intensity have been associated with *extraversion* (Marshall, Wortman, Vickers, Jr., Kusulas, & Hervig, 1994). In the same study (i.e., Marshall, Wortman, Vickers, Jr., Kusulas, & Hervig, 1994), hopelessness, self-esteem, optimism, anxiety, locus of control, self-control, anger, anger control, affect intensity, and anger in were linked to *neuroticism*. In a recent study by Realo and Allik (1998), the authors found neuroticism to be related to private and public self-consciousness, as well as social anxiety.

In addition, hardiness (Compton, Smith, Cornish, & Quall, 1996; Smith & Williams, 1992), maturity, optimism, self-esteem, self-deceptive enhancement, self-actualization (Compton, Smith, Cornish, & Quall, 1996), private self-consciousness, social anxiety (Realo & Allik, 1998), curiosity, rational expression of emotion, and introspection (Marshall, Wortman, Vickers, Jr., Kusulas, & Hervig, 1994) have been linked to *openness to experience*, while inhibited power motivation (Smith & Williams, 1992), flexibility (Wheaton, 1983), the Type A Behaviour pattern (Costa, Jr., & McCrae, 1987b; Costa, Jr., McCrae, & Dembroski, 1989), anger, anger out, anger control, and rational expression of emotion (Marshall, Wortman, Vickers, Jr., Kusulas, & Hervig, 1994) have all been related to *agreeableness*. *Conscientiousness* has been associated with private self-consciousness, social anxiety (Compton, Smith, Cornish, & Quall, 1996), components of the Type A

Behaviour Pattern. hopelessness. self-esteem. optimism. life purpose. locus of control. curiosity. self-control. and self-faith (Marshall. Wortman. Vickers. Jr.. Kusulas. & Hervig. 1994).

Few studies have assessed the connection between the five-factor model and coping. However. research by McCrae and Costa. Jr. (1986) does suggest that personality is moderately correlated with various coping strategies. Several of the factors have been related to the stress process through more direct coping strategies (McCrae & Costa. Jr.. 1986). For example. in a study that utilized two samples of community dwelling adults. McCrae and Costa. Jr. (1986) found that hostile reaction coping. escapist fantasy. self-blame. sedation. withdrawal. wishful thinking. indecisiveness. and passive coping responses were the most consistent correlates of neuroticism. Rational action coping. positive thinking. substitution and restraint coping were the most consistent coping correlates of extraversion. while humour and faith were the best correlates of openness to experience. Agreeableness and conscientiousness were not examined in this study.

In a more recent study that examined the relationships among the five factors. appraisal. and coping. David and Suls (1996: see also O'Brien & DeLongis. 1996: Suls & David. 1996: Watson & Hubbard. 1996) found that (1) neuroticism scores were predictive of cathartic and relaxation strategies. (2) extraversion was related to problem-redefinition. catharsis. use of religious coping strategies. and greater use of overall coping strategies. (3) openness to experience was negatively related to use of distraction techniques. (4) conscientiousness was negatively connected to religious coping. (5) neuroticism moderated the effects of perceived problem-severity on coping (i.e., distraction, relaxation, religion), and (6) openness to experience moderated the relation between problem-severity and cathartic and religious coping.

In a different study, Costa, Jr., Zonderman, and McCrae (1991) found that neuroticism was positively related to maladaptive action patterns and adaptive defences. In addition, extraversion was negatively linked to maladaptive action patterns and positively to adaptive defences while openness to experience was positively related to adaptive defences. Agreeableness was negatively related to image distortion, and positively to self-sacrificing defences, while conscientiousness was negatively associated with maladaptive action patterns. Conscientiousness may also influence the coping process through goal-setting and goal commitment (Barrick, Mount, & Straus, 1993), and through the development of personal projects (Little, Lecci, & Watkinson, 1992).

In a fourth study (Elliot, Herrick, MacNair, & Harkins, 1994), problem solving was found to be correlated with each of the five-factors, save openness to experience.[24] Data from the Elliot, Herrick, MacNair, and Harkins (1994) study found low scores on the neuroticism factor and high scores on the extraversion, agreeableness, and conscientiousness factors to be related to increased problem-solving confidence. Approach-avoidance coping was also found to be correlated with each factor except extraversion and openness to experience. Low scores on the neuroticism and high scores on the

[24] However, in a more recent study, openness to experience was linked to a different problem-solving variable, *problem solving through challenge* (Ferguson & Patterson, 1998; Watson & Hubbard, 1996).

extraversion, openness to experience, and conscientiousness factors were associated with more effective coping.

In general, the results from these studies suggest that neuroticism is more related to emotion-based coping while conscientiousness and extraversion are more related to problem-based and support coping (see Lazarus & Folkman, 1984). Openness to experience and agreeableness appear to be related to both types of coping patterns.

The five-factor model has also been linked to individual health practices such as exercise, smoking, driving accident involvement, and drinking (Arthur, Jr., & Graziano, 1996; Avia, Sanz, Sanchez-Bernardos, Martinez-Arias, Silva, & Grana, 1995; Berkman & Breslow, 1983; Booth-Kewley & Vickers, Jr., 1994; Friedman, Tucker, Schwartz, Martin, Tomlinson-Keasey, Wingard, & Criqui, 1995; Friedman, Tucker, Tomlinson-Keasey, Schwartz, Wingard, & Criqui, 1993; Tucker, Friedman, Tomlinson-Keasey, Schwartz, Wingard, Criqui, & Martin, 1995). For example, in a pooled data analysis of two samples in which each of the five-factors were partialled out from each other and health practices, Booth-Kewley and Vickers, Jr. (1994) found (1) conscientiousness to be related to wellness behaviours, accident control behaviours, and traffic risk taking; (2) neuroticism to be unrelated to any of the health practices; (3) extraversion to be related to traffic risk taking behaviours; (4) openness to experience to be related to substance risk taking; and (5) agreeableness to be related to traffic risk taking behaviour.

In an interesting longitudinal study spanning over 60 years, Tucker, Friedman, Tomlinson-Keasey, Schwartz, Wingard, Criqui, and Martin (1995; see also Friedman, Tucker. Tomlinson-Keasey. Schwartz. Wingard. & Criqui. 1993 and Friedman. Tucker. Schwartz. Martin. Tomlinson-Keasey. Wingard. & Criqui. 1995) found both smoking and alcohol use to be negatively predicted by childhood conscientiousness: that is. high scores on a measure of conscientiousness were associated with less risk-taking practices. Interestingly. smoking behaviour was positively predicted by cheerfulness (i.e.. extraversion). while sociobility (i.e.. extraversion) was positively related to alcohol use. suggesting that such characteristics may have a potential negative impact on health.

(3) **Genetic Markers**. Several models have been proposed that integrate personality with heritability. For example. Zuckerman (1992: Zuckerman. Kuhlman. Thornquist. & Kiers. 1991) has proposed a stepladder relationship between heritability and traits. That is. genetic inheritance determines one's neurology. biochemistry. the degree of conditioning. social behaviour. and the resultant traits (see Hettema. 1995 for an example related to depression). Similarly. Eysenck (1997) has suggested that for any causal theory of personality. there is a five-step process of understanding. According to Eysenck (1997). distal antecedents of personality (genetics) impact on the proximal antecedents of personality (biology) which impact on a particular trait constellation (psychoticism. extraversion. neuroticism: Eysenck's discussion implies applications to other models). The model also describes both proximal (e.g.. conditioning) and distal (social behaviour) consequences. Extrapolating from these models. it is logical to suggest that genetics may play a role in personality (e.g.. big five) - stress encounters. Research appears to bear this out (Suls & Rittenhouse. 1990). For example. some research indicates that each of the five factors and its constituant

components, have a genetic basis (e.g., Bergeman, Chipuer, Plomin, Pedersen, McClearn, Nesselroade, Costa, Jr., & McCrae, 1993; Brody, 1997; Jang, McCrae, Angleitner, Riemann, & Livesly, 1998; Loehlin, 1992; Loehlin, McCrae, Costa, Jr., & John, 1998; Saudino, Pedersen, Lichtenstein, McClearn, & Plomin, 1997). In general, research suggests that openness to experience has the greater genetic contribution, perhaps due to its association with intelligence, and conscientiousness the least (Pervin, 1996). For example, in a study by Loehlin (1992), the following heritability coefficients were reported: extraversion = .36; agreeableness = .28; conscientiousness = .28; neuroticism = .31; and openness to experience = .46. In an interesting study based on data obtained from the Swedish Adoption/Twin Study, Saudino, Pedersen, Lichtensteir, McClearn, and Plomin (1997) found genetics and life events (i.e., controllable, desirable, undesirable) to be mediated by extraversion, neuroticism, and openness to experience.

Overall, the data suggests that each of the five-factors may have a genetic basis and that one's placement on a given dimension of personality may influence one's encounters with life stress. These data also provide partial support for evolutionary, socioanalytic, and interactional theories. That is, given the link between genetics, the five factors or personality in general, the data suggests that traits have survival value (Pervin, 1996).

Summary. Several metamodels (e.g., evolutionary) have been used to explain how personality or more specifically, the five-factor model, is connected to health status. In addition, research has linked the five factors to measures of coping, health practices, and personal resource variables. The model has also been found to have a genetic influence that may form the basis of adaptation.

The next section will describe in detail eight non-process and process/path models that may help to (1) determine the extent to which personality is related to health status, and (2) understand the ways in which personality functions to effect health status. A summary of the hypotheses will then be presented.

Eight General Models: Non-Process and Process Models

The present research will focus on the development and testing of several process and non-process models. As previously indicated, personality-health research has been influenced by the metatheoretical viewpoint of causal primacy, the assumption that personality influences health status or practices. This section will focus on the description and justification for the development of the models that follow. Specifically, this section will discuss the direct effects and personality interaction (i.e., personality by personality) models with and without statistical control, the stress moderator model with statistical control, the stress moderator model without statistical control, the stress/health behaviour mediator model with statistical control, and the stress/health behaviour mediator model without statistical control.

To assess the extent to which the five-factors are related to health status, four *non-process* models will first be assessed. First, health status will be regressed on the big five (i.e., Restricted Direct Effects Model). Health status will then be regressed on each of the control variables (to be discussed) as well as the five factors (i.e., Full Direct Effects Model). Third, each of the health status variables will be regressed on the five factors as well as 10 higher-order two-way personality by personality interactions (i.e., Restricted Interaction Model). The last model will require the regression of health status on each of the control variables, the five factors, and the 10 higher-order personality by personality interactions (i.e., Full Interaction Model). To simplify the nature of the expected relationships, the five-factor to health status paths are illustrated in Figure 2 (Figures 2a to 2d: Path number 3). In general, it is expected that increases in each personality variable score may be paralleled by low scores on a negatively valenced health status measure.[25] The scores on the neuroticism measure will be reversed scored such that high scores will reflect individuals who are emotionally stable.

Of the four *process* models, Model 1 (see Figure 2a), the stress moderator model with the time one controls, is the most parameterized of the models. Model 1 includes all five interactions, statistical controls, covariances, paths, and mediators. Figure 2a denotes paths that range from 1-8 with multiple paths at each level. Model 2, the stress moderator model without the time one controls (i.e., Figure 2b), is identical to Model 1 except that it omits both demographic and autoregressive control variables.

The third path model (i.e., Figure 2c), the stress/health practice mediator model, is comprised of all the same paths as the model in Figure 2a, save the five interaction terms. As a result, Model 3 has fewer paths. It is made up of paths 1, 3, 4, 5, 6, 7, and 8.

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[25] The personality by personality interactions are not shown in Figures 2a to 2d.

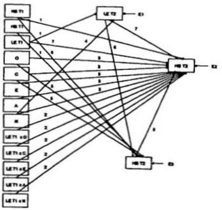

Figure 2a: Stress Moderator Model with Time 1 Controls

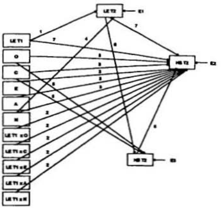

Figure 2b: Stress Moderator Model without Time 1 Controls

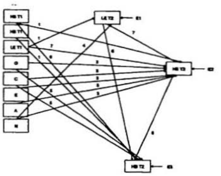

Figure 2c: Stress/Health Practices Mediator Model with Time 1 Controls

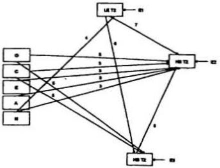

Figure 2d: Stress/Health Practices Mediator Model without Time 1 Controls

Figure 2. General path models. Interpretation of the abbreviations is as follows: T1 = Time 1; T2 = Time 2; HS = Health Status; HB = Health Behaviours; LE = Life Events; O = Openness to Experience; C = Conscientiousness; E = Extraversion; A = Agreeableness; N = Neuroticism; and x = Multiplied by.

As in Model 3, no interaction terms were included in Model 4, the stress/health practices mediator model without time one controls (Figure 2d). However, Model 4 differs from the former because it excludes the time 1 life events variable. The time 1 life events variable is no longer needed to test for any moderation and autoregressive effects. In Model 4, the impact of the five-factors on health status is assumed to be mediated by time 2 life events and health practices.

Saturated Structural and *Independence* models will also be constructed as nontheoretical comparison, reference, or baseline models for each of the path models (i.e., neither model is shown). In general, the saturated structural model is identical to each of the previously discussed path models except that in each model, all paths are freed for estimation. The saturated structural model is constructed by the researcher and submitted to the structural equation modelling program for estimation. The independence model is automatically constructed by the EQS software program and is ready for comparison with the research or theoretical model. The independence model is a model with all paths fixed to zero; this model is also known as the uncorrelated variable model (see Bentler, 1995, Bentler & Bonett, 1980, and MacCallum, Roznowski, & Necowitz, 1992). In total, there are 12 process models: four path models, four saturated models, and four independence models. A saturated and independence model is presented/developed with a respective path model. Paths 1 through 8 will now be discussed.

(1) **Path(s) 1: Time 1 Outcome Control to Time n Outcome**. As previously discussed, autoregressive effects tend to be greater than nonautoregressive effects

(e.g., Kozma, Stones, & McNeil, 1991). To account for these effects, two of the four path models (i.e., 1 and 3) incorporate three autoregressive variables, life events, health practices, and health status. To test the personality by life events interactions, the time 1 life events variable was kept in both interaction models. While not shown, several demographic and socioeconomic status variables will be incorporated into Models 1 and 3 subsequent to a principle components analysis. The hypotheses for these latter variables will therefore be presented in the Results section.

(2) **Path(s) 2: Personality *Moderator* by Objective Negative Life Stress**

Extraversion has been linked to the stress moderation process through both multiplicative physiological outcome and multiplicative illness outcome models.[26] In the former category, extraversion has been found to moderate the effects of stress/arousal (e.g., difficult tasks, caffeine-induced arousal) on various physiological measures such as auditory sensitivity (Dornic & Ekehammar, 1990; Geen, McCown, & Broyles, 1985; Stelmack & Campbell, 1974), pulse rate (Geen, 1984), and skin conductance levels (Fowles, Roberts, & Nagel, 1977). For example, in one study Geen (1984) examined levels of stimulation (i.e., noise intensity) for extraverts and introverts. Both pulse rate and the number of trials to criterion on a paired-associate task served as the dependent variables. When pulse rate

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[26] Objective negative life events was chosen as the measure of life stress as opposed to total or positive life events and daily hassles, primarily because negative or undesirable life stress has been shown to outpredict total and positive life events (e.g., Sarason, Johnson, & Siegel, 1978; Vinokur & Selzer, 1975). In the later case, there were concerns of confounding between hassles and health outcome (Dohrenwend & Shrout, 1986). In addition, life stress as opposed to measures of daily stress appear to be the predominant measure of stress used in personality, stress, and health research (e.g., Kessler, 1997).

served as the criterion. Geen found that as noise intensity increased to a moderate level, pulse rates for extraverts were significantly lower than for introverts. Similar results were also found in the paired associates task.

The second category, the multiplicative illness outcome model, focuses on the interactive relationship of extraversion and stress to illness. Overall, the findings are less clear about extraversion's impact on the stress-illness process. Of these investigations, two studies found suggestive evidence that extraversion moderates the relationship of life stress on both physical disorder (Miller & Cooley, 1981) and psychological strain (Duckitt & Broll, 1982). However, extraversion failed to buffer the relationship of life stress on virus shedding (Totman, Kiff, Reed, & Craig, 1980), anxiety, maladjustment, depression (Naditch & Morrissey, 1976), illness behaviour (Duckitt & Broll, 1982), and desire to drink (Forsyth & Hundleby, 1987).

While support for an extraversion by stress interaction is mixed, the data is more supportive for *neuroticism's* role in the moderation process. With the exception of only a few studies (e.g., Denney & Frisch, 1981; Duckitt & Broll, 1982), neuroticism appears to have an impact on the stress/illness process (Aldwin, Levenson, Spiro, & Bosse, 1989; Endler, 1988a; Endler, 1988b; Endler & Okada, 1975; Flood & Endler, 1980; King & Endler, 1990; Parkes, 1986; Spielberger, Auerbach, Wadsworth, Dunn, & Taubee, 1973). In general, the data suggests that individuals who score high on a measure of neuroticism tend to experience more symptoms under high stress relative to those who are emotionally stable.

There is little direct evidence to support a personality by stress interaction for *agreeableness, conscientiousness, or openness to experience*. However, some research does suggest that each of the factors may be indirectly implicated. For example, Wheaton (1983) found that the construct of flexibility, a conceptual correlate of agreeableness (See Costa, Jr. & McCrae, 1992a), moderated the relation between stress and depression. Individuals who considered themselves highly flexible, under high stress, experienced less depression than those less flexible. Openness to experience may also have a role to play as a stress moderator. For example, Smith and Williams (1992) have suggested that given the similarities between openness to experience and psychological hardiness, a presumed stress moderator, openness to experience may exert moderation effects on the stress-illness relationship. That is, individuals who are more open may experience less psychosomatic symptoms under high stress as opposed to those less open, or more closed (see also Costa, Jr., & McCrae, 1987a).

And last, some research indicates that conscientious individuals tend to experience more positive and less negative affect than those less conscientious (e.g., Watson & Clark, 1992). While these findings suggest a main- rather than an interactive effect, some research indicates that conscientious individuals tend to adopt positive health habits (see Costa, Jr., & McCrae, 1987a), a factor linked to life stress (Wiebe & McCallum, 1986). Based on this data, it is hypothesized that each of the five-factors will exert a moderation effect such that high scores on each of the factors, coupled with high scores on the stress measure, will lead to low scores on a negatively valenced measure of health.

(3) **Path(s) 3: Personality to Health**. With any model, the researcher needs to consider the possibility that the alternative hypothesis(es) will be rejected (i.e., interaction effects) in favour of the null hypotheses. The question then focuses on the extent to which the results support a main effects model. Within the context of the main effects model and theory (see e.g., Matthews & Deary, 1998), there is some evidence that each of the five-factors may have a direct impact on health.

With the main effects model, research suggests that several of the factors are linked to both psychological and physical morbidity, mortality, and well-being. For instance, *extraversion* has been related to disability (Russo, Katon, Lin, Von-Korff, Bush, Simon, & Walker, 1997), average mood, mood swings (Velting & Liebert, 1997), personal negativity, life satisfaction, self-esteem, happiness (Furr & Funder, 1998), positive, negative, and total affect (Carp, 1985; Costa, Jr., & McCrae, 1980; Cote & Moskowitz, 1998; Diener, Suh, Lucas, & Smith, 1999), saliva flow (Costa, Jr., Chauncey, Rose, & Kapur, 1980), obsessive symptomatology, interpersonal sensitivity, anxiety, phobic anxiety, paranoid ideation, psychosis, global symptomatology (Smith & Snell, Jr., 1996), well-being, distress, social adjustment (Saragovi, Liestner, Di Dio, & Aube, 1997), composite health (Garrity, Somes, & Marx, 1977), hospitalization (Cohler, Grunebaum, Weiss, Galbant, & Abernathy, 1974), anxiety, maladjustment, and depression (Furr & Funder, 1998; Naditch & Morrissey, 1976; Smith & Snell, Jr., 1996), muscular strength, endurance (Hogan, 1989), total symptomatology, virus shedding (Cohen, Doyle, Skoner, Fiireman, Gwaltney, Jr., &

Newsom, 1995; Totman, Kim, Reed, & Craig, 1980), purpose in life, personal growth, and positive relations with others (Schmutte & Ryff, 1997).

Neuroticism has also been linked to positive, negative, and total affect balance (Costa, Jr., & McCrae, 1980; Cote & Moskowitz, 1998; Emmons & Diener, 1985), average mood (Velting & Liebert, 1997), saliva flow (Costa, Jr., Chauncey, Rose, & Kapur, 1980), cold symptomatology, self-reported illness (Feldman, Cohen, Doyle, Skoner, & Gwaltney, Jr., 1999), physical symptomatology (Costa, Jr., & McCrae, 1987; Levenson, Aldwin, Bosse, & Spiro, III, 1988), coronary heart disease, cancer (Amelang, 1997), disgust sensitivity (Druschel & Sherman, 1999), disability, somatization (Russo, Katon, Lin, Non Korff, Bush, Simon, & Walker, 1997), muscular strength, endurance, and movement quality (Hogan, 1989), personal negativity, depression, life satisfaction, self-esteem (Furr & Funder, 1998), happiness, social adjustment (Carp, 1985; Furr & Funder, 1998), somatization, interpersonal sensitivity, dependence, anxiety, hostility, paranoid ideation, global symptomatology (Smith & Snell, Jr., 1996), suicidal ideation (Velting, 1999), self-acceptance, environmental mastery (Schmutte & Ryff, 1997), and health problems (Garrity, Somes, & Marx, 1977). When negative affect has been regressed against the five factors, neuroticism appears to be the most consistent predictor (Watson & Clark, 1992).

Openness to experience has been related to personal growth, autonomy (Schmutte & Ryff, 1997), mood fluctuations, mood swings (Velting & Liebert, 1997), positive affect (Heady & Wearing, 1989; McCrae & Costa, Jr., 1991a; Watson & Clark, 1992), self-esteem (Furr & Funder, 1998), negative affect (Heady & Wearing, 1989; McCrae & Costa, Jr., 1991; Watson & Clark, 1992), psychological well-being (Compton, Smith, Cornish, & Qualls, 1996), self-reported illness (Feldman, Cohen, Doyle, Skoner, & Gwaltney, 1999), social consequences (McCrae, 1996), disgust sensitivity (Druschel & Sherman, 1999), endurance, movement quality (Hogan, 1989), specific measures of positive and negative affect (e.g., fear and joviality; Watson & Clark, 1992), and peer and staff ratings of social adjustment (Carp, 1985). In an earlier study conducted by Costa, Jr. and McCrae (1987), openness to experience was found to be unrelated to physical symptoms.

Agreeableness has been found to be related to positive affect (Cote & Moskowitz, 1998; McCrae & Costa, Jr., 1991a; Watson & Clark, 1992), negative affect (McCrae & Costa, Jr., 1991a; Watson & Clark, 1992), personal negativity, depression, life satisfaction, self-esteem, happiness (Furr & Funder, 1998), environmental mastery, positive relations with others, autonomy (Schmutte & Ryff, 1997), distress, social adjustment (Saragovi, Koestner, Aube, & Di Dio, 1997), disgust sensitivity (Druschel & Sherman, 1999), self-reported illness (Feldman, Cohen, Doyle, Skoner, & Gwaltney, 1999), and peer and staff ratings of social adjustment (Carp, 1985). Like openness to experience, researchers have yet to find a clear link between agreeableness and physical symptomatology (see Costa, Jr., & McCrae, 1987a; questionnable statistical power). However, some theorists have implicated hostility, a component of neuroticism but related to agreeableness, to coronary heart disease (Costa, Jr., McCrae, & Dembroski, 1989; Costa, Jr., Stone, McCrae, Dembroski, & Williams, 1987; Costa, Jr., Zonderman, McCrae, & Williams, 1986; Dembrowski & Costa, Jr., 1988; see also Friedman & Booth-Kewley, 1985). Finally, research by Hogan (1989) using the Hogan

Personality Inventory, suggests that ambition/competitiveness (agreeableness) is significantly, though modestly related to physical fitness (i.e., muscular strength, endurance, and movement quality), a factor implicated in mortality.

And last, *conscientiousness* has been found to be related to positive affect (McCrae & Costa, Jr., 1991a; Watson & Clark, 1992), environmental mastery, purpose in life (i.e., well-being; Schmutte & Ryff, 1997), muscular strength, endurance, movement quality (Hogan, 1989), adherence to medication (Christensen & Smith, 1995), personal negativity, depression, life satisfaction, self-esteem, happiness (Furr & Funder, 1998), hostility, phobic anxiety, psychosis, global symptomatology (Smith & Snell, Jr., 1996), suicidal ideation (Velting, 1999), negative affect (McCrae & Costa, Jr., 1991a; Watson & Clark, 1992), disgust sensitivity (Druschel & Sherman, 1999), happiness, peer and staff ratings of adjustment (Carp, 1985), mental health (Martin, Friedman, Tucker, Schwartz, Criqui, Wingard, & Tomlinson-Keasey, 1995), general well-being (DeNeve & Cooper, 1998), and mortality (Friedman, Tucker, Schwartz, Martin, Tomlinson-Keasey, Wingard, & Criqui, 1995). However, research by Costa, Jr. and McCrae (1987a) found conscientiousness to be uncorrelated with physical symptoms. In this case, low statistical power may have contributed to the nonsignificant finding.

In consideration of these findings, it is hypothesized that the five factors will be inversely related to a negatively valenced health outcome measure, save openness to experience, but positively related to a positively valenced health outcome measure. Neuroticism will be the only variable of the five to be related to negative affect.[27]

(4) **Path(s) 4: Personality to Objective Negative Life Stress *Mediator***. It has been shown that personality can influence health status nonlinearly through its interaction with stress. Personality can also have a linear effect on stress. In the latter case, health status is typically regressed on both stress and personality, while stress is regressed on personality; no interaction term is included. Of the five factors, neuroticism appears to be the most consistent predictor of life stress (e.g., Aldwin, Levenson, Spiro, & Boise, 1989; Headey & Wearing, 1989). However, the strength of the association appears to be dependent on the nature of the stress instrument. For instance, in a prospective study, Headey and Wearing (1989) found that neuroticism was only correlated with adverse as opposed to favorable life events. This was later corroborated by Magnus, Diener, Fujita, and Pavot (1993) who found neuroticism to predict objective negative events but not objective positive events.

Unlike neuroticism, extraversion appears to be positively related to [objective] positive events but not [objective] negative events (Headey & Wearing, 1989; Magnus, Diener, Fujita, and Pavot, 1993). For openness to experience, the relationship with life stress is more complex. For example, in a study by Headey and Wearing (1989), openness to experience was found to be postdictively and positively correlated with a mix of subjective/objective favorable and adverse events. In a regression analysis that excluded conscientiousness and agreeableness, openness to experience and neuroticism were found

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[27] The relationships will also depend on the component solution. In addition, these effects may be attenuated by inclusion of the controls.

to predict adverse events. Openness to experience as well as extraversion were found to predict favourable events. Similarly, Saudino, Pedersen, Lichtenstein, McClearn, and Plomin (1997) found that extraversion, neuroticism, and openness to experience mediated the effects of genetics on subjective life stress (i.e., desirable, undesirable, controllable). In a different study, Magnus, Diener, Fujita, and Pavot (1993) found openness to experience to be positively related to both subjective positive and negative events, but not objective negative events. In both cases, regression analyses were not performed. The safest conclusion that can be drawn appears to be that openness to experience is related to subjective positive and negative life events but *not* objective negative events. It is not clear to what extent openness to experience is related to objective positive events. And last, Magnus, Diener, Fujita, and Pavot (1993) found that conscientiousness was positively correlated with objective positive events while agreeableness was unrelated to either objective positive or negative life events. Based on these findings, it is predicted that neuroticism will be the only variable of the big five to impact on negative life stress.

(5) **Path(s) 5: Personality to Health Practices *Mediator*.**[28] One construct through which personality may exert its effects on health status is health behaviours (Suls &

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[28] Just as there appears to be no acceptable definition of health status, there also appears to be minimal agreement on how to measure health behaviours. Health behaviours have been assessed in three ways, as a single practice (e.g., smoking: Lind, 1996), as a factor composite (e.g., alcohol and smoking: Steptoe, Sanderman, & Wardle, 1995; Woodruff & Conway, 1992), and as a total composite variable where all health practice scores are added together to yield a total score (Segovia, Bartlett, & Edwards, 1991). Given the size and complexity of the present research, it was decided to use a total composite measure of health behaviour.

Rittenhouse, 1990; Wiebe & McCallum, 1986). Both theory (e.g. Costa, Jr., & McCrae, 1981; Matthews & Deary, 1998; Suls & Rittenhouse, 1990; Taylor, 1991; Wiebe & Smith, 1997) and research (e.g., Booth-Kewley & Vickers, Jr., 1994) appear to corroborate inclusion of this path into the model. For example, in a partial test of the model using two samples of navy personnel and marines, Booth-Kewley and Vickers, Jr. (1994) found that after partialling out each of the five-factors from each other as well as health practices, conscientiousness and to some extent openness to experience were the best correlates of preventive and risky health practices. Interestingly, while neuroticism, extraversion, and agreeableness were correlated in varying degrees with wellness behaviours, accident control, traffic risk taking, and substance risk taking in the bivariate analyses, all failed to reach significance in the partial correlation analysis. This finding contradicts suggestions by some researchers (e.g., Costa, Jr., & McCrae, 1987a) that neuroticism and agreeableness are related to health practices. The results from Booth-Kewly and Vickers, Jr. (1994) illustrates the importance of controlling for each of the five factors. The model predicts that both conscientiousness and openness to experience will be positively related to health practices.

(6) **Path(s) 6: Objective Negative Life Stress, Distress (Health), to Health Practices *Mediator***. Many researchers have argued that life stress (Cohen, Frank, Doyle, Skoner, Rabin, & Gwaltney, Jr., 1998; Wiebe & McCallum, 1986) as well as various forms of distress (e.g., see Stroebe & Stroebe, 1995) are linked to health practices. For both life events and distress, it was hypothesized that given an overwhelming degree of stress and

distress, such individuals would engage in fewer health practices, resulting in subsequent distress at time two.

(7) **Path(s) 7: Stress to Health Outcome**. A large body of research indicates that various forms of life stress such as daily hassles, college student life stress, recent stressful experiences, work stress, negative stress, and general life stress are associated with various indices of negative dysphoria and symptomatology including *perceived physical symptomatology, disease* (Brown, 1991; Cohen, Frank, Doyle, Skoner, Rabin, & Gwaltney, Jr., 1998; Kobasa, 1979; Korotkov & Hannah, 1994; Linville, 1987; Porterfield, 1987), *depression* (Caldwell, Pearson, & Chin, 1987; Gannellon & Blaney, 1984; Nezu, Nezu, & Blissett, 1988; Porterfield, 1987; Zika & Chamberlain, 1987), and *psychological well-being* (Brown, 1991; Caldwell, Pearson, & Chin, 1987; Zika & Chamberlain, 1987). Based on this data, it is hypothesized that negative life events (as measured at time 2 but not time 1) would be positively related to a negatively valenced outcome measure but negatively related to a positively valenced outcome measure.

(8) **Path(s) 8: Health Behaviour to Health Outcome**. During the past few decades, several researchers have suggested that personal health practices such as exercise, and proper nutrition or their combination are linked to several health outcome variables including psychological distress (Nowack, 1987), physical health status (Reed, 1983; see also Adler & Matthews, 1994), illness (Wiebe & McCallum, 1986), physician utilization (Wetzler & Crues, 1975), mortality (Wingard, Berkman, & Brand, 1982), self-assessed health status, worry over health, chronic conditions, energy, physical condition, emotional

status, restriction of activities (Segovia, Bartlett, & Edwards, 1991), subjective health, psychological well-being (Gillis, 1994), satisfaction with health, health condition (Harris & Guten, 1979), and positive physical health (Belloc & Breslow, 1972). Given these findings, it is predicted that on a composite measure of health practices, those individuals who engage in more health practices will be in better health than those who practice fewer health practices.

(9) **Implied Covariances.** When developing a path model within the framework of a structural equation modelling program, it is necessary to model the covariances among each of the predictors.[29] In the present research, the predictions are identical to the hypothesized paths. With covariances, the paths are bi-directional implying no causal direction. To reduce the potential negative impact of multicollinearity amongst the predictors, moderators, and interaction terms, each of the predictors and criterion variables will be linearlized or *centered* (Jaccard & Wan, 1996). With centering, the mean of the variable is subtracted from the score of each subject for that variable, yielding a deviation mean of 0. Because centering may eliminate the covariation among certain predictors (i.e., life events, the big-five, and the interactions), no hypothesized bidirectional paths between each of the five factors and the interactions will be included in the model. Paths between life events (time 1)

[29] It has been suggested that researchers model all of the covariances (Hayduk, 1987), although not all scholars have followed this practice (e.g., Byrne, 1994). In order to develop a highly specified model, and to keep the number of parameters to a reasonable and estimable number in order to facilitate convergence of the statistical solution, only certain covariances were specified. As will be discussed in the results sections, the findings obtained from the modelling analyses were similar to a series of regression analyses where all of the covariance were implicated, thus supporting the modelled covariances.

and the interactions will be specified given that the centering of nonnormal variables (e.g., life events) may not fully reduce the intercorrelations to zero.

Summary. Based on a review of the literature, eight non-process and process models were developed: the full direct effects model (non-process), the restricted direct effects model (non-process), the full interaction model (non-process), the restricted interaction model (non-process), the stress moderator/interaction model with the time one controls (i.e., process: Model 1), the moderator model without the time one controls (i.e., process: Model 2), the stress/health practices mediator model with the time one controls (i.e., process: Model 3), and the stress/health practices mediator model without the time one controls (i.e., process: Model 4). In general, the moderator model is a single stage atheoretical predictive model unlike the stress/health practices mediation model, which is based strongly on theory and reflects a multi-stage approach to causal modelling (Kline, 1991). Within the later models, several paths among the independent and dependent variables were constructed into a *causal chain*.

Because it is possible to create a web of relations among both moderator and mediation models, a hybrid set of models were developed. Specifically, the moderator and mediator models were combined, forming several multistage models. Both life events and health practices were chosen as mediators and predictors given their importance in current stress-health theorizing (life events: e.g., O'Leary, 1990; health practices: e.g., Matthews & Deary, 1998; Suls & Rittenhouse, 1990). While it is possible to construct a single multistage model that will account for several of the previously mentioned models, the statistical assessment of parsimony, which will play a role in the model selection process, demands for a separate assessment of each.

Summary and Hypotheses

The history of personality-health psychology can be characterized by a tripartite approach to causal primacy: that traits have a direct impact on health status; that traits moderate the effects of stress on health status, and that various mediators serve as mechanisms that transmit the effects of personality to health status. However, at the same time, the personality-health field has been plagued by various theoretical (e.g., focus on single trait variables) and methodological (e.g., cross-sectional data) concerns. To help resolve these concerns, it was proposed that the five-factor model of personality, as well as several methodological and statistical adjustments would help to resolve these issues. The present study was guided by two questions. First, to *what* extent are the five factors linked to health status? And second, *how* are the five-factors linked to health status, through moderation and/or mediation, or neither? The following Primary and Secondary hypotheses were developed:

Primary Hypotheses

There are three sets of primary hypotheses, the non-process model comparison predictions, path model comparison hypotheses, and the parameter or path hypotheses.

(1) **Non-Process Models**. The hypotheses vary depending on the nature of the criterion as well as the final principle component solution for each of the ten health status and health

related measures. Note that a multiple regression analysis will be carried out on each health status measure as well as the components that are extracted from the components analyses.

There are four model comparison hypotheses. *First*, the control variable direct effects model (i.e., Full Direct Effects Model) will account for more of the variance than the no control variable direct effects model (i.e., Restricted Direct Effects Model). *Second*, the control variable interaction model (i.e., Full Interaction Model) will account for more of the variance than the no control variable interaction model (i.e., Restricted Interaction Model). The *third* inter-model comparison is that the no control interaction model (i.e., Restricted Interaction Model) will predict more of the variance than the no control direct effects model (i.e., Restricted Direct Effects Model) given that the former includes 10 personality by personality interaction terms (see Parameter Hypotheses section). And *last*, the control variable interaction model (i.e., Full Interaction Model) will explain more of the variance than the control variable direct effects model (i.e., Full Direct Effects Model).

(2) **Path Models**: In the the model testing analyses, it is hypothesized that each of the four models would provide an acceptable fit to the data, based on various measures of fit (to be discussed). The bootstrap simulation analyses will corroborate these findings. It is further hypothesized that each of the four models would better fit the data than the independence model (i.e., model of uncorrelated variables) or saturated structural models (i.e., a model with all paths freed for estimation). Rejection of the latter two models will provide further evidence for the validity of the theoretical models. The last set of model comparisons will compare model 1 to 2, 3 to 4, 2 to 4, and 1 to 3 in terms of the overall variance accounted

for by each of the four theoretical models. It is predicted that Model 1, the control variable stress interaction model will account for more of the variance than Model 2, the no control stress interaction model. It is further predicted that Model 3, the control variable stress/health behaviour mediator model, will account for more of the variance than Model 4, the no control variable stress/health behaviour mediator model. The inter-model hypothesis predicts that model 2, the no control variable interaction model will account for more of the variance than model 4, the no control variable mediator model. This latter hypothesis was predicted given the former includes the time one life events and the five interaction terms. The last inter-model hypothesis predicts that Model 1, the control variable interaction model will account for more of the variance than Model 3, the control variable mediator model, given the formers inclusion of the five-product-term interactions.

(3) **Parameter Hypotheses**. The following parameter hypotheses are presented:

(i) the time one autoregressive predictors, life events, health behaviours, and health, will be the strongest predictors of the same variables at time two (i.e., autoregression: positive relationships). The models will be tested with and without these predictors:

(ii) health status will be moderated by the cross-product interaction of the five-factors by objective negative life stress. High scores on each of the five factors, coupled with high scores on the measure of stress will predict low scores on a health status index[30];

(iii) each of the five factors will be negatively related to a negatively valenced health outcome measure, save openness to experience, but positively related to a positively

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[30] Neuroticism scores are reversed so that high scores reflect emotional stability.

valenced subjective health status measure. Neuroticism will be the only variable related to negative affect:

(iv) neuroticism (i.e., emotional stability) will be negatively related to time 2 (T2) objective negative life events:

(v) both conscientiousness and openness to experience will be negatively related to a time 2 composite measure of health behaviours:

(vi) time 2 objective negative life events and time 1 health status (negatively scored) will be negatively related to health behaviours at time two:

(vii) time 2 objective negative life events will be positively related to health status (negatively scored) at time two. For statistical reasons, time 1 life events was included in the analyses:

(viii) health behaviours at time 2 will be negatively related to health status (negatively scored) at time 2: and

(ix) extraversion as well as agreeableness will multiplicatively combine with neuroticism to effect health status such that highly stable and agreeable and highly stable and extraverted individuals will experience fewer health problems. No other personality by personality interactions are hypothesized although these will be examined.

In summary, the primary hypotheses will be assessed as follows:

(1) to test the non-process models, a series of multiple regression analyses will be carried out and a series of F-Tests will be conduced for inter-model comparison purposes: and

(2) to test process models 1 through 4. the models will be evaluated in the following order based on: overall fit (supplemented by the bootstrap simulations). the comparisons with the saturated and independence models. parameter assessments. intermodel comparisons. and last. by the Expected Cross-Validation Index.[31]

Secondary Hypotheses

The following pertains to the component structure of the health status measures: Each of the physician utilization and restriction of activity questions will load on separate though correlated factors while the remaining measures. physical symptoms. chronic conditions. general health. and positive. and negative affect will load on one to two separate though correlated factors.

[31] The Expected Cross-Validation Index is moderated by sample size such that with large samples. the Index tends to favour highly parameterized models. However. there are no clear guidelines as to what constitutes a large sample. Thus. the Expected Cross-Validation Index will supplement an overall multiple R-Squared test given that the latter appears to provide a more exacting and less biased indication of parsimony.

METHOD

Subjects

Using the Deliberate Sampling for Heterogeneity approach to sampling (Cook & Campbell, 1979), data were collected from 858 subjects (mean age = 37) who worked in several community based organizations, during the first wave of a two-wave prospective study. Six months later, 709 subjects (288 men, 421 women) from wave one participated in wave two of the study for an overall return rate of 82.52%.[32] Three cases were removed from the sample for medical reasons (i.e., pregnancy), leaving an overall sample of 706 subjects. Table 4 provides a breakdown by sex, marital status, education level, income, and occupation. As Table 4 indicates, the majority of the subjects were married, highly educated, and comprised of highly skilled workers.[33 34 35]

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[32] Attrition analyses will be discussed in the next chapter.

[33] To ensure that the occupational data were reliably coded, two raters were used to assess a random sample of sixty-five surveys, with the writer providing one set of codings. The surveys were also given to a second coder, a 27 year-old female. The coefficient of agreement was 95%, indicating a high degree of reliability. The data were initially coded using the 1991 Standard Occupational Classification system. To reduce the number of categories to a smaller number for the main analyses and to increase the normality of the distribution, the first codings were recoded into categories based on a system similar to that used in the General Social Survey (Statistics Canada, 1991).

[34] Pretest information can be found in Appendix B.

[35] No group differences by occupation were tested due to the small number of participants in some groups. Therefore, the data were combined to enhance statistical power.

Table 4

Frequencies for each of the demographic and SES categorical variables

Variable		Frequency
Sex	Women	418
	Men	288
Marital Status	Married	465
	Common-law	40
	Single (never married)	148
	Widowed	4
	Separated	23
	Divorced	26
Education Level	One or more graduate degrees	164
	University degree	227
	University degree unfinished	72
	Community college diploma	154
	Community college unfinished	11
	High school diploma	66
	Partial high school	10
	Junior high school	2
	Less than 7 years of school	0
Income	$10,000 or less	21
	Between $10,000 and $20,000	45
	Between $20,000 and $30,000	61
	Between $30,000 and $40,000	87
	Between $40,000 and $50,000	81
	Between $50,000 and $60,000	127
	Between $60,000 and $70,000	76
	Between $70,000 and $80,000	90
	More than $80,000	119
Occupation (Recodings based on the General Social Survey, 1991)	1 - High management/professionals	85
	2 - Mid-management/semi-professionals	105
	3 - Skilled workers	345
	4 - Unskilled workers	168

Measures

(1) **Negative Life Events Checklist (Myers, Lindenthal, & Pepper, 1973; Appendix C)**. To measure negative life stress, Myers, Lindenthal, and Pepper's (1973) 28-item undesirable life events index was administered to subjects. To reduce confounding with the health outcome measures, four items were removed from the Checklist prior to data collection (i.e., serious physical illness, serious injury or accident, frequent minor illness, mental illness: see Nezu, Nezu, & Blissett, 1988 for an example of this procedure), leaving 24 items. To increase the saliency of the Checklist for some subject populations (e.g., graduate students), two additional items were added (i.e., other broken love relationships, serious illness of family member: see e.g., Dohrenwend, 1973). For each of the 26-items, subjects were requested to indicate if they had experienced the event within the past six months.[36] The test-retest correlation was in the expected direction and magnitude typical of life event scales for this length of recall (i.e., r = .41: see Paykel, 1987 and Zimmerman, 1983).

(2) **Perceived Physical Symptoms Inventory (Derogatis & Melisaratos, 1983; Appendix D)**. The 7-item Somatization subscale of the Brief Symptom Inventory was used to measure perceived physical symptoms. Each item was rated on a 5-point scale ranging from 0 = *Not distressed at all* to 4 = *Extremely distressed*. Subjects were requested to respond to each item based on the past week. All items are summed to give a total score.

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[36] A six month period was chosen given that a smaller interval would have dramatically reduced the variability of the events scores.

(3) **Chronic Conditions Checklist (Segovia, Edwards, & Bartlett, 1997; Appendix E)**. The 27-item Chronic Conditions Checklist measures various categories of morbidity ranging from asthma to cancer and heart disease. Subjects were requested to place a checkmark next to those conditions experienced during the past six months. A chronic condition was defined for subjects to mean a condition present for the past three months or more. One item was taken from a recent version of the scale (i.e., Segovia, Edwards, & Bartlett, 1997: Final Report) for comparison and exploratory purposes. In addition, the *mental illness* item was retained for comparison purposes in the descriptive analyses, but removed for the main analyses in order to provide a more valid measure of chronic physical conditions. Comparison of the 27-item with the 26-item measure revealed a correlation of .99.

(4) **Physician Utilization**. Two questions were developed to measure physician utilization (i.e., frequency/usage, care). The first question asked subjects to respond to the following item: *During the past 6 months, how many times did you see or talk to a medical doctor about your health? Do not include check-ups. If none, please write in "0."* Research also suggests that frequency measures of utilization have different correlates than actual usage (e.g., Manga, Broyles, & Angus, 1983). Therefore, to provide a measure of simple usage (i.e., yes/no), a frequency of one or higher was (were) coded as 1. The second question (i.e., third utilization variable) pertained to physician care. Subjects were asked the following question: *Are you currently under a doctors care? Please check (✓) either yes or no* (J. Lavery, Personal Communication, 1992).

(5) **Restriction of Daily/Normal Activities**. Based on Segovia, Bartlett, and Edwards (1989), Canada's Health Survey (Health and Welfare Canada/Statistics Canada, 1981), and research by the National Centre for Health Statistics (U.S. Department of Health and Human Services, 1979), two measures were developed to assess the extent of activity restriction due to illness. Subjects were asked: (1) *During the past 2 months, how many days did illness or injury keep you in bed for all or most of the day? If none, please write in "0;"* and (2) *During the past 2 months, how many days did illness or injury cause you to cut down on the things you usually do? If none, please write in "0."*

(6) **General Health (Segovia, Bartlett, & Edwards, 1989a)**. A 1-item self-rating of health question was used to assess general health status. General health has been related to physical and mental health (see e.g., Ware, Jr., 1986), as well as physician utilization (Segovia, Bartlett, & Edwards, 1989a). The one-item general health measure has been shown to be both valid and reliable (e.g., Idler & Benyami, 1997; Mackenbach, Van Den Bos, Joung, Van De Mheen, & Stronks, 1994). Subjects were requested to respond to the following item: *Would you say your health is, Excellent or Good or Fair or Poor.*

(7) **Five-Factor Model Adjective Checklist (McCrae & Costa, Jr., 1985; Appendix F)**. To measure each of the five factors, McCrae and Costa, Jr.'s, (1985) 80-item bipolar adjective checklist was used. Based on the results from a number of pilot tests, the checklist was reduced to 79-items (see Appendix B for pilot test results). One item (i.e., stupid/intelligent) was removed due to a high percentage of missing data found during pretesting. As the descriptive analyses will show, the openness to experience factor was still

highly reliable despite removal of this item. Subjects were requested to respond to each item on a nine-point scale ranging from 1 to 9. All items were presented in randomized order and approximately half were reverse scored. Research has shown the scales to be relatively stable over a 6-year period when correlated with the NEO-PI-R (rs = .6 to .69; see McCrae & Costa, Jr., 1989). To yield a total score for each of the factors, the reversed items are rescored and the items summed.

(8) **The Alameda Health Practices Index (AHPI: Berkman & Breslow, 1983: Appendix G)**. The five-category Alameda Health Practices Index was used to assess the number of health behaviours that subjects engage in. The index is comprised of five items that measure physical activity, one item to assess smoking history (i.e., cigarettes), two items to assess the Body Mass Index, six items to measure alcohol frequency and amount, and one item that assesses sleep time. The body mass index was calculated following the guidelines stipulated by Health and Welfare Canada (1988: see also Segovia, Edwards, & Bartlett, 1997). Each of the health practice categories were recoded with 0 = not a health practice or 1 = engages in health practice. Thus, a score of 0 or 1 was possible for each of the categories. Each of the categories are then summed to provide a total score ranging from 0 to 5. The five-item Alameda Health Practices Index has been shown to be moderately stable over a one-year period (Rakowski, 1987: Standardized Beta = .60).

(9) **The Positive and Negative Affect Schedule (PANAS: Watson, Clark, & Tellegen, 1988: Appendix H)**. To measure both positive and negative affect, the 20-item Positive and Negative Affect Schedule measure was used. Each scale, which is

comprised of 10-adjectives to describe mood, requires subjects to indicate the intensity of their affect over the *past few weeks*. In addition, subjects were to respond to each item on a five-point scale ranging from 1 = *Very slightly or not at all* to 5 = *Extremely*. Research by Watson, Clark, & Tellegen (1988) indicates that the Positive and Negative Affect Schedule is a reliable and valid measure of positive and negative affect.

(10) **Demographics Questionnaire (Appendix I)**. Data was also collected with respect to subject age, sex, marital status, level of education, occupation, and income.[37]

Procedure

(1) **Power Calculations**. In order to avoid a Type II error, an a priori power analysis was conducted. Standard approaches to power analysis require the determination of expected effect size, as well as a predetermined level of power (e.g., .80), and alpha (i.e., .05; see e.g., Judd, McClelland, & Culhane, 1995). However, with structural modelling, one must also consider the number of parameters (i.e., path coefficients, covariances, variances). Because of this, standard approaches represent only an approximation of the number of subjects needed for adequate power (e.g., .80). Unfortunately, with covariance structure modelling, it is difficult to perform such an analysis prior to data collection due in part to various statistical demands (Jaccard & Wan, 1996). It has only been within the past

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[37] Upon completion of data collection, it was discovered that the income measure had been partially misconstructed with overlapping categories. However, the effect appears to be minimal. Little change in the impact of income to life events was found when measurement error (i.e., 10%) was taken into account in an initial latent variable analysis.

five years that researchers have seriously examined this issue and developed valid methods for calculating power in structural modelling (see e.g., Kaplan, 1995; MacCallum, Browne, & Sugawara, 1996). Jaccard and Wan (1996) suggest using the standard approach as a preestimate, as was done in the present study. As a post hoc assessment of overall power, MacCallum, Browne, and Sugawara's (1996) approach to power analysis with covariance models will be used.

Using the GPOWER software program (Faul & Erdfelder, 1992) to calculate the required sample size for .8 power, with an effect size of .09, 21 predictors (i.e., maximum number of predictors in a model), and .05 alpha, it was determined that 255 subjects would be needed. Based on the prospective nature of the study, several other factors were considered. It was expected that 60% of the 255 subjects (i.e., n = 153) would respond at time 1 (see Jackson, 1995 for first wave estimates). To compensate for an expected 40% loss, the initial sample size of 255 was doubled (N = 510). It was further estimated that 50% would drop out at time 2. Exactly 255 subjects were added to compensate for this potential loss, leaving 765. To allow for cross-validation, this estimate was doubled to 1530. Because of other considerations (e.g., follow-up surveys, number of parameters, number of participating and additional organizations, and employees), 2300 questionnaires were printed. Because two organizations agreed to participate but failed to provide written consent, only 1994 surveys were administered during the first phase of study.[38]

[38] As just discussed, the initial sample size estimates were based on the standard approach to power calculation. At that time, it was initially decided to use the split-sample approach to cross-validation. The sample size estimates therefore took into account the required sample size needed for a second sample. However, to provide more accurate and stable

(2) **Study Sample**. The first sampling objective was to develop a preliminary sampling frame. Three approaches were used to define potential populations: (1) the Newfoundland and Labrador Yellow Pages; (2) discussions with faculty, peers, and friends; and (3) prior knowledge of the St. John's community. After approaching several organizations in the St. John's community, the following agencies and institutions agreed to participate: The Evening Telegram, the YMCA-YMCA, the Waterford Psychiatric Hospital nursing staff, the Canadian Red-Cross, the faculty, staff, and graduate students of Memorial University, the Government of Newfoundland and Labrador Department of Social Services, Her Majesty's Penetentiary correctional officers, Prince of Wales Collegiate/Mt. Pearl Senior/Mt. Pearl Jr./McDonald Elementary school teachers, the Bank of Nova Scotia, and the Canadian Armed Forces (i.e., Recruiting and Pleasantville base).[39] [40]

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parameter estimates, a decision was made to utilize the whole sample in the main analyses with the Expected Cross-Validation Index used as an estimate of expected cross-validation. As Browne (1999) points out, single-sample and two-sample validation approaches tend to give similar though not necessarily equivalent results.

[39] See Appendix J for letters of introduction.

[40] Several organizations were approached including, the Canadian Red Cross, the Government of Newfoundland and Labrador Treasury Board and Social Services, The Bank of Nova Scotia, the Royal Bank, the Canadian Armed Forces Recruiting and Pleasantville base, Newfoundland Power/Telephone/Hydro, Johnson's Insurance, the Royal Canadian Mounted Police, the Department of Justice, the Avalon/Roman Catholic/Seventh Day Adventist School Board, Newfoundland Association of Public Employees, the Newfoundland Teachers Association, the Evening Telegram, Avalon and Village Malls, Department of Faculty and Staff Labour Relations of Memorial University, the Assistant Dean of Graduate Studies, the YMCA-YWCA, the Waterford Psychiatric Hospital, the Grace Hospital, the Janeway Hospital, the Health Sciences Hospital, the Legal Aid Commission, and the St.John's Firefighters Association.

After permission was obtained from each of the organizations, data collection commenced on November 8, 1993. Approximately 1994 surveys were either sent out or dropped off at the organization from the second to third week of November 1993. A total of 858 surveys were returned for an overall return rate of 43%.[41 42]

The members of the Canadian Armed Forces Recruiting Centre were tested as a group in a separate, quiet room, adjacent to the main office. For the remaining populations, the surveys were either dropped off or mailed to the subjects. In addition, the Bank of Nova Scotia had distributed the surveys to at least one employee from each of their branches *across Newfoundland and Labrador*. Frequency of questionnaire pick-up was dependent on the availability of the Psychology Department vehicle. For the next few weeks, pick-up occurred on average, two to three times per week. Faculty, staff, and graduate student questionnaires were returned by interdepartmental mail. After approximately two weeks, a follow-up letter was delivered/mailed to each of the organizations (see Appendix K for a copy of an example follow-up letter).

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[41] Several steps were taken to increase participation (see e.g., Harvay, 1984). These strategies can be categorized based on the *personal nature of the survey* (e.g., appeal to human goals, hand-written signatures), the *salience of the survey* (e.g., incentive during wave 2, letter of permission from the Unions, stressing of health care issue), *confidentiality* (e.g., discarding of surveys), and *survey design* (e.g. logo, minimum number of pages, personal information last).

[42] To obtain an estimation of the first phase response rate, Goyder's prediction equation was used (see Jackson, 1995). Taking into account such variables as the year of field work, number of contacts, salience of the survey, incentives and population type, the percentage of people expected to respond was 55%. According to Jackson (1995), an acceptable response rate is to be within 20% of the predicted rate. Thus, the first phase was within the expected range.

In order to match the phase 1 with the phase 2 questionnaires, the subjects were requested to generate a code based on the two digits representing their month of birth, the two digits of the year of birth, and the number of digits in their mother's first name (see Appendix L). Subjects were also required to fill-out a consent form in order to participate (see Appendix M). Save the demographics sheet (i.e., last page), each of the questionnaires were randomly ordered. The single-item general health, physician utilization, and restriction of activity questions were kept together in order to enhance the appearance of the questionnaire.

Six months later, exactly 858 questionnaires were dropped off to each of the same organizations that participated at time 1. Of the questionnaires distributed at phase 2, 708 were returned (82 %). As in the first phase, the questionnaires were presented in random order. With the exception of the adjective checklist (i.e., big five measure) and the demographic sheet, the same questions administered to subjects at time 1 were readministered to each of the subjects at time 2.

OVERVIEW OF PLANNED STATISTICAL ANALYSES

The present study was guided by two objectives. The first objective was to determine if the five-factor model of personality could predict a range of health and health related variables. The second goal of the study was to assess how the five factors are related to such variables. To test the hypotheses, the following three sets of statistical analyses will be carried out.

Descriptive Analyses. To assess the psychometric properties of the data, several descriptive analyses will first be carried out. First, the means, standard deviations, as well as the frequencies for each of the variables will be computed for comparative purposes. Second, reliability statistics (i.e., alpha, test-retest) will be calculated to assess the degree to which a measure's stability and consistency may impact on subsequent analyses. To evaluate the degree to which the data for each variable maps onto a bell curve, an assessment of skewness and kurtosis will be undertaken. To reduce the impact of skewness and kurtosis in subsequent analyses, a number of data transformations may be conducted (e.g., assign less deviant scores to outlying cases). Because multiple regression and structural equation modelling are influenced by the degree of skewness and kurtosis, it is important to reduce the impact of potential outliers.

To provide for a more manageable data set, the next set of analyses will focus on reducing the number of health and health-related variables. In doing this, the data reduction method of Principle Components Analysis will be used. Based on the results, composite scores will be created for each of the resultant components. To determine if the health variables could be replicated during the second phase of the study, a second Principle Components Analysis will be conducted. As the secondary hypotheses predict, it is expected that the health and health related measures would be reduced to three to four components. In a similar vein, the six demographic and socioeconomic status variables (i.e., sex, age, marital status, income, education, and occupation) will be subject to the same data reduction method as the health variables. Based on the results of this analysis, one variable from each resultant component will be selected for inclusion into the multiple regression and structural equation modelling analyses that follow.

Once these latter analyses have been conducted, all of the variables will then be correlated. And last, to rule out subject attrition (i.e., mortality) as an alternative explanation for the findings, a series of t-tests will be conducted for each of the variables. This analysis will compare those who participated in both phases of the study to those who only participated in the first phase. Differences would indicate that mortality may be a threat to data interpretation.

Does Personality Influence Health Status? This section will set out to answer the question of whether personality can predict the scores of the health and health-related measures. In answering this question, several multiple regression analyses will be conducted with each of the health measures serving as the dependent or criterion variables. In general, four regression models will be tested. One model will examine the extent to which the five factors are predictive of health status. The second model will test whether several control variables (e.g., sex, time 1 health) in addition to the five factors, are related to the time 2 health variables. A third model will examine how the five factors in addition to their interactions (i.e., personality by personality) impact on health status. And last, the demographic, life events, and five factor variables, as well as their interactions will be related to health status.

The models will then be compared to determine which model explains most of the variance in each of the health variables. This set of analyses has implications for the variance versus theory debate. That is, if personality predicts health status without any statistical control variables, this would support the theory side of the debate. Conversely, support would be found for the variance side to the extent that the explained variance is maximized while minimizing or erasing any effects of personality on health status.

How is Personality Related to Health Status? The third set of analyses will attempt to answer the question of how personality is related to health. Structural equation modelling will be used in this section. Four process or theoretical models will be tested.[43] The resultant components from the health status data reduction analyses (i.e., descriptive analyses) will be used as the dependent measures. Along with these theory based models, there will be two nontheoretical baseline or comparative models, the saturated structural and the independence models. To reiterate, the saturated structural model is a model created by the researcher in which all of the variables are connected to each other by paths except for some of the predictors or independent variables. With the independence model,

[43] The phrase *theoretical model(s)* is used to simplify the discussion. The dichotomy proposed in the variance versus theory debate still stands.

none of the variables are assumed to be related to one another. This model is automatically created by the statistical software program (i.e., EQS).

To determine which is the most reliable model, several statistical tests will be conducted. First, a test of statistical power for each model will be conducted to determine if enough subjects were used to test the hypotheses. Second, tests of overall model fit or acceptance will be conducted. Given appropriate levels of model acceptance, the model is deemed to be acceptable for further analysis. Third, to determine if the theoretical model is more valid than either of the two nontheoretical models (i.e., saturated structural and independence models), a series of tests will be carried out to determine if they are statistically different. Support for the theoretical model would be found given a lack of statistical difference with the saturated model because it has fewer parameters, but a statistical difference with the independence model because the latter is extremely atheoretical.

To assess the degree to which one of the four theoretical models would replicate with a new sample of subjects, two tests will be conducted. First, a test of expected cross-validation (i.e., use of the Expected Cross-Validation Index) will be computed. The coefficients for each of the models will be compared. The model with the smallest cross-validation coefficient is expected to stand the best chance of replicating in an independent sample of the same size. The second method relies on the computer simulation method called bootstrapping. The end result of the bootstrap method will be an average estimate of several overall measures of model acceptance or fit. Thus, both the expected cross-validation and bootstrap tests provide a unique perspective on the extent to which the models would replicate or cross-validate.

The next part of the assessment will be to examine the path coefficients or beta weights (i.e., parameter estimates: see Introduction for paths 1 through 8). These estimates will be provided in diagram or figure form to simplify interpretation. A statistically significant path coefficient indicates that the predictor (e.g., personality) had an effect on the dependent variable (i.e., health status, health behaviour, life events). The next set of analyses will compare the total variance explained by each model. A statistical test (i.e., W-test) will be used to compare the amount of total variance explained by each model: four model comparisons will be made. In general, the model that explains most of the variance with more or fewer variables will be the preferred model. As in the second set of analyses (i.e., personality and the prediction of health status), these comparisons have direct implications for the variance versus theory debate.

Upto this point, the analyses have made use of personality by life event interactions or product-terms. Because of certain limitations with this method (e.g., multiple overlapping interactions), a second assessment technique called the *Subgrouping Method* will be used to assess for moderation effects.

The last set of analyses will examine the effects of combining the best control variable model with the best no control variable model. The purpose of these *Template Analyses* is to provide a further examination of the theory versus variance debate and to provide a basis for future research.

RESULTS 1: DESCRIPTIVE ANALYSES

Overview

Prior to testing the models, a psychometric assessment was conducted. In general, the variables were found to be reliable and within expected ranges. In comparison to a random sample of Newfoundland and Labrador residents, the subjects used in the present study were found to be relatively similar although on average were younger, more educated, and healthier in terms of general and physical health. Principle components analyses indicated that the 10 health status variables could be described by three correlated components, physician utilization (PU), restriction of activities (ROA), and general health (GH). A principle components analysis also revealed that the six demographic and socioeconomic status variables could be explained by three components. Based on this analysis, sex of subject, education, and income were chosen as time 1 control variables for subsequent regression and structural equation modelling analyses. Examination of the overall correlation matrix indicated that several of the hypothesized paths in Models 1-4 (see introduction) were supported. While replicating past research, the correlations provide new data linking the five-factor model to stress, health behaviours, and health outcome. Attrition analyses suggested that subjects who participated in only the first phase of data collection were less conscientious, had experienced more life events, and were more restricted in their activities.

Psychometric Analyses

(1) **Means, Standard Deviations, Reliability**. The data were analyzed using SPSS 7.5 and EQS 5.7 for Windows (C: Bentler. 1998). The means. standard deviations. and reliability coefficients (i.e.. Cronbach's alpha, test-retest) for each of the continuous and categorical variables as well as comparative data from the Newfoundland Adult Health Survey (Segovia. Edwards. & Bentler. 1997) can be found in Tables 5. 6. and 7.

As Table 5 points out. the reliability values were found to range from .17 to .89. Cronbach's alpha for openness to experience. conscientiousness. extraversion. agreeableness. and neuroticism ranged from .79 to .89. Alpha was calculated for several of the health variables. Both time 1 and time 2 positive and negative affect were in the high .80s while time 1 and time 2 physical symptom coefficients ranged from .72 to .74. respectively. Test-retest correlations were calculated for health behaviours. negative life events. general health. chronic conditions. physician utilization. and the two restriction of activity questions. In each case. save the days in bed questions. the reliability values were found to be in their expected ranges.[44]

As can be seen from Table 7. the study sample was found to be in many ways similar to the Adult Health Survey random sample. In general. the subjects in the present study were comprised of slightly more women. were on average younger. more educated. and healthier. These comparisons are based on percentages.

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[44] Given the nature of these latter *causative* as opposed to *effect* constructs (see Bollen. 1989). alpha was expected to be relatively low. Test-retest correlations were therefore calculated (see e.g.. Fergusson & Horwood. 1986).

Table 5

Means, standard deviations, and alpha values for each of the study variables

Variable	M	sd	Alpha/ Test-Retest
Openness to Experience	86.30	14.16	.79
Conscientiousness	160.54	19.65	.89
Extraversion	99.84	15.28	.83
Agreeableness	142.68	17.97	.85
Neuroticism	81.89	15.04	.84
Negative Life Events (T1)*	1.03	1.31	.41
Negative Life Events (T2)*	.96	1.17	
Health Behaviours (T1)*	3.57	1.02	.72
Health Behaviours (T2)*	3.58	.99	
Physical Symptoms (T1)	2.67	3.52	.72
Physical Symptoms (T2)	2.64	3.46	.74
Negative Affect (T1)	18.48	6.77	.87
Negative Affect (T2)	18.43	6.52	.87
Positive Affect (T1)	32.25	6.71	.87
Positive Affect (T2)	32.18	7.02	.89

(*table continues*)

General Health (T1)*	1.76	.62	.64
General Health (T2)	1.79	.65	
Chronic Conditions (T1: 28 items)*	1.55	1.46	.71
Chronic Conditions (T2: 28 items)	1.51	1.45	
Chronic Conditions (T1: 27 items)*	1.53	1.44	.69
Chronic Conditions (T2: 27 items)	1.49	1.44	
Physician Usage Frequency (T1)*	1.59	2.57	.39
Physician Usage Frequency (T2)	1.55	2.15	
Days in Bed due to Illness (T1)*	.68	1.73	.17
Days in Bed due to Illness (T2)	.83	1.89	
Cut down on Activities due to Illness (T1)*	2.09	4.93	.42
Cut down on Activities due to Illness (T2)	2.74	6.46	

Note. *Test-Retest correlation in place of alpha: Test-retest for physician care = .29 and for physician usage (yes/no) = .36. T1 = Wave 1 of data collection: T2 = Wave 2 of data collection: M = Mean: sd = Standard Deviation.

Table 6

Frequencies for each of the categorical physician usage and care variables

Variables	Category	Frequency
Physician Usage (T1)	0	305
	1	401
Physician Usage (T2)	0	286
	1	420
Physician Care (T1)	0	254
	1	452
Physician Care (T2)	0	171
	1	535

Note. T1 = Wave 1 of data collection: T2 = Wave 2 of data collection.

Table 7

Comparative data (Percentage) from the Adult Health Survey (Segovia et. al., 1997)

Variable	Present Study (N = 855)	Adult Health Survey (N = 12,194)
Sex		
Female:	56.7	53.5
Male:	43.3	46.5
Age		
Less than 20 years	.1	-
20-29 years	23.9	21.6
30-39 years	37.0	23.5
40-49 years	28.4	23.7
50-59 years	9.5	13.1
60-69 years	1.3	9.4
70 and over	.1	8.6
Education		
Less than high school	1.6	36.0
High school completed	9.8	19.1
Trades	22.0	25.0
Univ., no degree	11.5	10.0
Univ., with degree	55.0	10.0
Marital Status		
Married	65.0	65.8
Common law	6.0	6.7
Single	20.7	17.4
Widowed	.8	6.2
Separated	3.2	1.4
Divorced	3.9	2.6
Self-Assessed Health Status/ General Health (1-item)		
Excellent	33.0	21.5
Good	57.0	57.9
Fair	9.7	18.1
Poor	.4	2.5
Chronic Conditions		
None	29.4	27.2
1	29.5	26.0
2	17.4	18.9
3 +	23.7	28.0

The next step in the planned analyses is to examine the shape of the distributions for each variable. The question is, to what extent do the variables approximate a bell curve? Given a skewed or kurtotic distribution, can anything be done to normalize the data? Several strategies are discussed that may help to manage any undue bias in the data that may influence subsequent stages of analyses.

(2) **Assessment of Skewedness and Kurtosis**. Estimates of skewness and kurtosis, as well as the respective z-scores for each variable can be found in Table 8. As Table 8 indicates, all variables, save openness to experience were found to be skewed. However, given that z-scores are influenced by sample size (i.e., standard errors), the overall shape of the distribution was *eye-balled* as well (see Tabachnik & Fiddell, 1989). Examination of the distributions suggested that the departures from zero were minor in most cases. However, several variables were severely skewed.

Examination of Table 8 also revealed that, with the exception of time 1 and time 2 general health, education, time 2 chronic conditions, neuroticism, extraversion, time 1 and time 2 positive mood, time 1 health behaviours, and openness to experience, all variables were highly kurtotic. Once again, assessment of the overall shape of most of the distributions suggested only minor departures from normality; however, several of the variables were severely kurtotic.

(3) **Nonnormality and Structural Equation Modelling**. According to West, Finch, and Curran (1995), researchers must deal with nonnormal data sets prior to estimating model fit in path analysis or structural equation modelling. Several strategies are available

Table 8

Skewedness and kurtosis coefficients for each of the study variables

Variable	Skewness (z-score)	Kurtosis (z-score)
Openness to Experience	.15 (1.65)	-.07 (-.39)
Conscientiousness	-.79 (-8.59)	1.63 (8.87)
Extraversion	-.33 (-3.53)	.24 (1.29)
Agreeableness	-.52 (-5.68)	.74 (3.99)
Neuroticism	-.31 (-3.36)	.04 (.22)
Physician Utilization (T1)	5.46 (59.39)	53.03 (288.18)
Physician Utilization (T2)	3.15 (34.21)	16.39 (89.09)
Physician Usage (T1)	-.28 (-3.11)	-1.93 (-10.49)
Physician Usage (T2)	-.39 (-4.24)	-1.86 (-10.11)
Physician Care (T1)	-.59 (-6.41)	-1.66 (-9.22)

(table continues)

Physician Care (T2)	-1.21 (-13.15)	-.55 (-2.99)
Days in bed (T1)	10.19 (110.85)	160.84 (874.15)
Days in bed (T2)	3.69 (40.18)	17.15 (93.18)
Cut down on activities (T1)	6.10 (66.33)	45.32 (246.32)
Cut down on activities (T2)	5.69 (61.85)	37.42 (203.38)
General health (T1)	.27 (2.96)	-.23 (-1.24)
General health (T2)	.32 (3.49)	-.29 (-1.58)
Chronic (T1: 28-items)	1.00 (10.87)	.94 (5.11)
Chronic (T2: 28-items)	.96 (10.43)	.42 (2.28)
Chronic (T1: 27-items)	.95 (10.34)	.62 (3.39)
Chronic (T2: 27-items)	.95 (10.37)	.34 (1.83)
Perceived Symptoms (T1)	1.95 (21.23)	4.88 (26.50)
Perceived Symptoms (T2)	1.97 (21.41)	4.48 (24.32)

(*table continues*)

Positive Affect (T1)	-.43 (-4.72)	.11 (.57)
Positive Affect (T2)	-.24 (-2.61)	.15 (.79)
Negative Affect (T1)	1.11 (12.07)	.87 (4.73)
Negative Affect (T2)	1.15 (12.48)	1.09 (5.96)
Negative Events (T1)	1.86 (20.16)	5.16 (28.04)
Negative Events (T2)	1.45 (15.77)	2.35 (12.78)
Health Behaviours (T1)	-.45 (-4.91)	-.05 (-.27)
Health Behaviours (T2)	-.31 (-3.33)	-.45 (-2.42)

Note. The standard errors for both skewedness and kurtosis are .09 and .18, respectively.

to help manage skewness and kurtosis. One strategy is to remove the offending case(s) from the data file (Bentler. 1995). A second strategy is to change the score on the variable for the outlying case so that it is less deviant (Tabachnick & Fiddell. 1989). For instance. the outlier may be reassigned a score one unit larger than the next most extreme score. The benefit of this approach is that not all of the values in the distribution are transformed and that the reassigned score is still the most extreme score in the distribution. A similar. though more extreme and nonequivalent option is to transform each score in the distribution through. for instance. logarythmic or square root transformations.

A fourth option is to take into account the degree of nonnormality during the path analysis estimation process (Byrne. 1994). Two options are available. The first is to select an estimator that makes no distributional assumptions (e.g.. Arbitrary Generalized Least Squares: Browne. 1984). The second is to use a statistic that corrects for such distributional problems. Because the first option generally requires an extremely large sample size (e.g.. 5000). the latter approach is perhaps the most reasonable alternative for researchers.[45]

To deal with skewness and kurtosis. the present study implemented two of the previously discussed strategies. First. extreme scores on 6 variables (i.e.. time 1 and time 2 days in bed. activities. and physician usage frequency) were reassigned less deviant.

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[45] The eliptical method of estimation can also be used for assessing nonnormal distributions. specifically with shapes that are highly kurtotic. However. the eliptical approach requires scale equivalency. an unrealistic assumption with the present research (e.g.. see Bentler. 1995).

though still extreme values. This more conservative approach involves fewer interpretational problems than the more radical distributional transformation. And second. Bentler's (1995) Robust Maximum Likelihood estimation procedure will be used to provide corrected measures of fit and standard errors. The Robust procedure is useful when dealing with product-term interactions (Ping. 1994. 1995. 1996).

In summary. after examining the distributions. it was discovered that the scores of several variables did not approximate a bell shape curve. To remedy this. several variables were immediately reassigned less deviant scores in order to reduce their effect in subsequent regression and structural equation modelling analyses. A second method will be used during the structural equation modelling analyses (i.e.. a correction statistic). The next step in the planned analyses is to determine if both the health and health-related sets of variables. as well as the demographic and socioeconomic status variables could be reduced in number.

(4) **Principle Components Analysis of Health Measures**. To determine if the 10 health status measures could be reduced in number. the variables were subject to a Principle Components Analysis with Oblimin Rotation (i.e.. correlated rotation) using the factor analysis module in EQS (Bentler. 1995). Prior to analysis. the correlation matrix was analyzed to determine its suitability for components analysis.[46]

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[46] Principal components analysis was chosen over factor analysis given its usefulness in matters of data reduction (Fabrigar. Wegener. MacCallum. & Strahan. 1999) and exploratory analysis (Tabachnik & Fidell. 1989). An oblimin rotation was chosen over an orthogonal or *uncorrelated* rotation (e.g.. varimax) because it was expected that the health status and health related measures would be correlated. an argument based on both

Examination of the correlation matrix revealed that 9 of the 45 (20 %) correlations were above the standard .3 threshold (see Tachnick & Fiddell. 1989). The highest correlation was between physician utilization and physician usage ($\underline{r}$ = .54). Several other relationships were borderline to .3.[47]

Using a loading cutoff of .4. meaningfulness criterion, and simple structure assessment. initial extraction and subsequent rotation yielded three correlated and interpretable components, two of which partly supported the secondary hypotheses (see Gorsuch. 1983).[48 49 50 51]

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conceptual and empirical grounds (see e.g.. Fabrigar. Wegener. MacCallum. & Strahan. 1999 for a discussion on this issue).

[47] One issue that arises when using oblimin or correlated rotation is that the resultant components or factors are correlated. Given the correlations, the solution could also be subject to a higher-order principle components analysis. As will be shown, the solution indicated that the resultant components were modestly to moderately correlated. Assuming a higher-order analysis was undertaken, one component would be the likely result. While one component would simplify subsequent analyses, a higher-order analysis would be questionnable for several reasons. First, a correlated rotation does not automatically imply that a higher-order analysis needs to be done. The variables may be correlated but subjecting the components to further analysis may not make conceptual sense, especially if there is a reason to suspect a theoretical or causal relation amongst the first-order components (see Byrne. 1994 and Rainey. 1999 for examples). The question then becomes, what are we measuring in the one component especially when measures of health, illness and sick-role behaviours are combined? Furthermore, medical care research has tended to view such variables as physician utilization and perceived health as separate and causal (see e.g.. Andersen. 1995; Berki & Ashcroft. 1979; Rundall & Wheeler. 1979; Segovia. Bartlett. & Edwards. 1989; Tessler. Mechanic. & Dimond. 1976; Wan & Soifer. 1974; Wolinsky. 1978). Therefore, it was decided to analyze the resultant component(s) separately in subsequent analyses.

[48] To simplify the discussion, the terms component and factor will be used interchangeably. It is acknowledged that some researchers (e.g.. Fabrigar. Wegener. MacCallum. & Strahan. 1999) view principal components and exploratory factor analyses as separate methodologies.

Component 1 was comprised of physician utilization frequency, physician usage (i.e., yes/no), physician care, and chronic conditions. This component was labelled Physician Utilization (PU: see Table 9).

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[49] Cattell (1973) suggests that multiple methods be used when deciding on the number of components or factors to extract. This practice was adopted for the present study.

[50] Fabrigar, Wegener, MacCallum, and Strahan (1999) have pointed out that when selecting variables to include in an factor analysis or principle components analysis, 3-5 measured variables should be used for each construct or common factor. However, because the goal of the present study was to examine how the five factors are related to a wide range of variables, this suggestion was not realistic. Nonetheless, the component structure of the health measures was found to be conceptually clear and reliable. Not only were there three and four variables for two of the components (i.e., physician utilization, general health, save restriction of activities), the three-component structure was replicated across both waves of data collection despite some attrition (see later section on threats to internal validity). The replication will be discussed in a later section.

[51] Bargmann's Test (1955: cited in english translation by Kres, 1983: see also Cattell, 1973) was carried out in order to assess the degree of simple structure present in the pattern matrix. In general, Bargmann's Test sets out the required number of zero loadings (e.g., +- .10) per factor in a solution required for simple structure. For a component to be simple in structure, it must have a set number of zero loadings that did not occur by chance. According to Bargmann's Test tables, with a p-value of .05, each factor should have at least five zero loadings in the hyperplane (i.e., number of zero loadings in each factor or factors). With ten variables at three components, component one was found to have only three zero loadings (nonsignificant). Therefore, component one was not as clear as preferred, despite its interpretability. However, given that the first component is always general structurally (Kline, 1994), the lack of simple structure or low hyperplane count on component one would be expected. Note that other issues were considered when interpreting component one as physician utilization. First, each of the physician utilization variables had the highest loadings (i.e., > .4) on the component while the remaining variables had stronger loadings on the other components. And second, the variable to factor ratio was small. As Harman (1976) points out, the smaller the hyperplane count. Components 2 and 3 each had 5 ($p < .05$) and 6 ($p < .05$) zero loadings respectively; therefore, both appear to be simple in structure, statistically and conceptually.

Table 9

Principal components analysis for the wave 1 and 2 health status measures

Variables	Components 1	2	3	h^2	Eigenvalue
		Wave 1			
Physician Utilization	.43	.03	.36	1.00	3.13
Physician Usage	.49	.02	.16	1.00	1.35
Physician Care	-.49	.05	.05	1.00	1.06
Days in bed	-.06	-.03	.66	1.00	.89
Cut down on activity	.04	.04	.65	1.00	.86
General Health	.27	.47	.03	1.00	.71
Chronic Conditions	.41	.25	.09	1.00	.61
Perceived Symptoms	.25	.50	.04	1.00	.52
Negative Mood	.01	.59	.01	1.00	.51
Positive Mood	.15	-.54	.01	1.00	.36
Hyperplane Count*	3/10 = 3%	5/10=50%	6/10=60%		
		Wave 2			
Physician Utilization	**.55**	-.04	.33	1.00	3.29
Physician Usage	**.59**	-.08	.13	1.00	1.46
Physician Care	**-.61**	.03	-.01	1.00	1.11
Days in bed	-.05	.06	**.65**	1.00	.81
Cut down in activities	.11	.02	**.64**	1.00	.78
General Health	.26	**.48**	.11	1.00	.69
Chronic Conditions	**.49**	.27	-.09	1.00	.59
Perceived Symptoms	.29	**.49**	.02	1.00	.50
Negative Mood	-.02	**.60**	-.02	1.00	.49
Positive Mood	.14	**-.55**	-.08	1.00	.29
Hyperplane Count	2/10=20%	5/10=50%	5/10=50%		

Note. *A Hyperplane Count refers to the percentage of variables in a factor that have *essentially* zero loadings. Essentially is typically taken to mean plus or minus .10 for each of the loadings. Ideally, the higher the hyperplane count, the better the simple structure. However, the smaller the factor to variable ratio, the smaller the hyperplane count (Harman, 1976). The symbol h^2 is referred to as the communality. Eigenvalue refers to the variance accounted for by a specific component.

Specifically, component 1 accounted for 31% of the variance. Component 2 was found to be mixed and comprised of negative mood, positive mood, perceived physical symptoms, and general health. This component appears to reflect a general health composite comprised of both positive and negative facets of health (i.e., General Health). Exactly 14% of the variance was accounted for by this component structure. The days in bed and activity questions made up the third component, and was therefore labelled Restriction of Activities (see Segovia, Bartlett, & Edwards, 1989). Eleven percent of the variance was explained by this component. The total variance accounted for was 55%.

The inter-component correlations were found to be of modest size: physician utilization (Component 1) was correlated with general health (Component 2) with r = .27; physician utilization (i.e., Component 1) was correlated with restriction of activities (i.e., Component 3) with r = .44; and restriction of activities (i.e., Component 3) was correlated with general health (i.e., Component 2) with r = .34.[52] The component structure was also supported by the first-order correlations. Examination of the correlation matrix revealed that several of the variables were moderately related (e.g., r = .55 between physician utilization and usage; r = .42 between negative mood and symptoms; and r = .49 between days in bed and cut down on activities; See Table 11).

To determine if the component structure could be replicated at time 2, the same variables were subject to a principle components analysis.[53] The resulting solution was

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[52] The solution was replicated with Orthosim rotation.

[53] A confirmatory factor analysis with EQS was initially attempted with a measurement model consisting of three correlated factors. However, difficulties arose when estimating

virtually identical to the first analysis (Table 9), strongly suggesting that the wave one structure had been replicated: component 1 was comprised of physician utilization frequency, physician usage, physician care, and chronic conditions (i.e., Physician Utilization: 33% of the variance); component 2 was comprised of negative mood, positive mood, perceived physical symptoms, and general health (i.e., General Health: 15% of the variance); and component 3 was made up of both restriction questions (i.e., Restriction of Activities: 11% of the variance). Fifty-nine percent of the variance was explained. Physician utilization (i.e., component 1) was correlated with general health (i.e., component 2: $r = .27$) and restriction of activities (i.e., component 3: $r = .42$), while general health (i.e., component 2) was correlated with restriction of activities (i.e., component 3: i.e., $r = .25$).[54]

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model fit. While fit appeared to be adequate based on several overall fit measures, examination of the remaining output suggested problems with the estimation process. This analysis was therefore abandoned. However, Kline (1994) points out that where the nature of the factor structure is unknown, as was partially the case in the present study, a subjective interpretation of the output is sufficient. If the pattern of loadings are similar on the same factors, our confidence in these increases. This appears to be true in the replication.

[54] In terms of simple structure, the results were somewhat similar though not equivalent to the findings obtained from the time 1 analysis. While the loadings were of similar magnitude, components 1 and 3 had 1 fewer zero loading each (i.e., 2, 5, respectively). As in wave one, components 2 and 3 were found to be significant with 5 ($p < .05$) and 5 ($p < .05$) zero loadings in the hyperplanes, respectively. While component 1 could be interpreted, Bargmann's Test suggested that component one lacked simple structure. Only two zero loadings were found to be in the hyperplane (nonsignificant). Once again, the three physician utilization variables had the strongest loadings on component one while the remaining variables loaded more strongly on the other two components. Thus, while components two and three were found to possess simple structure in terms of Bargmann's criterion, the two component one's were still interpretable in light of a number of statistical and conceptual considerations (see previous discussion).

Each of the 10 variables, across both waves, were standardized and then summed to form three composite health status indicators.[55] These composites were used in the regression and model testing analyses.

(5) **Principle Components Analysis of Demographic and Socioeconomic Status Variables.** To increase power and to provide for a manageable data set in the main analyses, the six demographic and socioeconomic status variables (i.e., sex, age, education, income, occupation, marital status) were subject to a principle components analysis with oblimin rotation. Examination of the output indicated that a two-component solution described the data. However, close examination of the eigenvalues with the criterion of 1 for component cut-off (eigenvalue for sex = .997), suggested that a 3-component solution was a better model (see Table 10).[56] The three-component model was therefore rotated to solution. As can be seen from Table 10, income, marital status, and age had the highest loadings on component 1 (variance = 31%). Component 2 was comprised of education and occupation (variance = 24%) while component 3 was described solely by sex of subject (variance = 17%). Component 1 was correlated with component 2 with r = -.12 and component 3 with r = .10. Component 2 was uncorrelated

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[55] Prior to standardizing the variables, positive affect was reversed scored by multiplying each data point by -1.

[56] Cattell (1973; see also Child, 1973; Fabigar, Wegener, MacCallum, & Strhan, 1999) has pointed out that Kaiser's criterion of 1 tends to be conservative when the number of variables is less than 20; thus, several criteria were used in selecting the number of components to extract.

with component 3 ($r = .01$). In selecting controls for the path analysis, the variables with the highest loading on each component were chosen (i.e., income, education, and sex).[57] [58] At the outset of this dissertation it was hypothesized that several of the health measures could be reduced to three to four components. Overall, the results provided partial support in finding three correlated components termed physician utilization, restriction of activities, and general health. All three variables will be used in the multiple regression and structural equation modelling analyses that follow. The demographic and socioeconomic status variables were reduced in number as well. The variables were reduced to three components in which sex of subject, income, and education were selected for subsequent multivariate analyses.

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[57] An empirical approach to variable selection was chosen given that each of the demographic and socioeconomic status variables appear to have distinct correlates (Abramson, Gofin, Habib, Pridan, & Gofin, 1982). Instead of *blindly* regressing each of the dependent variables in the path analyses on each of the demographics, several relationships were hypothesized: time 2 health was regressed on sex of subject; time 2 events was regressed on income; and time 2 health behaviours were regressed on education. The demographic and socioeconomic variables were allowed to covary with each other. In addition, *sex* was allowed to covary with time 1 health status, neuroticism, and agreeableness; *income* was allowed to covary with time 1 events and neuroticism and *education* was allowed to covary with time 1 health behaviours, openness to experience, and conscientiousness (see MacCallum, 1995). In addition, because the solution in part depends on the number of parameters estimated, it was necessary to keep the number of parameters to a reasonable number. As a general rule of thumb with structural equation modelling, there should be 5-10 subjects per parameter (Bentler & Chou, 1987).

[58] The purpose of the components analysis for the health indicators was to reduce the variables (i.e., data reduction; see Fabrigar, et. al., 1999) to an interpretable number of components. For the demographic and socioeconomic status data, the objective was to reduce the number of variables for selection and subsequent multivariate analyses. Therefore, Bargmann's test of simple structure was not necessary in this latter analysis.

Table 10

<u>Principle components analyses for the demographic and socioeconomic variables</u>

	Components				
Variables	1	2	3	h^2	Eigenvalue
Sex	-.00	.01	**-.66**	1.00	1.87
Age	**.60**	.01	.02	1.00	1.44
Education	.05	**.69**	.01	1.00	.99
Income	**.66**	-.19	-.05	1.00	.71
Occupation	.05	**-.66**	.03	1.00	.54
Marital Status	**.64**	.12	.02	1.00	.44

Note. Thirty-one percent of the variance was accounted for by the first component, 24% by the second, and 17% by the third, for a total of 72%.

A correlational analysis will now be conducted on all of the study variables. The correlational analyses allows for a preliminary assessment of the parameter hypotheses.

(6) **First-order Correlations**. First-order Pearson correlations for all study variables were next computed (see Table 11). [59] As seen from Table 11, several of the correlations provide initial support for several of the primary hypotheses. For example, each of the time 1 variables were more strongly related to their time 2 counterparts (e.g., time 1 health behaviour to time 2 health behaviours) than were the remaining nonautoregressive variables (e.g., conscientiousness, openness to experience). While of modest size, time 1 and time 2 life events were found to be related to time 1 and time 2 health practice scores. As expected, neuroticism, but not openness to experience was related to time 1 and time 2 life events. Openness to experience was correlated with time 1 but not time 2 health behaviours. As expected, conscientiousness was correlated with time 1 and time 2 health behaviours. In addition, several of the five factors (e.g., conscientiousness, agreeableness, neuroticism) were negatively related to a number of stress, well-being, general health and physical health variables (e.g., chronic conditions, physical symptoms, general health). The five factors were also correlated with time 1 and time 2 General Health (composite) but not the two objective measures, time 1 and time 2 Restriction of Activities and Physician Utilization. The one exception was neuroticism. Neuroticism was also found to be correlated with time 1 and time 2 Physician Utilization and time 1 Restriction of Activities.

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[59] The correlations were based on the corrected data set in order to facilitate interpretation of the regressions that follow.

Table 11

First-order Pearson correlations for all study variables

Variables	Sex	Age	MS	Ed	Inc	Occ
Sex	-					
Age	-.06	-				
Marital Status	.07	-.19	-			
Education	-.00	-.01	.09	-		
Income	-.01	.43	.45	-.19	-	
Occupation	-.03	.06	.03	-.47	.21	-
Negative Life Events (T1)	.00	-.15	-.12	.05	-.16	-.06
Negative Life Events (T2)	.02	-.12	-.10	.01	-.18	-.07
Health Behaviours (T1)	.05	-.02	.04	-.21	.06	.09
Health Behaviours (T2)	.08	-.04	.02	-.19	.04	.04
Openness to Experience	-.11	-.08	-.06	-.29	-.01	.19
Conscientiousness	.06	.09	.07	-.13	.15	.07
Extraversion	.08	-.09	.08	-.00	.04	.02
Agreeableness	.11	.06	.06	-.00	.05	-.04
Neuroticism	-.11	.16	.12	-.06	.17	.06
Physician Utilization (T1)	.08	-.02	-.03	.02	-.05	-.04
Physician Utilization (T2)	.13	.01	-.02	-.02	.01	-.03
Physician Usage (T1)	.16	-.02	-.01	.01	.01	.04
Physician Usage (T2)	.14	.06	.02	-.05	.09	.03
Physician Care (T1)	-.09	-.04	-.05	-.09	-.06	.05
Physician Care (T2)	-.09	-.14	-.02	-.02	-.02	.00
Chronic (T1: 27-items)	.22	.09	-.06	-.01	-.05	-.01
Chronic (T2: 27-items)	.23	.07	-.01	-.01	-.00	-.02
Chronic (T1: 28-items)	.22	.09	-.07	-.00	-.05	-.01
Chronic (T2: 28-items)	.23	.08	-.01	-.00	-.01	-.02
Days in Bed (T1)	.12	-.04	-.03	-.00	-.07	-.01
Days in Bed (T2)	.08	-.05	-.03	-.06	-.05	.03
Cut Down on Activities (T1)	.03	-.08	-.13	-.00	-.11	.02
Cut Down on Activities (T2)	.01	-.03	-.07	-.03	-.04	-.02
Perceived Symptoms (T1)	.16	-.16	-.07	.06	-.12	-.05
Perceived Symptoms (T2)	.15	-.07	-.06	.02	-.12	-.04

(table continues)

General Health (T1)	.03	-.05	-.03	.08	-.13	-.04
General Health (T2)	.03	-.05	-.01	.08	-.12	-.01
Positive Affect (T1)	-.05	.05	.04	-.09	.11	.04
Positive Affect (T2)	-.08	.05	.06	-.09	.13	.08
Negative Affect (T1)	.09	-.13	-.11	-.02	-.09	.02
Negative Affect (T1)	.01	-.12	-.09	-.03	-.09	.01
Physician Utilization (T1: C)	.20	.03	-.02	.04	-.01	-.02
Physician Utilization (T2: C)	.20	.09	.01	-.02	.05	-.01
General Health (T1: C)	.12	-.14	-.09	.09	-.17	-.04
General Health (T2: C)	.09	-.10	-.08	.06	-.17	-.04
Restriction (T1: C)	.08	-.07	-.09	-.01	-.11	.01
Restriction (T1: C)	.05	-.05	-.06	-.05	-.05	.01

	LE (T1)	**LE (T2)**	**HB(T1)**	**HB(T2)**	**Open**	**Con**
Sex						
Age						
Marital Status						
Education						
Income						
Occupation						
Negative Life Events (T1)	-					
Negative Life Events (T2)	.41	-				
Health Behaviours (T1)	-.15	-.09	-			
Health Behaviours (T2)	-.11	-.08	.72	-		
Openness to Experience	.06	-.01	.10	.06	-	
Conscientiousness	-.09	-.14	.18	.14	.28	-
Extraversion	-.02	-.09	.07	.03	.38	.47
Agreeableness	-.11	-.15	.11	.09	.08	.56
Neuroticism	-.17	-.17	.17	.12	.22	.49
Physician Utilization (T1)	.11	.14	-.14	-.09	-.02	-.04
Physician Utilization (T2)	.11	.09	-.11	-.12	-.03	-.03
Physician Usage (T1)	.13	.07	-.09	-.07	-.06	-.06
Physician Usage (T2)	.05	.07	-.04	-.01	-.01	-.01
Physician Care (T1)	-.07	-.01	.14	.05	.10	-.02
Physician Care (T2)	-.03	-.02	.14	.07	.04	.04
Chronic (T1: 27-items)	.26	.26	-.18	-.12	.02	-.07
Chronic (T2: 27-items)	.15	.22	-.06	-.05	-.03	-.08
Chronic (T1: 28-items)	.26	.27	-.17	-.11	.02	-.08
Chronic (T2: 28-items)	.16	.22	-.06	-.05	-.03	-.09
Days in Bed (T1)	.19	.11	-.07	-.00	-.01	-.01
Days in Bed (T2)	.09	.08	-.03	.01	.02	-.02

(*table continues*)

Cut Down on Activities (T1)	.16	.10	-.12	-.14	-.01	-.09
Cut Down on Activities (T2)	.12	.06	-.07	-.09	-.00	-.04
Perceived Symptoms (T1)	.29	.23	-.15	-.10	-.06	-.13
Perceived Symptoms (T2)	.18	.24	-.17	-.15	-.05	-.14
General Health (T1)	.21	.14	-.28	-.24	-.11	-.27
General Health (T2)	.15	.14	-.21	-.19	-.09	-.24
Positive Affect (T1)	-.07	-.07	.18	.12	.32	.36
Positive Affect (T2)	-.02	-.16	.13	.09	.29	.28
Negative Affect (T1)	.31	.26	-.17	-.09	-.10	-.23
Negative Affect (T2)	.21	.35	-.10	-.11	-.08	-.24
Physician Utilization (T1: C)	.21	.17	-.20	-.12	-.06	-.06
Physician Utilization (T2: C)	.12	.14	-.12	-.09	-.04	-.05
General Health (T1: C)	.32	.25	-.28	-.20	-.21	-.36
General Health (T2: C)	.19	.32	-.22	-.19	-.19	-.32
Restriction (T1: C)	.20	.12	-.11	-.08	-.01	-.06
Restriction (T2: C)	.12	.08	-.06	-.05	-.01	-.04

	Ext	Agree	Neur	DrF(t1)	DrF(t2)	DrU(t1)
Sex						
Age						
Marital Status						
Education						
Income						
Occupation						
Negative Life Events (T1)						
Negative Life Events (T2)						
Health Behaviours (T1)						
Health Behaviours (T2)						
Openness to Experience						
Conscientiousness						
Extraversion	-					
Agreeableness	.51	-				
Neuroticism	.38	.53	-			
Physician Utilization (T1)	.01	-.01	-.12	-		
Physician Utilization (T2)	.01	-.03	-.11	.39	-	
Physician Usage (T1)	.02	-.04	-.12	.54	.32	-
Physician Usage (T2)	.02	-.01	-.09	.29	.59	.36
Physician Care (T1)	-.01	-.02	.08	-.21	-.13	-.16
Physician Care (T2)	.01	.01	.07	-.25	-.44	-.23
Chronic (T1: 27-items)	-.06	-.02	-.21	.33	.29	.29
Chronic (T2: 27-items)	-.04	-.01	-.18	.28	.28	.24
Chronic (T1: 28-items)	-.07	-.08	-.23	.34	.31	.29

(table continues)

Chronic (T2: 28-items)	-.05	-.01	-.19	.29	.29	.24
Days in Bed (T1)	.01	.08	-.04	.27	.19	.19
Days in Bed (T2)	-.05	-.01	-.06	.11	.29	.09
Cut Down on Activities (T1)	-.04	-.04	-.09	.47	.42	.22
Cut Down on Activities (T2)	-.03	-.04	-.02	.16	.52	.14
Perceived Symptoms (T1)	-.10	-.13	-.35	.31	.28	.25
Perceived Symptoms (T2)	-.09	-.09	-.32	.19	.31	.21
General Health (T1)	-.18	-.13	-.32	.29	.20	.26
General Health (T2)	-.19	-.15	-.32	.27	.32	.23
Positive Affect (T1)	.41	.19	.36	-.07	-.10	-.07
Positive Affect (T2)	.33	.15	.29	-.02	-.07	-.01
Negative Affect (T1)	-.26	-.28	-.57	.15	.12	.11
Negative Affect (T1)	-.19	-.24	-.41	.07	.12	.06
Physician Utilization (T1: C)	-.01	-.04	-.19	.76	.42	.73
Physician Utilization (T2: C)	-.01	-.02	-.15	.42	.79	.39
General Health (T1: C)	-.34	-.26	-.58	.29	.25	.25
General Health (T2: C)	-.29	-.23	-.48	.19	.29	.18
Restriction (T1: C)	-.02	.02	-.08	.43	.35	.24
Restriction (T2: C)	-.05	-.03	-.05	.16	.47	.14

	DrU(T2)	**DrC(T1)**	**DrC(T2)**	**Ch27(t1)**	**Ch27(2)**	**Ch28(t1)**
Sex						
Age						
Marital Status						
Education						
Income						
Occupation						
Negative Life Events (T1)						
Negative Life Events (T2)						
Health Behaviours (T1)						
Health Behaviours (T2)						
Openness to Experience						
Conscientiousness						
Extraversion						
Agreeableness						
Neuroticism						
Physician Utilization (T1)						
Physician Utilization (T2)						
Physician Usage (T1)						
Physician Usage (T2)	-					
Physician Care (T1)	-.09	-				

(*table continues*)

Physician Care (T2)	-.29	.29	-			
Chronic (T1: 27-items)	.25	-.20	-.28	-		
Chronic (T2: 27-items)	.29	-.19	-.30	.69	-	
Chronic (T1: 28-items)	.25	-.21	-.28	.99	.69	-
Chronic (T2: 28-items)	.29	-.19	-.30	.69	.99	.71
Days in Bed (T1)	.12	-.12	-.18	.22	.19	.22
Days in Bed (T2)	.21	-.04	-.12	.19	.18	.19
Cut Down on Activities (T1)	.17	-.12	-.22	.24	.17	.25
Cut Down on Activities (T2)	.23	-.02	-.26	.18	.17	.19
Perceived Symptoms (T1)	.21	-.14	-.19	.37	.28	.38
Perceived Symptoms (T2)	.22	-.13	-.22	.39	.38	.39
General Health (T1)	.13	-.18	-.20	.36	.31	.37
General Health (T2)	.22	-.18	-.29	.34	.33	.35
Positive Affect (T1)	-.09	-.00	.07	-.06	-.09	-.07
Positive Affect (T2)	-.04	.03	.03	-.07	-.11	-.08
Negative Affect (T1)	.11	-.03	-.06	.23	.15	.25
Negative Affect (T2)	.08	-.03	-.03	.21	.19	.22
Physician Utilization (T1: C)	.36	-.58	-.38	.67	.52	.67
Physician Utilization (T2: C)	.75	-.24	-.70	.53	.65	.53
General Health (T1: C)	.19	-.13	-.19	.37	.30	.39
General Health (T2: C)	.19	-.13	-.21	.36	.36	.38
Restriction (T1: C)	.17	-.14	-.23	.27	.21	.27
Restriction (T2: C)	.25	-.04	-.21	.21	.20	.21

	Ch28(t2)	**Bed(t1)**	**Bed(t2)**	**Cut(t1)**	**Cut(t2)**	**Sym(1)**
Sex						
Age						
Marital Status						
Education						
Income						
Occupation						
Negative Life Events (T1)						
Negative Life Events (T2)						
Health Behaviours (T1)						
Health Behaviours (T2)						
Openness to Experience						
Conscientiousness						
Extraversion						
Agreeableness						
Neuroticism						
Physician Utilization (T1)						
Physician Utilization (T2)						

(table continues)

Physician Usage (T1)						
Physician Usage (T2)						
Physician Care (T1)						
Physician Care (T2)						
Chronic (T1: 27-items)						
Chronic (T2: 27-items)						
Chronic (T1: 28-items)						
Chronic (T2: 28-items)	-					
Days in Bed (T1)	.19	-				
Days in Bed (T2)	.19	.17	-			
Cut Down on Activities (T1)	.17	.49	.19	-		
Cut Down on Activities (T2)	.17	.11	.50	.42	-	
Perceived Symptoms (T1)	.29	.16	.17	.25	.19	-
Perceived Symptoms (T2)	.38	.14	.21	.18	.22	.52
General Health (T1)	.32	.14	.17	.26	.16	.39
General Health (T2)	.34	.15	.22	.28	.30	.34
Positive Affect (T1)	-.10	-.06	-.09	-.09	-.09	-.19
Positive Affect (T2)	-.12	-.01	-.11	-.04	-.10	-.15
Negative Affect (T1)	.16	.11	.13	.17	.09	.42
Negative Affect (T2)	.20	.08	.11	.07	.11	.24
Physician Utilization (T1: C)	.52	.29	.16	.39	.18	.39
Physician Utilization (T2: C)	.65	.23	.28	.34	.41	.33
General Health (T1: C)	.32	.17	.21	.28	.19	.73
General Health (T2: C)	.37	.13	.23	.20	.26	.45
Restriction (T1: C)	.21	.86	.21	.86	.31	.24
Restriction (T2: C)	.20	.16	.87	.34	.87	.21

	Sym(t2)	GH(t1)	GH(t2)	Pmd(t1)	Pmd(2)	Nmd(1)
Sex						
Age						
Marital Status						
Education						
Income						
Occupation						
Negative Life Events (T1)						
Negative Life Events (T2)						
Health Behaviours (T1)						
Health Behaviours (T2)						
Openness to Experience						
Conscientiousness						
Extraversion						

(table continues)

Agreeableness						
Neuroticism						
Physician Utilization (T1)						
Physician Utilization (T2)						
Physician Usage (T1)						
Physician Usage (T2)						
Physician Care (T1)						
Physician Care (T2)						
Chronic (T1: 27-items)						
Chronic (T2: 27-items)						
Chronic (T1: 28-items)						
Chronic (T2: 28-items)						
Days in Bed (T1)						
Days in Bed (T2)						
Cut Down on Activities (T1)						
Cut Down on Activities (T2)						
Perceived Symptoms (T1)						
Perceived Symptoms (T2)	-					
General Health (T1)	.38	-				
General Health (T2)	.46	.64	-			
Positive Affect (T1)	-.17	-.29	-.29	-		
Positive Affect (T2)	-.20	-.21	-.31	.57	-	
Negative Affect (T1)	.29	.26	.26	-.25	-.16	-
Negative Affect (T1)	.37	.19	.30	-.18	-.28	.48
Physician Utilization (T1: C)	.34	.39	.37	-.07	-.05	.19
Physician Utilization (T2: C)	.38	.29	.40	-.12	-.09	.15
General Health (T1: C)	.49	.71	.56	-.63	-.39	.70
General Health (T2: C)	.72	.51	.74	-.43	-.64	.43
Restriction (T1: C)	.18	.23	.25	-.09	-.03	.16
Restriction (T1: C)	.25	.19	.30	-.11	-.12	.13

	Nmd(t2)	**PU(t1)**	**PU(t2)**	**GHC(1)**	**GHC(2)**	**Res(t2)**
Sex						
Age						
Marital Status						
Education						
Income						
Occupation						
Negative Life Events (T1)						
Negative Life Events (T2)						
Health Behaviours (T1)						
Health Behaviours (T2)						

(*table continues*)

Openness to Experience						
Conscientiousness						
Extraversion						
Agreeableness						
Neuroticism						
Physician Utilization (T1)						
Physician Utilization (T2)						
Physician Usage (T1)						
Physician Usage (T2)						
Physician Care (T1)						
Physician Care (T2)						
Chronic (T1: 27-items)						
Chronic (T2: 27-items)						
Chronic (T1: 28-items)						
Chronic (T2: 28-items)						
Days in Bed (T1)						
Days in Bed (T2)						
Cut Down on Activities (T1)						
Cut Down on Activities (T2)						
Perceived Symptoms (T1)						
Perceived Symptoms (T2)						
General Health (T1)						
General Health (T2)						
Positive Affect (T1)						
Positive Affect (T2)						
Negative Affect (T1)						
Negative Affect (T2)	-					
Physician Utilization (T1: C)	-.05	-				
Physician Utilization (T2: C)	-.09	.58	-			
General Health (T1: C)	-.39	.38	.38	-		
General Health (T2: C)	-.64	.32	.36	.66	-	
Restriction (T1: C)	-.03	.39	.19	.26	.19	-
Restriction (T1: C)	-.12	.19	.28	.23	.28	.29

Note. t1 = Time 1; t2 = Time 2; Ed = Education; Inc = Income; Occ = Occupation; LE = Negative Life Events; HB = Health Behaviours; Open = Openness; Con = Conscientiousness; Ext = Extraversion; Agree = Agreeableness; Neur = Neuroticism; DrF = Physician Utilization Freq.; DrU = Physician Usage; DrC = Physician Care; Ch27 = Chronic Conditions (27 items); Ch28 = Chronic Conditions (28 items); Bed = Days in Bed item; Cut = Cut Down on Activities item; Sym = Symptoms; GH = 1-item General Health; Pmd = Positive Mood; Nmd = Negative Mood; PU = Physician Utilization composite; GHC = General Health composite; Res = Restriction of Activities composite.

Note. Correlations greater than .08, $p < .05$ and .1, $p < .01$.

These findings contradict and extend previous research on the health related correlates of the five-factor model. Interestingly, while not incorporated into any of the models, conscientiousness and agreeableness were also found, along with neuroticism, to be correlated with negative life events.[60]

Taken together, the correlational analyses provide preliminary support for several of the primary hypotheses. The last part of the descriptive analyses will be to examine subject attrition (i.e., mortality) as a potential alternative explanation for these results as well as for those that follow.

(7) **Threat to Validity: Mortality.** According to Cook & Campbell (1979), researchers need to consider several alternative hypotheses when examining the validity of their research design and findings. One threat to internal validity that is specific to the prospective design, is *Mortality*. In general, mortality occurs when subjects leave or drop out of a study, thereby affecting the variation of the variables in question. Instead of attributing the effects to the independent varibles, the findings may be due to the attenuated range of scores.

To examine this alternative hypothesis, the time 1 scores for those who participated in both waves of data collection were compared to the time 1 scores of those who

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[60] The data suggests that the women in the sample differed from the men on several of the variables (e.g., chronic conditions: see Table 11). Given concerns with statistical power (i.e., number of subjects per parameter: see Bentler & Chou, 1987), the total sample will be analyzed in the regressions and model testing analyses.

participated in the first wave, for each study variable (i.e., time 1 life events, time 1 health behaviours). A series of independent t-tests indicated that scores from three variables differed among the two groups. *Time 1 life events* [(mean for n of 149 = 1.28 vs. 1.03 for n of 706), $t(853) = -2.2.08$, $p = .038$)], *time 1 restriction of activities* [(mean for n of 149 = .2934 vs. -.06 for n of 706), $t(853) = -2.293$, $p = .046$)], and *concientiousness* [(mean for n of 149 = 156.56 vs. 160.54 for n of 706), $t(853) = 2.24$, $p = .026$)] differed across the two groups. Although the differences were small, the data suggests that individuals who dropped out of the study were less conscientious, experienced greater life stress, and had greater restricted activity levels. This issue will be addressed in more detail in the discussion section.

Final Summary

The data were subject to several descriptive analyses including an assessment of the data distributions and how to manage any skewed and kurtotic data. Principle components analysis for both the health and demographic/socioeconomic status variables, a correlational analysis, and an assessment of subject mortality were also conducted.

The analyses indicated that the scores of the variables were in the expected ranges and when compared to a random sample of Newfoundland and Labrador residents, were found to be comprised of more women than men, were younger, more highly educated, and in better health. The variables were also found to be reliable. Several scores on a

The health and health-related variables, as well as the demographic and socioeconomic status variables were reduced in number through the data reduction method of Principle Components Analysis. The results suggested that the 10 health variables could be reduced to three components or composite variables named physician utilization, restriction of activities, and general health. These findings provide partial support for the secondary hypotheses. Similarly, the demographic and socioeconomic status variables were reduced in number through the same data reduction method as the health and health-related measures. The analysis yielded three components of which one variable from each was selected for further multivariate analyses (i.e., sex of subject, income, education).

All of the study variables were then correlated. The correlations provided partial and preliminary support for the primary hypotheses. The last part of the planned descriptive analyses called for an assessment of the mortality threat to internal validity. The results indicated that subjects who dropped out were less conscientious, had experienced more negative life events, and were more restricted in their activities due to health concerns.

The second part of the planned analyses calls for an examination of the personality to health status connection. To examine this question, a series of multiple regression analyses will be run. Four models will be assessed and compared to each other. The three health status variables, as well as the variables comprising each of the composites will serve as the dependent or criterion variables. This section provides a more stringent test of the personality to health relationship in that the interrelationships amongst the predictors are taken into account.

RESULTS 2: NON-PROCESS MODELS

Does Personality Predict Health Status?

Overview

Multiple regression analyses were conducted to assess the degree to which the five factors as well as 10 higher-order two-way personality by personality interactions, would predict scores on each of the health status measures. Four sets of multiple regressions were conducted on each health status and health-related variable, followed by a series of F-test model comparisons. The results indicated that (1) personality, as assessed by the five-factors appear to operate independently as opposed to interactively, in relation to health status, (2) personality appears to be more related to subjective measures of well-being as opposed to the more objective measures of health status (e.g., chronic conditions): and (3) the relationship between personality and the health status variables appears to vary depending on whether other personality and control variables are accounted for. Neuroticism was the most robust predictor of the five factors. Specifically, it was found that with each criterion, the Full Direct Effects Model was more parsimonious than the Full Interaction Model and accounted for a significantly greater share of the variance than either Restricted Direct Effects or Restricted Interaction Models (i.e., control variables excluded).[61]

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[61] As will be shown, personality appears to be more related to some measures of health status than others. However, this does not preclude assessment of personality by life event interaction terms given that moderation can be ordinal as well as disordinal in nature (see e.g., Kerlinger & Pedhazur, 1973). Therefore, despite a number of nonsignificant effects in the regression analyses, personality by stress interactions were still conducted in the model testing analyses.

Multiple Regressions and Comparison of Direct Effects Models

Sex of subject, time 1 health status, and time 1 life events served as the control variables. To be consistent with the structural equation model testing analyses, the time 1 health behaviour variable was not included because it was predicted that only the time 2 health behaviour variable would impact on health status given that it was assessed at the same time. None of the remaining demographic and socioeconomic variables (i.e., education, income) were included as it was predicted that sex of subject would be the only variable related to health status. The remaining variables were hypothesized to have indirect effects on health status through health behaviours and life events, and were therefore excluded.

In analyzing the data, the following steps were taken: first, health status will be regressed on each of the five-factors (i.e., Restricted Direct Effects). Second, health status will be regressed on each of the five factors plus the control variables (i.e., Full Direct Effects Model). Third, health status will be regressed on the five factors plus the 10 product term interactions (i.e., Restricted Interaction Model). And last, health status will be regressed on the three control variables followed by the five factor variables, and the 10 interaction terms (i.e., Full Interaction Model).[62] In the latter case, comparisons will be made between the restricted direct effects model and the full direct effects model.

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[62] A useful distinction between main effects used within the context of interaction terms and main effects tested in isolation is that in the former, the main effects are conditional upon the interactions. As such, the *simple conditional main effects* only approximate the main effects tests tested in isolation of any interactions (Aiken & West, 1991).

between the restricted interaction model and the full interaction model, between the full direct effects model and the full interaction model, and last, between the restricted direct effects model and the restricted interaction model. In each comparison, an *omnibus* F-test will be computed that compares the multiple R-Squared (R^2) for each model: a significant F-test indicates that the two models are significantly different and the model that accounts for the most variance is the preferred model. A nonsignificant F-test indicates that the models are not statistically different. Based on the principle of parsimony, the model with the fewest parameters is the preferred model (see e.g., Epstein, 1984).

The results will be presented in the following order. *First*, the Restriction of Activities (ROA) composite factor along with each of the variables that comprise it (i.e., days in bed, missed activities) will be presented. *Second*, the Physician Utilization (PU) component along with physician utilization frequency, care, usage, and chronic conditions will then be evaluated. And *last*, the General Health (GH) composite variable, along with each variable (i.e., positive and negative affect, general health, physical symptoms) will be presented.[63]

Restriction of Activities. When the Restriction of Activities composite variable served as the criterion, none of the five factors were significant within the framework of

[63] Because the purpose of this section is to examine if personality impacts on health status, each of the 10 health status measures as well as the three components will be analyzed. Research also suggests that component effects may hide specific effects based on the variables that comprise the factor(s) (see e.g., Bentler, 1995). The components were used to simplify these analyses and others that follow.

the restricted direct effects model (see Table 12). The full direct effects model analyses indicated that the time 1 restriction of activities predictor was significant in predicting its time 2 counterpart. The difference between the two models was significant ($F[3, 697] = 22.96$, $p < .01$) indicating that the full model is to be preferred. When the restricted interaction model was run, none of the predictors were significant. As in the full direct effects analyses, when the time 1 controls were implemented, the time 1 restriction of activities composite variable was the only significant predictor. The difference between the interaction models was significant ($F[3, 687] = 22.65$, $p < .01$). This comparison indicates that the full interaction model is preferred given that it accounts for a greater percentage of the variance in the criterion than the restricted model. When the full direct effects model was compared to the full interaction model, no difference was observed ($F[10, 687] = .24$, ns). The last comparison was between both restricted models. The F-test indicated no difference between the latter two models ($F[10, 690] = .23$, ns). In both cases, the data suggests that the more parsimonious full direct effects and restricted direct effects models are preferred, respectively. However, because the full direct effects model accounted for more of the variance than the restricted direct effects model, and was found to be more parsimonious than the full interaction model (i.e., no significant difference), the former is the overall preferred model.[64]

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[64] The results from each of the comparisons follow a similar pattern and therefore will not be repeated.

Table 12

Multiple regression analyses comparing the four restricted and full direct effect models

Variable	Restricted Direct Effects	Full Direct Effects	Restricted Interaction	Full Intn.
		Restriction of Activities (ROA) T2		
Sex		.04		.04
T1 ROA		.28***		.38***
T1 Events		.06		.06
Openness (O)	.04	.03	.04	.03
Conscientiousness (C)	-.02	.01	-.03	-.00
Extraversion (E)	-.06	-.06	-.05	-.06
Agreeableness (A)	.03	-.01	.02	-.02
Neuroticism (N)	-.04	.01	-.03	.01
O X C			-.01	-.00
O X E			-.01	-.03
O X A			-.02	.00
O X N			-.02	-.01
C X E			.00	.00
C X A			-.03	-.02
C X N			.01	.00
E X A			.04	.02
E X N			.04	.01
A X N			-.04	-.03
R^2	.01	.09	.01	.09

(table continues)

Physician Utilization (PU) T2

Sex		.09**		.08*
T1 PU		.55***		.56***
T1 Events		-.00		.00
Openness (O)	-.02	.02	-.01	.03
Conscientiousness (C)	-.01	-.03	-.02	-.05
Extraversion (E)	.04	-.01	.04	-.01
Agreeableness (A)	.07	.03	.09	.06
Neuroticism (N)	-.19***	-.04	-.19***	-.03
O X C			-.03	-.01
O X E			-.00	-.04
O X A			-.04	-.04
O X N			.01	-.01
C X E			-.03	.00
C X A			.01	-.00
C X N			-.01	-.04
E X A			.13	.08
E X N			-.02	-.02
A X N			.01	.04
R^2	.03	.34	.04	.35

General Health (Composite) T2

Sex		.02		.01
T1 GH		.56***		.55***
T1 Events		-.00		-.00
Openness (O)	-.02	-.01	-.03	-.02
Conscientiousness (C)	-.12**	-.06	-.13**	-.07
Extraversion (E)	-.13**	-.04	-.12**	-.03
Agreeableness (A)	.14**	.04	.13**	.04
Neuroticism (N)	-.44***	-.13*	-.44***	-.14**
O X C			-.02	.01
O X E			.03	.01
O X A			.00	-.00
O X N			.02	.00
C X E			-.02	-.04
C X A			-.13	-.05
C X N			.09	.07
E X A			.08	.05
E X N			-.03	-.01
A X N			-.02	-.02
R^2	.26	.45	.26	.45

(table continues)

Physician Utilization Frequency T2

Sex		.09*		.09*
T1 PU		.38***		.37***
T1 Events		.06		.06
Openness (O)	-.03	-.03	-.01	-.01
Conscientiousness (C)	.00	.00	-.00	-.01
Extraversion (E)	.07	.04	.06	.03
Agreeableness (A)	.01	-.03	.01	-.02
Neuroticism (N)	-.13**	-.04	-.13**	-.04
O X C			-.10	-.09
O X E			.05	.03
O X A			-.05	-.04
O X N			.03	.02
C X E			.02	.03
C X A			.02	.02
C X N			-.01	-.02
E X A			.12	.09
E X N			-.01	-.03
A X N			-.03	-.01
R^2	.02	.17	.03	.18

Days in Bed T2

Sex		.07		.07
T1 Days in Bed		.15**		.15**
T1 Events		.05		.06
Openness (O)	.06	.06	.06	.06
Conscientiousness (C)	-.01	-.00	-.02	-.01
Extraversion (E)	-.08	-.09	-.08	-.09
Agreeableness (A)	.08	.04	.07	.03
Neuroticism (N)	-.08	-.04	-.07	-.02
O X C			.00	-.00
O X E			-.02	-.03
O X A			.02	.04
O X N			-.09	-.07
C X E			.01	.03
C X A			-.04	-.05
C X N			.00	-.00
E X A			.01	-.01
E X N			.09	.07
A X N			-.04	-.04
R^2	.01	.04	.02	.05

(*table continues*)

T2 Missed Activities

Sex		.00		.00
T1 Missed Activities		.41***		.41***
T1 Events		.06		.06
Openness (O)	.01	-.01	.02	-.00
Conscientiousness (C)	-.02	.01	-.03	.01
Extraversion (E)	-.02	-.02	-.02	-.01
Agreeableness (A)	-.03	-.05	-.03	-.05
Neuroticism (N)	.01	.05	.01	.05
O X C			-.03	.00
O X E			.06	-.00
O X A			-.06	-.00
O X N			.06	.03
C X E			-.01	-.05
C X A			-.01	.04
C X N			.01	.00
E X A			.06	.05
E X N			-.02	-.04
A X N			-.03	-.03
R^2	.00	.18	.01	.18

General Health T2

Sex		.00		.00
T1 GH		.59***		.59***
T1 Events		.00		.01
Openness (O)	.03	.02	.03	.02
Conscientiousness (C)	-.13**	-.03	-.15**	-.02
Extraversion (E)	-.09*	-.05	-.08	-.05
Agreeableness (A)	.12*	.03	.09	.02
Neuroticism (N)	-.29***	-.12**	-.29***	-.12**
O X C			-.07	-.06
O X E			.03	-.00
O X A			-.01	-.01
O X N			.00	.01
C X E			-.05	-.03
C X A			-.02	.04
C X N			.05	.03
E X A			.04	.02
E X N			.02	-.01
A X N			-.07	-.01
R^2	.12	.43	.13	.43

(*table continues*)

Physical Symptoms T2

Sex		.06		.05
T1 Symptoms		.45***		.46
T1 Events		.02		.02
Openness (O)	.04	.04	.04	.02
Conscientiousness (C)	-.03	-.05	-.02	-.05
Extraversion (E)	-.02	-.03	-.02	-.01
Agreeableness (A)	.13**	.09*	.14**	.09*
Neuroticism (N)	-.37***	-.18***	-.39***	-.18***
O X C			.00	.02
O X E			.03	.01
O X A			.04	.04
O X N			-.03	-.05
C X E			-.02	-.04
C X A			-.06	-.09
C X N			.07	.10*
E X A			.08	.05
E X N			-.06	-.03
A X N			.01	-.00
R^2	.11	.30	.12	.31

Chronic Conditions T2

Sex		.07*		.06*
T1 Conditions		.68***		.68***
T1 Events		-.03		-.02
Openness (O)	.03	-.01	.02	-.02
Conscientiousness (C)	-.05	-.06	-.05	-.06
Extraversion (E)	-.02	-.01	-.00	.00
Agreeableness (A)	.15**	.11**	.17**	.11*
Neuroticism (N)	-.23***	-.05	-.25***	-.05
O X C			.08	.06
O X E			.01	.01
O X A			-.02	-.04
O X N			-.04	-.04
C X E			-.14	-.09
C X A			.01	.05
C X N			.05	-.00
E X A			.15*	.09*
E X N			-.08	-.03
A X N			-.02	-.06
R^2	.05	.49	.06	.51

(*table continues*)

Negative Affect T2

Sex		-.04		-.04
T1 Negative Affect		.35***		.34***
T1 Events		.07		.07*
Openness (O)	.03	-.00	.01	-.02
Conscientiousness (C)	-.04	-.06	-.07	-.08
Extraversion (E)	-.04	.00	-.04	.01
Agreeableness (A)	-.00	-.01	.01	-.00
Neuroticism (N)	-.38***	-.17**	-.38***	-.17**
O X C			.02	.06
O X E			-.04	-.03
O X A			.03	-.01
O X N			.08	.06
C X E			.01	-.04
C X A			-.18*	-.11
C X N			.07	.00
E X A			.02	.04
E X N			-.04	-.03
A X N			.09	.05
R^2	.17	.27	.19	.28

Positive Affect T2

Sex		-.05		-.05
T1 Positive Affect		.48***		.48***
T1 Events		.03		.03
Openness (O)	.15***	.08*	.15**	.08*
Conscientiousness (C)	.12**	.04	.14**	.02
Extraversion (E)	.22***	.09*	.21***	.08
Agreeableness (A)	-.14***	-.04	-.13*	-.04
Neuroticism (N)	.19***	.07	.18***	.08
O X C			.01	.03
O X E			-.08	-.05
O X A			.06	.03
O X N			.01	-.01
C X E			.01	-.01
C X A			.11	.01
C X N			-.10	-.05
E X A			-.09	-.04
E X N			-.02	-.01
A X N			.09	.07
R^2	.18	.35	.19	.36

(table continues)

Physician Usage (PU)

Sex		.39*		.38**
T1 PU		1.46***		1.48***
T1 Events		-.00		.00
Openness (O)	-.00	.00	.00	.01
Conscientiousness (C)	.00	.00	.00	.00
Extraversion (E)	.01	.00	.01	-.00
Agreeableness (A)	.00	.00	.00	.00
Neuroticism (N)	-.02 **	-.01	-.02**	-.00
O X C			-.00	.00
O X E			-.00	-.01
O X A			-.00	.00
O X N			.00	-.00
C X E			-.00	-.00
C X A			.00	-.00
C X N			.00	-.00
E X A			.00	.00
E X N			-.00	-.00
A X N			.00	-.00
Cox & Snell R^2	.01	.13	.02	.14
Nagelkerke R^2	.02	.18	.03	.19

Physician Care (PC)

Sex		.31		.34
T1 PC		1.32***		1.40***
T1 Events		.01		.01
Openness (O)	-.01	.00	-.00	.00
Conscientiousness (C)	-.00	-.01	-.01	-.01
Extraversion (E)	.00	-.00	.00	-.00
Agreeableness (A)	.00	.00	.00	.01
Neuroticism (N)	-.01	-.00	-.01	.00
O X C			-.00	-.00
O X E			-.00	-.00
O X A			.00	.00
O X N			-.00	-.00
C X E			.00	.00
C X A			-.00	-.00
C X N			-.00	-.00
E X A			.00	.00
E X N			.00	.00
A X N			.00	.00
Cox & Snell R^2	.01	.08	.02	.10
Nagelkerke R^2	.01	.12	.03	.15

(*table continues*)

*p < .05. **p < .01. ***p < .0001:

Note. ROA = Restriction of Activities: PU = Physician Utilization.

Note. For both the Physician Usage and Physician Care variables, logistic regression was used. As a result, only the unstandardized regression coefficients were available from the program.

The days in bed question was next assessed. Across both restricted models, none of the variables were significant. The time 1 days in bed question was the only variable to predict the time 2 criterion; this finding was consistent across both models. As predicted, the full direct effects model predicted more of the variance than the restricted direct effects model ($F[3, 697] = 8.49$, $p < .01$). The difference between the two interaction models was also found to be significant ($F[3, 687] = 8.18$, $p < .01$). Comparison of the two full models indicated that the models did not differ statistically ($F[10, 687] = .46$, ns). A similar finding was obtained when the two restricted models were compared ($F[10, 690] = .51$, ns). In each case, the results indicate that the full direct effects model is preferred.

The second restriction of activities question was the missed activities question. Once again, the pattern of findings paralleled the previous analyses. None of the variables were significant across both direct effects models. When both of the interaction models were analyzed, the time 1 missed activities question was the only significant predictor. When the two direct effects models were analyzed, the full model was found to predict more of the variance than the restricted model ($F[3, 697] = 50.24$, $p < .01$). The full interaction model was also found to account for a greater share of the variance than its restricted model counterpart ($F[3, 687] = 49.66$, $p < .01$). The analyses also revealed that the more parsimonious restricted direct effects model did not differ from the restricted interaction model ($F[10, 687] = .28$, ns). Comparison of both full models yielded a similar finding

($F[10, 690] = .31$, ns) suggesting that the full direct effects model is to be preferred given its more parsimonious structure.

In general, the findings indicate that the five factors did not predict any of the restriction of activitiy variables but that the time 1 autoregressive variables were the best predictors. The most parsimonious model in each analysis was the full direct effects model. In keeping with the planned analyses, the physician utilization variables will be similarly analyzed.

Physician Utilization. When the time 2 physician utilization composite variable served as the criterion, neuroticism was found to be the only significant predictor when the restricted direct effects model was tested. When the full direct effects model was tested, both sex of subject and time 1 physician utilization were found to predict the time 2 criterion: neuroticism was no longer significant. The difference between both multiple R-squares was significant ($F[3, 697) = 110.54$, $p < .01$), suggesting that the full direct effects model is to be preferred. The third analysis involved regressing the time 2 criterion on the five factors and the 10 interaction terms. As before, neuroticism was found to be the only variable to predict physician utilization. As in the previous analysis, only sex of subject and time 1 physician utilization were significant when the full interaction model was tested. The difference between the restricted interaction and the full interaction model was significant ($F[3, 687] = 110.58$, $p < .01$), indicating that the latter model is to be preferred. No difference was found between the two full models ($F[10, 687] = .95$, ns], as well as the two restricted models ($F[10, 690] = .62$, ns).

The one-item physician utilization frequency variable was next assessed. When the restricted direct effects model was tested, neuroticism was the only variable to predict the criterion. Within the context of the full direct effects model, sex of subject and the time 1 physician utilization frequency variables were the only significant predictors; neuroticism was no longer significant. Comparison of the multiple R-squares indicated that both models differed statistically ($F[3, 697] = 43.88$, $p < .01$). As in the first analysis, when the restricted interaction model was examined, neuroticism was the only variable to predict time 2 physician utilization frequency. When the controls were implemented, sex of subject and the time 1 utilization variable were the only significant predictors. Once again, the F-test revealed that both models differed statistically ($F[3, 687] = 42.76$, $p < .01$). When both full models were compared, no difference was found ($F[10, 687] = .73$, ns). The fourth test between the two restricted models also revealed no difference ($F[10, 690] = .86$, ns).

The next criterion examined was the time 2 chronic conditions variable. When the restricted direct effects model was examined, both neuroticism and agreeableness predicted the outcome. Inclusion of the control variables revealed sex of subject, agreeableness and the time 1 chronic conditions variable to be significant in predicting the criterion. The difference between both models was found to be significant ($F[3, 697] = 211.34$, $p < .01$). The restricted interaction model was next examined. The results indicated that agreeableness, neuroticism, and the extraversion by agreeableness interaction was significant. To assess the interaction model when the control variables were included, the results indicated that sex of subject, agreeableness, time 1 chronic conditions, and the extraversion by agreeableness interaction were significant. When the interaction models were compared, the models were found to be significantly differently ($F[3, 687] = 208.14$, $p < .01$). Despite the significant extraversion by agreeableness interaction found in the previous analysis, comparison of the full models revealed that the models failed to differ statistically ($F[10, 687] = 1.03$, ns) suggesting that the significant interaction was the likely result of sampling error. Because the full interaction model failed to differ statistically from the full direct effects model when compared using the F-test, the interactions were not plotted. Furthermore, given that 130 interactions were tested, with only three significant findings, the results strongly suggest that the interactions were significant by chance. Results from the restricted model comparison indicated that the models did not differ statistically ($F[10, 690] = 1.06$, ns).

Because the time 2 physician care and usage variables are dichotomous, logistic regression was used. Like the standard approach to regression, both continuous and nominal variables are allowed entry into the regression equation and an F-Test is used to compare regression models. To compare models in logistic regression, separate regressions are run for each of the models. Model chi-squares from each of the analyses are then compared in a nested like fashion with the difference in degrees of freedom used to find the critical chi-square value.

To assess the restricted direct effects model with physician usage as the criterion, each of the five factors were entered into the regression equation. As Table 12 indicates, neuroticism was the only variable to predict the criterion (Model $\chi 2$ [5. N = 706] = 8.82. ns). This relationship disappeared when the three covariates were added to the regression. Sex of subject and time 1 physician usage were found to be the only variables to predict the criterion (Model $\chi 2$ [8. N = 706] = 100.45. $\underline{p} < .0000$). When the models were compared. the chi-square model difference was found to be significant (Model $\chi 2$ Difference[3. N = 706] = 91.63. $p < .0000$). When the interactions were added to the restricted model. neuroticism was once again found to be the only variable to predict physician usage (Model $\chi 2$[15. N = 706] = 13.19. ns). When the full interaction model was tested. sex of subject and time 1 physician usage were the only variables to predict the time 2 usage outcome (Model $\chi 2$[18. N = 706] = 104.82. $\underline{p} < .0000$). Comparison of the restricted interaction model with the full interaction model revealed a statistical difference (Model $\chi 2$ Difference (3. N = 706] = 91. $p < .0000$) indicating that the full model is to be preferred. When the restricted direct effects and the restricted interaction models were compared. no differences were observed (Model $\chi 2$ Difference [10. N = 706] = 4.37. ns). Similarly. no difference was observed when the two control variable models were compared (Model $\chi 2$ Difference [10. N = 706] = 4.37. ns). suggesting that the least parameterized full direct effects model was preferred.

With physician care serving as the criterion. none of the five factors were found to be significant when tested within the framework of the restricted direct effects model (Model $\chi 2$[5. N = 706] = 4.50. ns]. When the full direct effect model was assessed. time 1 physician care was found to be the only significant predictor (Model $\chi 2$ [8. N = 706] =

60.49, $p < .0000$). Comparison of both models yielded a significant chi-square model difference (Model $\chi 2$ Difference [3, N = 706] = 55.99, $p < .0000$). Assessment of the restricted interaction model indicated that none of the variables were significant in predicting the criterion (Model $\chi 2$[15, N = 706] = 14.08, ns). When the full interaction model was evaluated, physician care was found to be the only variable to predict care at time 2 (Model $\chi 2$ [18, N = 706] = 74.27, $p < .0000$). The difference in model chi-squares for both interaction models was found to be significant (Model $\chi 2$ Difference [3, N = 706] = 60.19, $p < .0000$). Comparison of both restricted models suggested that the restricted direct effects model was more parsimonious (Model $\chi 2$ Difference [10, N = 706] = 9.58, ns). Similarly, when both full models were compared, the direct effects model was found to be the most parsimonious (Model $\chi 2$ Difference [10, N = 706] = 13.78, ns).

Taken together, when the physician utilization variables were used as dependent or criterion variables, both neuroticism and agreeableness were statistically significant predictors. However, these relationships tended to disappear when the time one control models were tested. This suggests that, like the restriction of activities criteria, what effects the five factors have is minimal or nonexistent when other variables are factored into the analyses.

General Health. The General Health composite variable was the next criterion to be assessed. When the restricted direct effects model was tested, conscientiousness, extraversion, agreeableness, and neuroticism were all significant in predicting the outcome. When the full direct effects model was tested, both neuroticism and time 1 general health were significant. The difference between both models was significant ($\underline{F}$[3, 697] = 82.19, $\underline{p}$ < .01). The results indicate that the full model is the preferred model. When the restricted interaction model was tested, main effects were found for conscientiousness, extraversion, agreeableness, and neuroticism. When the controls were included, most of these relationships disappeared. Time 1 general health and neuroticism were found to be the only variables to predict the time 2 outcome variable. The difference between the two models was significant ($\underline{F}$[3, 687] = 78.99, $\underline{p}$ < .01). No difference was found between both full models ($\underline{F}$[10, 687] = .31, ns). Similarly, when the two restricted models were compared, the difference was not significant ($\underline{F}$[10, 690] = .77, ns).

With physical symptoms serving as the next criterion, both agreeableness and neuroticism were found to predict the criterion when the restricted direct effects model was tested. The full direct effects model yielded similar findings: both agreeableness and neuroticism were found to be significant as was the time 1 symptoms variable. When both models were compared, the models were found to differ statistically ($\underline{F}$[3, 697] = 64.10, $\underline{p}$ < .01). The restricted interaction model analysis yielded findings similar to those found in the first set of analyses. Both agreeableness and neuroticism were found to be the only significant predictors of the criterion. When the full interaction model was tested, agreeableness, neuroticism, time 1 symptoms, and the conscientiousness by neuroticism interaction were significant. Comparison between both interaction models indicated that they differed statistically ($\underline{F}$[3, 687] = 63.63, $\underline{p}$ < .01). However, when the two control models were compared, no difference was found ($F[10, 687] = .67$, ns), suggesting that the significant interaction was spurious. As in a previous section, the interaction was not plotted. Therefore, the more parsimonious full direct effects model is preferred. And last, no difference was found between the restricted direct effects model and the restricted interaction model ($F[10, 690] = .56$, ns).

When the restricted direct effects model was assessed, the data revealed that all five factors predicted the positive affect measure. Inclusion of the control variables indicated that extraversion, openness to experience, and the time 1 positive affect variable were significant in predicting the criterion. Comparison of both models revealed that the two models differed statistically ($F[3, 697] = 61.19$, $p < .01$). Examination of the restricted interaction model results indicated that, once again, each of the five factors predicted the time 2 positive affect variable; none of the 10 higher-order interactions were significant. The full interaction model yielded a different pattern of findings: openness to experience and the time 1 positive affect variable were the only variables to predict the time 2 outcome. The difference between the two interaction models was significant ($F[3, 687] = 58.13$, $p < .01$). The comparison between the full models was found to be nonsignificant ($F[10, 687] = .53$, ns), suggesting that the full direct effects model is to be preferred. And last, no difference was found between the two restricted models ($F[10, 690] = 1.16$, ns).

Examination of the output for the restricted and full direct effects models indicated that neuroticism was the only significant five factor variable to predict the time 2 negative affect criterion. The time 1 negative affect predictor was also significant. The F-test revealed that both models differed statistically ($F[3, 697] = 30.73$, $p < .01$) indicating that the full model accounted for a greater share of the variance than the restricted model. Negative affect was next regressed on the five factors as well as the higher-order interactions. The output revealed that both neuroticism and the conscientiousness by agreeableness interaction term were significant in predicting the outcome. When the controls were added, time 1 life events, neuroticism, and the time 1 negative affect variable were significant in predicting the outcome; the conscientiousness by agreeableness interaction was no longer significant. Once again, the results suggest that the interaction was spurious. Comparison of the latter two models found a difference ($F[3, 687] = 28.19$, $p < .01$). In addition, comparison between both of the full models revealed that they did not differ statistically ($F[10, 687] = .92$, ns). And last, when the two restricted models were compared, no difference emerged ($F[10, 690] = 1.49$, ns).

The 1-item general health question was next examined. When assessed within the context of the restricted direct effects model, conscientiousness, extraversion, agreeableness, and neuroticism were all significant in predicting the time 2 criterion. When the full model was assessed, only neuroticism and the time 1 general health variable were significant; conscientiousness, extraversion, and agreeableness were no longer significant. Comparison of the two models indicated that they were statistically different ($F[3, 697] = 124.53$, $p < .01$). The restricted interaction model was the next criterion assessed. Examination of the output revealed that neuroticism and conscientiousness were the only predictors of the outcome. The results from the full interaction model analysis revealed that both neuroticism and the time 1 general health predictors were significant. The difference between the restricted and full interaction models was significant ($F[3, 687] = 63.63$, $p < .01$). Comparison of the two full models revealed no difference between multiple R-squares ($F[10, 687] = .39$, ns). And last, when the multiple R-squares for the two restricted models were examined, no difference was found ($F[10, 690] = .67$, ns).

The analyses for the general health variables yielded some interesting findings. Overall, when the general health composite variable was analyzed, without any control variables, conscientiousness, extraversion, agreeableness, and neuroticism were statistically significant predictors. However, when the control variables were implemented, neuroticism was the only predictor to remain significant. Another interesting finding was that despite implementation of the controls, several personality to health relationships remained significant. One interesting finding was that openness to experience remained significant in predicting positive affect even after the control variables were included. In addition, while extraversion failed to reach significance in the full interaction model analysis (i.e., positive affect), it was significant when the full direct effects model was tested. Given the lack of statistical difference between the latter two models, extraversion was a significant predictor of positive mood.

Final Summary

Overall, the results from this set of analyses can be summarized as follows. When the restriction of activities and physician utilization variables were analyzed, the five factors had little effect and what effect was present. tended to disappear when the control variables were added. When the general health variables were analyzed. the five factors tended to have stronger effects than in the previous sets of analyses. Neuroticism appeared to be the most reliable predictor of the five although openness to experience was the best predictor of positive affect. followed by extraversion. In general. the results strongly suggest that their effects on the health and health related measures tend to be direct (i.e.. main effects) and not interactive.

The findings lend further support to the complexities of the theory versus variance debate in that more personality to health relationships were found without the autoregressive variables than when they were included. although personality was more related to the subjective general health variables.

This concludes the second part of the planned analyses. The next series of chapters will attempt to determine in what ways personality is related to health status. In doing so. several theory-based models linking personality to health. life events. and health behaviours will be tested and compared. Assessment of these models will follow several statistical criteria. Prior to testing the models. a brief discussion on the nature of these statistical tests will be presented. Each of the four models will be related to each of the three health and health-related dependent variables that were found in the health measure data reduction section (i.e.. principle components analysis). After the four models are tested. they will then be compared to determine which model is more parsimonious. Once again. analysis of the models will have implications for the variance versus theory debate.

RESULTS 3:

PATH ANALYSES WITH RESTRICTION OF ACTIVITIES (ROA) AS THE CRITERION

How Does Personality Influence Health Status?

Overview

Each model was evaluated on five criteria: (1) overall and incremental fit; (2) comparisons with the atheoretical saturated structural and independence models: (3) the Expected Cross-Validation Index (ECVI): (4) parameter estimates: and (5) the W-Test for the inter-model comparisons. Analyses of the data suggested that when restriction of activities served as the health status criterion. each of the models provided a good fit to the data. alone and in comparison with both saturated and independence models. Expected cross-validation was found to be the highest for Model 4. the no control mediator model. although this model also accounted for less of the overall variance and had the fewest number of parameters than the other models. In both the no control variable stress moderator and stress/health behaviour mediation models (i.e.. Models 2 and 4). conscientiousness and neuroticism were found to predict health behaviours and negative life stress. respectively. However. none of the five-factors predicted the restriction of activities criterion across any of the four models. When the control models were evaluated. time 1 life events. health behaviours. and restriction of activities were the strongest predictors of their respective time 2 criteria. While the effect of neuroticism on time 2 life events remained significant. conscientiousness no longer predicted health behaviours. And last, when each of the models were compared based on the overall multiple R-square, Model 3, the time 1 control mediator model, was the preferred model.

Measures of Fit, Software, and Model Setup

A critical element in the model validation process involves determining the extent to which a model fits or describes the data. To assess fit, various overall (a.k.a., stand-alone, absolute) and incremental or practical measures of fit are used. Of the former, both the chi-square *badness of fit* (i.e., nonsignificant chi-square: see Bollen, 1989, pp. 263-269) and the Goodness of Fit Index (GFI: Joreskog & Sorbom, 1986) are among the most popular indices currently used in structural equation modelling research.[65]

When the chi-square statistic is used as a measure of overall fit, a nonsignificant value suggests that the *implied model* (i.e., theoretical model) approximates the observed covariance matrix (i.e., the data), a goal in structural equation modelling research. Conversely, a significant chi-square value suggests that the implied covariances failed to reproduce the observed covariances. One limitation of chi-square is that a model may become significant even when it is well specified. This tends to occur with large sample sizes and when the data are nonnormally distributed (Hoyle, 1995; Pedhazur, 1997). Several writers (e.g., Hu & Bentler, 1995) have therefore recommended that researchers report several other fit indexes such as as the Goodness of Fit Index (GFI: Joreskog

[65] Badness of fit refers to a statistically significant chi-square value. A nonsignificant chi-square reflects a model that adequately fits the data.

& Sorbom. 1986). The Goodness of Fit Index. which is analogous to multiple R-squared (Hoyle. 1995). varies between 0 and 1 with higher values. preferably over .90. reflecting a good fit to the data.

The second class of measures. the incremental indices. measure the extent to which the implied or theoretical model is superior to an alternative model (e.g.. independence model). In general. incremental measures have values that range from 0 to 1 with larger values reflecting a model that is better able to reproduce the observed covariances than the alternative. The incremental measures have been referred to as goodness of fit indices given that higher values. preferably over .90. reflects a *good* fit to the data. The independence model is built into the measure upon estimation and therefore is not constructed and determined by the researcher. However. an alternative baseline model can be constructed by the researcher (see Sobel & Bohrnstedt. 1985: see also Pedhazur. 1997. p. 831). Note that the computer specified independence model was used for the purposes of this research. thereby allowing for cross-study comparison. Note also that the independence model is used in two ways. First. the coefficient is built into the fit measure(s). and second. the computer program (i.e.. EQS 5.7 for Windows) outputs a separate independence model chi-square statistic. The latter statistic allows researchers to compare the independence model with the theoretical model. as will be shortly discussed.

According to Hoyle (1995). there are three classes of incremental measures. The first class. the Type-1 Indexes (e.g.. Normed Fit Index: Bentler. 1995) are not recommended for use in structural equation modelling research and therefore will not be discussed or used. Hoyle (1995) suggests that at least one measure from each of the Type-2 and 3 indexes be used. A complete listing of measures is not recommended (RCFI: Byrne. 1994: Type 3). Based on several recommendations. the following indexes will be used: the [Corrected or Robust] Satorra-Bentler Chi-Square statistic. the Goodness of Fit Index. the Incremental Fit Index (IFI: Bollen. 1989: Type 2). and both the Comparative Fit Index (CFI: Bentler. 1995: Type 3). and the Robust or Corrected Fit Index (RCFI: Byrne. 1994: Type 3).

In addition. the Root Mean Square Error of Approximation (RMSEA: Browne. 1992). which like the chi-square assesses badness of fit. and which measures the *fit per degree of freedom of the model*. will be used. When interpreting the Root Mean Square Error of Approximation. a model that has a perfect fit to the data. will reach a value of 0. As Browne (1992) argues. a Root Mean Square Error of Approximation of .05 can be considered a close fit to the data. Closeness of fit can also be assessed by examination of the exceedance probabilities associated with the Root Mean Square Error of Approximation. That is. when computing an exceedence probability. the null hypothesis (i.e.. close fit) is compared to an alternative value such as .08. If the exceedance value is significant. the null hypothesis of close fit is rejected in favour of the alternative hypothesis (e.g.. Root Mean Square Error of Approximation = .08). As a further assessment of fit. the confidence interval around the Root Mean Square Error of Approximation should be relatively narrow. Wide confidence intervals suggest that other models that may take on other Root Mean Square Error of Approximation values may also fall within the band.

And last, the Expected Cross-Validation Index (Browne, 1999; Browne & Cudeck, 1989), which measures the expected probability that a model will cross-validate in a new sample, will also be used. Low values (e.g., 0) reflect a model that stands a reasonable chance of cross-validating. When interpreting the expected cross-validation index, several models are typically compared. The models are then ranked based on the expected cross-validation index and the model with the smallest value is chosen. However, as will be shortly discussed, the expected cross-validation index has a built-in sample size bias and therefore needs to be interpreted accordingly.

To compare the total summed or generalized variance accounted for across each of the four models, the W-test (i.e., chi-square: Specht, 1975) will be computed. In general, the W-test takes into account the variance accounted for by each of three equations in each model (i.e., health status, life events, health behaviours). The total variance or generalized multiple R-squared for one model can then be compared with the generalized multiple R-squared for a second model. Four model comparisons or W-tests per health status criterion will be conducted: Model 1 will be compared to Model 2, 3 to 4, 1 to 3, and 2 to 4. To determine if the control variable models (i.e., Models 1 and 3) would account for more of the variance than the no control models (i.e., Models 2 and 4), Model 1, the control variable interaction model, will be compared to Model 2, the no control interaction model, and Model 3, the control variable mediator model will be compared to Model 4, the no control mediator model. To determine if Model 1, the control variable interaction model would outpredict Model 3, the control variable mediator model, a W-test comparison will also be conducted. And last, to determine if the no control interaction model would differ from the no control mediator model, Model 2, the no control interaction model will be compared to Model 4.

Each of the models will be estimated using EQS 5.7 for Windows (C; Bentler, 1998). Additional statistical power estimates will be calculated for each model using a program developed by Dudgeon (1999). In addition, both the Expected Cross-Validation Index as well as the Root Mean Square Error of Approximation exceedance probabilities test will be computed using Browne's (1992) FITMOD program. To calculate the chi-square difference test (see Anderson & Gerbing, 1988; Bentler & Bonnett, 1980), and the W-test (see Specht, 1975), a visual based Window's (C) program, Extra-Fit, developed by this writer (Korotkov, 1999; see Appendix N for the program's graphical interface) will be used. Extra-Fit was used to calculate the F-test ratios used in the regression analyses.[66]

Each conceptual model was first translated into a series of *graphical path diagrams* and structural equations. To interpret the discussion that follows, it is useful to note that EQS uses the Bentler-Weeks statistical model which designates each variable as either an

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[66] Extra-fit was developed using Visual Basic (Windows; C), Versions 4 and 5. While Extra-fit outputs several fit measures not used in the present research, these were developed solely for exploratory purposes. Separate code was written to calculate the error variances and factor loadings for the latent variable product-term interactions. As indicated in the introduction, the latent variable approach was abandoned in favour of the observed variable path analytic strategy. As a result, this part of the program was not utilized. Extra-fit was developed because EQS as well as other structural equation modelling programs do not calculate particular indices that might be of use to other researchers.

independent or dependent variable. While each criterion may predict a variable in a causal stream. EQS considers the former to be a criterion or dependent variable. or endogenous to the predictor. independent variable. or exogenous variable. The basic structural equation matrix that relates each of the variables is indicated by $\eta = \beta\eta + \gamma\xi$. where η is an endogenous variable. ξ is equal to the exogenous predictor. β is equal to the weight or regression coefficient expressed in conjunction with η on η. and γ is the weight expressed in conjunction with ξ.

Note that EQS considers the variances of the independent variables. covariances. and regression coefficients to be estimable parameters unlike the variances of the dependent variables. which are determined by the predictors. Furthermore. the terms path coefficient and standardized/nonstandardized beta will be used interchangeably (see Pedhazur. 1997).

To clarify which time 1 and time 2 variables are used in the analyses. the time 1 variables include all demographic and socioeconomic variables (i.e.. sex. education. income). time 1 health status. time 1 health behaviours. time 1 life events. as well as the five factors and the five factor by time 1 life event interactions. To assess for mediation effects. time 2 life events. time 2 health behaviours will be used. along with the time 2 health status variables.

To summarize. several measures of model acceptance will be utilized (i.e.. fit measures). Acceptable fit occurs when the Robust Comparative Fit Index. the Comparative Fit Index. the Incremental Fit Index. and the Goodness of Fit Index are at or above .90. When chi-square is nonsignificant, when the Root Mean Square Error of Approximation is close to .05, and when the Expected Cross-Validation Index takes on small values relative to other models, fit is assumed to be good. In addition, there should not be a statistical difference between the theoretical model (i.e., Models 1 - 4) and the saturated structural model; however, the theoretical model should differ from the independence model. The path coefficients (i.e., parameter estimates) are also reported as well as their significance level in diagram form. Models one to four will now be presented for the restriction of activities composite variable. This will be followed by a comparison of the four models in terms of the overall variance accounted for. And last, an alternative method for analyzing the data, the subgrouping method, will be presented.

Model 1: Stress Moderator Model with Time 1 Controls

Overall / Incremental Fit and Power. The Robust Maximum Likelihood estimation procedure was used to provide corrected estimates of model fit and standard errors. Examination of the results suggested that the model provided a good fit to the data (see Table 13). With the exception of the Satorra-Bentler chi-square statistic ($\chi 2[94, N = 706] = 145.18$, $p < .000$), the goodness of fit index as well as the practical or incremental indices were all above the .90 threshold for model acceptance (i.e., Comparative Fit Index = .97, Robust Comparative Fit Index = .98, Incremental Fit Index = .97). In addition, the Root Mean Square Error of Approximation was found to be within acceptable limits (i.e., .04) and within the 90% confidence interval (i.e., CI =

Table 13

Measures of fit for Models 1-4 with restriction of activities as the criterion

Model	χ^2	S-B χ^2	GFI / IFI	CFI /RCFI	RMSEA	RMSEA CI
1	193.53	145.18	.97/.97	.97/.97	.039	.031 ; .046
2	86.51	55.36	.98/.98	.98/.99	.035	.023 ; .046
3	105.31	99.67	.98/.97	.97/.97	.049	.038 ; .060
4	9.74	8.87	.99/.99	.99/.99	.024	.000 : .055

Note. Model 1 = Stress Moderator Model with T1 Controls: Model 2 = Stress Moderator Model without T1 Controls: Model 3 = Stress/Health Behaviour Mediator Model with T1 Controls: Model 4 = Stress/Health Behaviour Mediator Model without T1Controls: S-Bχ2 = Satorra-Bentler Chi-Square Statistic: GFI = Goodness of Fit Index: IFI = Incremental Fit Index: CFI = Comparative Fit Index: RCFI = Robust Comparative Fit Index: RMSEA = Root Mean Square Error of Approximation: CI = Confidence Interval.

.031 : .046).[67] The Root Mean Square Error of Approximation exceedance probability test failed to reject the null hypothesis of a close fit ($\underline{p}$ = .99). Calculation of statistical power for Model 1 was found to be 1, well above Cohen's (1992) .8 standard.[68]

Model Comparisons. To help establish the validity of the theoretical model (i.e., Model 1), two chi-square difference tests were carried out. First, the theoretical model was compared to the nontheoretical independence model (i.e., the model of uncorrelated variables: $\chi 2[11, N = 706] = 3176.28, \underline{p} < .000$).[69] With a difference in chi-square and degrees of freedom of 2982.74 and 77, respectively, the two models were found to differ statistically ($\underline{p} < .000$), suggesting that the theoretical model represents a substantial gain in explanation.[70] The second test was conducted between the theoretical model and the

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[67] As will be shown in the remaining analyses for each health status criterion, Model 4 has the broadest Root Mean Square Error of Approximation confidence interval bands, suggesting that several other models may provide a similar or better fit to the data. While a similar conclusion can be reached when examining the other confidence intervals, this is less so. In general, across each health status criterion, Model 1 had the narrowest band, followed by Models 3, 2, and 4. To avoid redundancy, these findings will not be repeated except where necessary.

[68] Based on the computer output and the calculated number of parameters per data point, Models 1 - 4, across each of the criterion variables, appear to be overidentified. Because there are more data points than parameters, the program appears to have provided a unique solution across each health status criterion and model.

[69] The independence model coefficient is calculated by EQS and not the researcher.

[70] Interpretation of the baseline model comparisons is as follows. First, no difference was expected between the saturated and theoretical model given that the former has more, though fewer interesting parameters. And second, because the independence model is atheoretical (i.e., all variables uncorrelated), the theoretical model was expected to diverge from it. This was found to be true in all analyses, across each of the health status variables.

saturated structural model ($\chi 2[68, N = 706] = 164.89$, $p < .000$: see Anderson & Gerbing, 1988).[71] This comparison indicates that the more parsimonious theoretical model explains as much of the observed covariances as the saturated model, but with fewer parameters ($p > .05$).

Expected Cross-Validation and Bootstrap Simulations. Calculation of Browne and Cudeck's (1989) single sample expected cross-validation index produced an estimate of .55 (90% confidence interval = .496 : .609: see Table 14). To obtain an additional estimate of model stability, a bootstrap analysis using EQS was conducted. In brief, when *bootstrapping the data*, the total sample is resampled with replacement N number of times. Based on the total number of specified resamplings, the program then calculates an average for several fit measures, parameter estimates, and standard errors. Because of computer time and space limitations, 65 resamplings with maximum likelihood estimation (uncorrected) were computed. The Goodness of Fit Index, Comparative Fit Index, Root Mean Square Error of Approximation, and the noncorrected chi-squares for both the independence and theoretical models were estimated. Computer space considerations precluded additional replications and estimation of average parameter estimates. The mean and standard deviations for the bootstraps were calculated for each of the forementioned statistics (see Table 14). As can be seen from Table 14, each of

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[71] When constructing the saturated structural model, the researcher frees all paths but not all of the covariances.

Table 14

Expected Cross-Validation Index and bootstrap output for Models 1-4 with restriction of activities as the criterion

			Bootstrap Analysis				
Model	q/df	ECVI (90% CI)	Ho: $\chi2$ (sd)	$\chi2$ (sd)	GFI (sd)	CFI (sd)	RMSEA (sd)
1	96/94	.55 .496:.609	3446.74 (259.34)	306.16 (40.07)	.90 (.03)	.94 (.01)	.0563 (.01)
2	58/47	.28 .256: .330	2427.58 (237.22)	149.57 (33.27)	.94 (.02)	.96 (.01)	.0549 (.01)
3	66/39	.34 .299:.385	2205.12 (138.16)	146.20 (21.84)	.95 (.02)	.95 (.01)	.0621 (.01)
4	29/7	.09 .092:.114	1085.66 (95.58)	17.28 (7.62)	.99 (.00)	.99 (.01)	.0420 (.02)

Note. Model 1 = Stress Moderator Model with Time 1 Controls: Model 2 = Stress Moderator Model without Time 1 Controls: Model 3 = Stress/Health Behaviour Mediator Model with Time 1 Controls: Model 4 = Stress/Health Behaviour Mediator Model without Time 1 Controls: q = Number of Parameters: df = Degrees of Freedom: ECVI = Expected Cross-Validation Index: Ho:$\chi2$ = Independence Model Chi-square: $\chi2$ = Chi-square: GFI = Goodness of Fit Fit Index: CFI = Comparative Fit Index: RMSEA = Root Mean Square Error of Approximation.

the mean values were comparable to the original model fit estimates.[72] The chi-square statistics (and p-values) were somewhat larger than the output from the main analysis. In addition, both the comparative fit index and goodness of fit index estimates were lower than their .97 single sample estimates, although both were still above .9. The average Root Mean Square Error of Approximation was slightly higher though still close to Browne's (1999) .05 criterion (i.e., close fit).

Parameter Estimates. Examination of the critical ratios (i.e., parameter estimate divided by the corrected standard error) for each of the criterion variables provided partial support for several of the primary hypotheses. As can be seen from Figure 3a, time 1 restriction of activities (−) was the only variable to predict restriction of activities at time 2. The variables in this equation accounted for 11 percent of the variance in the time 2 scores.

Time 1 life events (+), as well as income (-) and neuroticism (-), were all significant in predicting T2 life events. Eighteen percent of the variance was accounted for by the variables in this equation. And last, time 1 health behaviours (+) was found to predict time 2 health behaviours: approximately 52% of the variance was accounted for by the variables in this equation.

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72 Ideally, thousands of replications should be conducted. However, because the bootstrap algorythm is exceedingly complicated and cumbersome, some researchers have suggested that at least 100 replications could be useful (e.g., see Chou & Bentler, 1995). Other writers (e.g., MacCallum, Roznowski, Mar, & Reith, 1994) have shown that as many as 20 replications may provide insight into average parameter and fit estimates. One limitation is that while average parameter estimates may be insightful, it may be problematic when interpreting the Root Mean Square Error of Approximation confidence interval. Because of this, the bootstrapped confidence intervals were not reported.

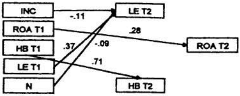

Figure 3a: Model 1 (Interaction Model with Controls)

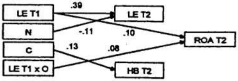

Figure 3b: Model 2 (Interaction Model without Controls)

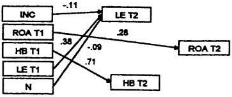

Figure 3c: Model 3 (Mediator Model with Controls)

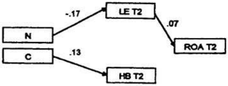

Figure 3d: Model 4 (Mediator Model without Controls)

Figure 3. Summary of significant path analysis parameter estimates with restriction of activities (ROA) as the criterion. Interpretation of the abbreviations is as follows: Inc = Income; ROA = Restriction of Activities; HB = Health Behaviours; T1 = Time 1; T2 = Time 2; LE = Life Events; N = Neuroticism; O = Openness to Experience; C = Conscientiousness; x = Multiplied by.

Overall, the findings indicate that the model met acceptable statistical standards for model acceptance, was found to be a better model than the nontheoretical saturated and independence models, and had a reasonable chance of cross-validating in a new sample. However, none of the five factors predicted the restriction of activities dependent variable, although neuroticism was significant in predicting life events.[73]

Model 2: Stress Moderator Model without Time 1 Controls

Overall / Incremental Fit and Power. The Satorra-Bentler Chi-square Statistic was nonsignificant ($\chi 2[47, N = 706] = 55.36$, ns; see Table 13). In addition, the Goodness of Fit Index was found to be .90. The incremental fit measures were all above .90 (i.e., Comparative Fit Index = .98, Robust Comparative Fit Index, = .99, Incremental Fit Index = .98). The Root Mean Square Error of Approximation was found to be .04 and within the 90% confidence interval (i.e., .023 : .046). The exceedance probabilities test indicated that the null hypothesis of close fit could not be rejected ($p = .989$). Power was found to be 1.

Model Comparisons. To determine if the theoretical model provides a better description of the data than either the saturated structural or independence models, a series of chi-square difference tests were conducted. The theoretical model was first compared to the independence model. With a chi-square difference of 2159.16 and 44 degrees of freedom, both models were found to differ statistically ($p < .000$). This

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[73] Directional signs will be used to indicate both positive and negative relationships.

indicates that the theoretical model provides a better explanation of the data than the uncorrelated variable model.

The theoretical model was then compared to the saturated structural model ($\chi 2$ [29, N = 706] = 57.75, $\underline{p} > .05$). The difference in chi-square and degrees of freedom was found to be nonsignificant ($\chi 2$ difference [18] = 28.77, $\underline{p} > .05$). The analysis suggests that the theoretical model is more parsimonious than the saturated model.

Expected Cross-Validation and Bootstrap Simulations. The Expected Cross-Validation Index was found to be .29 and within the 90% confidence interval (i.e., .256 : .33). To provide a further estimate of stability, the model was bootstrapped (see Table 14). As indicated by Table 14, the chi-squares were somewhat higher than the original model estimates and the incremental indices were slightly attenuated. Both the Comparative Fit Index and the Goodness of Fit Index were close to their original estimates of .98, at .96, and .94, respectively. The Root Mean Square Error of Approximation, though somewhat higher than the original coefficient of .04, was still close to Browne's .05 criterion.

Parameter Estimates. Figure 3b presents the standardized coefficients for each of the paths. Interestingly, time 1 but not time 2 life events (+) was a significant predictor of restriction of activities. Unlike the previous model, openness to experience interacted with time 1 life events to predict the criterion. Examination of the corrected critical ratio found this parameter to be nonsignificant. Given that (1) the interaction disappeared when controls were added, (2) the beta weight was less than .1 (see Kerlinger and Pedhazur's, 1973, p. 318 discussion on the meaningfulness of beta), (3) the uncorrected critical ratio was not significant, and (4) 30 interactions were tested across three health status variables, where an expected one out of every 20 interactions would be expected by chance, the interaction was in all likelihood, spurious. Because of these reasons, the interaction was not interpreted. Four percent of the variance in restriction of activity scores was accounted for by the variables in this equation.

As predicted, both time 1 life events (+) and neuroticism (-) predicted time 2 life events: 17% of the restriction of activities scores was accounted for by both variables. And last, conscientiousness (+) but not openness to experience or time 2 life events, was the only variable to predict time 2 health behaviour scores (i.e., 2% variance).

In summary, the model demonstrated adequate fit when examined using standard statistical criteria and when compared to both nontheoretical models. While personality did not predict restriction of activities, neuroticism and conscientiousness were related to both life events and health practices, respectively.

Model 3: Stress/Health Behaviour Mediator Model with Time 1 Controls

Overall / Incremental Fit and Power. The Satorra-Bentler Chi-square statistic was found to be significant ($\chi2[39, N = 706] = 99.67$, $p < .000$; see Table 13). The Goodness of Fit Index suggests that the model provides an excellent fit to the data (i.e., .98). All of the practical indices were above the .9 threshold, indicating a good fit to the data (i.e., Comparative Fit Index = .97, Robust Comparative Fit Index = .97, Incremental Fit Index

= .97). In addition, the Root Mean Square Error of Approximation was found to be .05 and within the bounds of the 90% confidence interval (i.e., .038 : .060). The exceedance probabilities test found that the null hypothesis of a close fit could not be rejected ($\underline{p}$ = .53). In addition, power for this test was found to be .99.

Model Comparisons. To determine if the theoretical model provides a better fit to the data than the independence and saturated models, two chi-square difference tests were conducted. The independence model ($\chi 2[91, N = 706] = 2103.37$) was first compared to the theoretical model. The analysis indicated that with a chi-square difference of 1998.06 and 52 degrees of freedom, the theoretical model provides a better explanation of the data than the independence model ($\underline{p} < .000$).

The theoretical model was next compared to the saturated structural model ($\chi 2[23, N = 706] = 94.75$, $\underline{p} < .000$). The difference in chi-square (i.e., 10.56) and degrees of freedom (i.e., 16) was found to be nonsignificant, suggesting that the theoretical model provides a more parsimonious explanation of the data than the saturated model.

Expected Cross-Validation and Bootstrap Simulations. The Expected Cross-Validation Index was found to be .34 and within the bounds of the 90% confidence interval (.299 ; .385). A bootstrap simulation was next carried out (see Table 14). As in the previous analyses, the chi-square values were somewhat higher, though still in the expected range. Both the Comparative Fit Index and Goodness of Fit Index had attenuated, though still respectable, mean values of .95. The Root Mean Square Error of Approximation, although somewhat higher (i.e., .06), is close to Browne's .05 criterion.

Parameter Estimates. Figure 3c presents the path model along with the standardized coefficients. As expected, time 1 restriction of activities (+) was found to be the only predictor of time 2 restriction of activities scores with 10% of the variance accounted for. None of the other variables in the equation were significant. Time 2 life events was predicted by all three independent variables (i.e., time 1 life events [+], neuroticism [-], income [-]), which accounted for 18% of the variance in the dependent variable. And last, time 2 health behaviour was predicted by time 1 health behaviour (+). In combination, the variables explained 52% of the variance in time 2 health behaviour scores.

As in the previous sets of analyses, model three demonstrated acceptable levels of statistical model fit and expected cross-validation. Neuroticism was the only variable of the five factors to predict any of the dependent variables (i.e., life events). The last model will now be presented.

Model 4: Stress/Health Behaviour Mediator Model without Time 1 Controls

Overall / Incremental Fit and Power. The output revealed that Model 4 provided an excellent fit to the data, although some qualification is in order. The Satorra-Bentler Chi-Square statistic was found to be nonsignificant ($\chi 2[7, N = 706] = 8.87$, ns; see Table 13). Furthermore, the Goodness of Fit Index was found to be very high (i.e., .997). In addition, each of the incremental indexes were in the high .90s (i.e., Comparative Fit Index = .997, Robust Comparative Fit Index = .99, Incremental Fit Index = .99). The Root Mean Square

Error of Approximation was found to be .02 and well within the bounds of the 90% confidence interval (.000: .055). The null hypotheses of close ($\underline{p}$ = .91) and perfect fit ($\underline{p}$ = .20) could not be rejected. Power for Model 4 was found to be .63.

Model Comparisons. The first test compared the theoretical model with the independence model ($\chi 2[28. N = 706] = 1053.37$). The difference in chi-square (i.e.. 1043.37) with 21 degrees of freedom. was found to be significant ($\underline{p}$<. 000). indicating that the theoretical model provided a better fit to the data than the uncorrelated variable model (i.e.. independence model).

The second test compared the theoretical model with the saturated structural model ($\chi 2$ [0. N = 706] = 0. ns). With a difference in chi-square of 7.43 and 7 degrees of freedom. the difference was not significant. suggesting that the theoretical model provides a more parsimonious explanation of the data.

Expected Cross-Validation and Bootstrap Simulations. As might be expected. the Expected Cross-Validation Index was found to be .096 and within the 90% confidence Interval (.092: .114). As can be seen from Table 14. the bootstrapped estimates closely paralleled the findings obtained in the main analyses. Both chi-squares were somewhat higher but the average p-value indicated that the model provided a good fit across 65 resamplings. Both the Comparative Fit Index and Goodness of Fit Index were similar in magnitude as the original estimates. The only noticeable difference was the bootstrapped Root Mean Square Error of Approximation values. The mean Root Mean Square Error of

Approximation was found to be .04 (i.e., close fit), slightly higher than the [perfect fitting] .02 found in the main analyses.

Parameter Estimates. When the time 2 restriction of activities equation was examined, only time 2 life events (+) was found to predict the criterion; 1% of the time 2 restriction of activities scores was accounted for (see Figure 3d). As hypothesized, neuroticism (-) was found to predict time 2 life event scores with 3% of the variance in the criterion explained. In addition, conscientiousness (+) was found to be related to time 2 health behaviour; 2% of the variance in the criterion was explained by the the variables in this equation. Openness to experience and time 2 life events failed to reach significance.

The results from this set of analyses indicated that while none of the five factors predicted restriction of activities, neuroticism and conscientiousness predicted life events and health behaviours, respectively. Model fit was within acceptable levels. Of the four models, Model 4 was found to have the best chance of cross-validating. In keeping with the planned analyses, the four models will now be compared based on an overall test of variance accounted for per model.

This will be followed by an alternative set of analyses that makes use of the subgrouping method. This method was used to counter limitations inherent within the present method of analyses.

<u>**Overall Model Comparisons**</u>

The last set of analyses compared each of the models based on the overall variance or generalized multiple R-squared accounted for by each of the models (see Specht, 1975). To estimate these differences, the <u>W</u>-Test was calculated for each of the comparisons. Table 15 presents the results of the analyses.

As Table 15 suggests, several of the primary hypotheses were supported. As predicted, the time 1 variables had a significant impact on the restriction of activities criterion; the two models with the time 1 variables outpredicted their no control counterparts. In addition, the data suggests that the mediator model with the time 1 controls (i.e., Model 3) is more parsimonious than the time 1 interaction model (i.e., Model 1 with no controls). As might be predicted, the no control interaction model accounted for more of the variance than the no control mediator model, primarily because time 1 life events was kept in the former model. As a result, it accounted for more of the variance in time 2 life event scores.

The subgrouping method for assessing interaction effects will now be examined.

<u>**Subgrouping Interaction Analyses**</u>

In a typical interaction analysis, the product-term is entered into the regression equation after the main effects have been accounted for (i.e., $y = a + bX1 + cX2 + dX1X2 + e$). The present study utilized this method by hypothesizing five product-term interactions. With the exception of one interaction (i.e., openness to experience by stress:

Table 15

Four model comparisons based on the W-Test (Specht, 1975) with restriction of activities as the criterion

Comparison	**W**	**df**
Model 1 vs. Model 2	551.81**	15
Model 3 vs. Model 4	665.40**	18
Model 1 vs. Model 3	8.32 (ns)	15
Model 2 vs. Model 4	124.27**	18

Note. Model 1 = Stress Moderator Model with T1 Controls; Model 2 = Stress Moderator Model without T1 Controls; Model 3 = Stress/Health Behaviour Mediator Model with T1 Controls; Model 4 = Stress/Health Behaviour Mediator Model without T1 Controls; W = W-test coefficent; df = Degrees of Freedom ** = $p < .001$.

no controls). none of the remaining interactions were significant. One possible explanation for the lack of significant interactions is that the time 1 life events measure was *not variable enough*. thereby limiting the range of scores in the product-term to health outcome relationship. To help rule this out as a potential alternative explanation. a series of subgrouping moderation analyses were conducted.

According to Jaccard and Wan (1996) and Hayduk (1989: see also Li. Harmer. Duncan. Duncan. Acock. Boles. 1998). subgrouping analyses are useful in testing for moderation effects *when* (1) the scale of a predictor has a limited score range (e.g.. 1 - 9: life events). and when (2) there are multiple interactions. The primary limitation of this procedure is that given a nonsignificant finding among the subgroups. it is difficult to interpret the main effects. This is partially resolved by combining the groups and rerunning the analyses. as was done in the previous analyses. A second related problem. and more central to the present study. is that in order to assess the stress by big five interactions. the time 1 life events variable must be removed as well as its covariances and paths to the two criterion variables (i.e.. time 2 life events and health status). However. the interaction test is still preserved. one priority of this research.

According to Jaccard and Wan. there are three steps for testing an interaction with the subgrouping method. First. the researcher calculates overall fit across two or more groups without imposing any equality constraints on the parameters of interest (i.e.. personality to health status).[74] Second. the analyses are then rerun with equality constraints

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[74] Equality constraints allow the researcher to test if certain parameters are equal. Thus. the null hypothesis is that the parameter(s) is(are) equal across groups.

imposed on the parameters from both groups. In other words, the parameters from both groups are held to be equal. And last, a chi-square difference test is conducted, which compares both unconstrained and constrained solutions. If the difference in chi-square is significant, an interaction effect is present.

Six sets of subgrouping analyses were conducted. For each criterion, both the control and no control interaction models were tested. For each control and no control model, two subgrouping analyses were run, one with no constraints and the other with constraints. Because of a restricted range in the time 1 event scores, the data were recoded simply as 0 (i.e., no stress: 0 events) or 1 (i.e., stress: 1 or more events). The overall sample was then split based on the stress and no stress dichotomy. Exactly 379 subjects were in the stress group versus 327 in the no-stress group. The model was identical to the control and no control interaction models save the covariance between time 1 life events and neuroticism and income, and its path to time 2 life events and health status. The alternative hypotheses were as follows: there will be a significant difference between the two groups for each of the big five and health status paths. An interaction effect will be reflected by a significant difference between the chi-squares values of the constrained and unconstrained solutions. Failure to find any difference in the cross-group constraints and chi-square indicates the absence of interaction effects. In the latter case, the alternative hypothesis is rejected in favour of the null hypothesis. Based on the significant interaction effect, the samples are then combined, the analyses rerun, and the main effects are interpreted accordingly. The following subgrouping analyses were conducted with the restriction of activities health criterion. The general health and physician utilization composite variable analyses are reported in the chapters that follow.[75]

Restriction of activities served as the criterion. The first series of analyses were conducted with the time 1 interaction model. In the unconstrained solution, chi-square ($\chi 2$ [64, N = 706]=126.68, p<.001) was found to be significant. However, the Goodness of Fit Index (.97), Comparative Fit Index (.97), and Incremental Fit Index (.97) were all above .90, suggesting a good fit across groups. In addition, the Root Mean Square Error of Approximation was found to be .04 and within the 90% confidence interval (i.e., .028; .047). No differences were found for any of the parameter estimates when the five constraints were imposed on the data. The difference in chi-squares was not significant ($\chi 2$ difference[5, N = 706] = 4.654, ns). The overall and incremental fit measures remained essentially the same (i.e., $\chi 2$[69, N = 706]=131.32, p<.001, Goodness of Fit Index = .97, Comparative Fit Index = .97, Incremental Fit Index = .97, Root Mean Square Error of Approximation = .036, Root Mean Square Error of Approximation confidence interval = .026 : .045).

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[75] When running multi-population analyses in EQS, the program does not output corrected estimates of model fit. Therefore, the standard coefficients are presented. Note that with corrected estimates, that is, the Robust Comparative Fit Index, Satorra-Bentler chi-square statistic, the noncorrected chi-square estimate (i.e., Comparative Fit Index, Incremental Fit Index, Goodness of Fit Index) were essentially the same. Thus, the analyses which compared the output from the maximum likelihood to the Robust maximum likelihood results were similar.

The last set of analyses were repeated with the no control variable interaction model. For the unconstrained solution, the models provided a good fit (i.e., $\chi 2[14] = 22.19$, ns: Goodness of Fit Index = .99, Comparative Fit Index = .99, Incremental Fit Index = .99, Root Mean Square Error of Approximation = .028, Root Mean Square Error of Approximation confidence interval = .000 ; .049). When the five constraints were imposed, no differences were observed among any of the cross-groups parameters ($\chi 2$ difference [5, N = 706] = 3.62, ns). The Goodness of Fit Index (.99), the Comparative Fit Index (.99), the Incremental Fit Index = .99), and the Root Mean Square Error of Approximation (i.e., .028 : confidence interval = .000 ; .049) remained virtually the same. As with the product-term analyses (i.e., Models 1 - 4), no significant interactions were detected.

<u>Overall Summary</u>

The analyses based on the restriction of activities criterion can be summarized as follows. First, across all four models and simulations, overall fit was strong even though the bootstrap analyses produced attenuated estimates. Estimates based on the Goodness of Fit Index and the incremental measures were all above .90. The single sample chi-square values were difficult to interpret as sample size, model complexity, and nonnormal data considerations may have impacted on the estimates for each model differently. Examination of the parameter estimates suggested that what effect the five-factors had on the respective criterion, all but disappeared when the time 1 variables were included in the analyses. However, this effect did not appear to impact on the time 2 life event predictors: neuroticism still predicted the criterion even though time 1 life events was controlled. Conversely, when the time 1 health behaviour variable was controlled for, the regression of time 2 health behaviours on conscientiousness disappeared. Save for a significant time 1 life events by openness to experience interaction, there were no other interactions or main effects that reached significance. In the former instance, the openness to experience by stress interaction disappeared when the time 1 variables were controlled for, suggesting a spurious effect.

Each of the theoretical models provided a better fit to the data than either the saturated structural or independence models. These comparisons suggest that the theoretical models are viable in the model building process. More importantly, when each of the models were compared, the stress/health behaviour mediator model with time 1 controls (i.e., Model 3) was found to be the best model. Model 3 explained more of the variance than either of the least parameterized or no control models. When the time 1 control models were compared, the mediator model was found to explain just as much of the variance as the interaction model, but with fewer parameters (i.e., 66 vs. 96). The results were validated with the subgrouping approach to moderator effects. As expected, the Expected Cross-Validation Index was smaller for Model 3 (.34) than Model 1 (.55) and the Root Mean Square Error of Approximation confidence interval was narrower. While both the no control variable stress interaction (i.e., Model 2) and stress/health behaviour mediator models (i.e., Model 4) yielded smaller Expected Cross-Validation Index's than their counterparts. Model 1 and 3 explained a greater share of the variance. Based on the multiple R-square. Expected Cross-Validation Index and other measures of fit. Model 3 is the preferred model.

Final Summary

Each of the four models demonstrated acceptable levels of fit based on standard statistical tests. When compared to the nontheoretical saturated and independence models. the theoretical models were found to be superior. While the five factors were variously related to life events (i.e.. neuroticism) and health behaviours (i.e.. conscientiousness). none were related to the restriction of activities dependent variable. With the exception of the neuroticism to life event relationship. the conscientiousness to health behaviour relationship disappeared when the control variable models were evaluated. When the four models were compared. the stress/health behaviour mediator model with the time one controls (i.e.. model 3) was the best model in terms of the variance accounted for as well as parsimony.

RESULTS 4:

PATH ANALYSES WITH

GENERAL HEALTH (GH) AS THE CRITERION

Overview

Each of the four models provided a good fit to the data. In addition, when the models were compared to both saturated and independence models, the theoretical models provided a better explanation in all cases. Based on the Expected Cross-Validation Index, the no control variable stress/health behaviour mediation model (i.e., Model 4) was expected to have the greatest chance of replicating in a new sample. Examination of the no control models revealed that conscientiousness, extraversion, agreeableness, and neuroticism were significant in predicting the general health criterion. Neuroticism and conscientiousness were also related to time 2 life events and health behaviours. When the control models were assessed, neuroticism was the only five-factor variable to predict the general health criterion. In addition, while neuroticism still predicted the time 2 life events variable, conscientiousness failed to reach significance in predicting time 2 health behaviours. The inter-model comparisons revealed, once again, that the mediator model with the time 1 controls (i.e., Model 3) was the most robust model.

Model 1: Stress Moderator Model with Time 1 Controls

Overall / Incremental Fit and Power. The Satorra-Bentler Chi-Square statistic was found to be significant ($\chi2$ [94, N = 706] = 151.69, p < .000; see Table 16). Despite the significant chi-square, the Goodness of Fit Index (i.e., .97), and the practical indices were over .90 (i.e., Comparative Fit Index = .97, Robust Comparative Fit Index = .97, Incremental Fit Index = .97). In addition, the Root Mean Square Error of Approximation was found to be .04 and within the bounds of its 90% confidence interval (i.e., .033 ; .048). The exceedance probabilities test indicated that the null hypothesis of close fit could not be rejected., suggesting that the model provides a close fit to the data. In addition, power was found to be 1.

Model Comparisons. To determine if Model 1 provides a better explanation of the data than either the saturated structural and independence models, two chi-square difference tests were conducted. The difference in chi-square and degrees of freedom between the saturated model ($\chi2$ [68, N = 706] = 170.84, p < .001) and the theoretical model ($\chi2$[94, N = 706] = 202.49, p < .001) was 31.65 with 26 degrees of freedom (p > .05). Once again, this suggests that Model 1 provides a more parsimonious explanation of the data.

The second comparison between the independence model ($\chi2$ [171, N = 706] = 3941.22, p < .000) and the theoretical model was found to be significant ($\chi2$ difference [77, N = 706] = 3738 .73, p < .000). This difference indicates that the theoretical model offers a better explanation of the observed covariance matrix.

Expected Cross-Validation and Bootstrap Simulations. The Expected Cross-Validation Index was found to be .56 and within the 90% confidence interval (i.e., .507 :

Table 16

Measures of fit for Models 1-4 with general health as the criterion

Model	χ^2	S-B $\chi 2$	GFI / IFI	CFI / RCFI	RMSEA	RMSEA CI
1	202.49	151.69	.97/.97	.97/.97	.040	.033 : .048
2	86.51	55.35	.98/.98	.98/.99	.035	.023 : .046
3	115.47	109.16	.98/.97	.97/.97	.053	.042 : .064
4	9.74	8.87	.99/.99	.99/.99	.024	.000 : .055

Note. Model 1 = Stress Moderator Model with T1 Controls: Model 2 = Stress Moderator Model without T1 Controls: Model 3 = Stress/Health Behaviour Mediator Model with T1 Controls: Model 4 = Stress/Health Behaviour Mediator Model without T1 Controls: $\chi 2$ = Chi-Square: S-B$\chi 2$ = Satorra-Bentler Chi-Square; GFI = Goodness of Fit Index: IFI = Incremental Fit Index: CFI = Comparative Fit Index: RCFI = Robust Comparative Fit Index: RMSEA = Root Mean Square Error of Approximation: CI = Confidence Interval.

.623; see Table 17). To assess the stability of the overall fit and incremental fit measures. a bootstrap analysis was next conducted. In general. the findings were similar to those from the main analysis (Table 16). First. chi-square was found to be higher (i.e.. 315.14) than in the main analysis. and still significant. The Goodness of Fit Index was found to be .89. though still close to the traditional .90 cut-off. Furthermore. the mean Comparative Fit Index was found to be .95. indicating that Model 1 provides a close fit to the data. In addition. the mean Root Mean Square Error of Approximation value (i.e.. .06) suggests that the model approximates the data set.

Parameter Estimates. Examination of the critical ratios indicated that five variables were significant in predicting time 2 general health: time 2 health behaviours (-). time 1 and time 2 life events (+). time 1 general health (+). and neuroticism (-: See Figure 4a). None of the remaining five factors predicted the criterion. Exactly 47% of the variance in time 2 general health scores was accounted for. As hypothesized. time 1 life events (−). income (-). and neuroticism (-) were all found to predict time 2 life events (17% variance). The only variable to predict the time 2 health behaviour criterion was time 1 health behaviours (+). which accounted for 52% of the variance (see Figure 4a).

In summary. the analyses indicated that the model's structure was acceptable when analyzed with the separate fit measures and when compared to the nontheoretical models. The results from the cross-validation analyses suggested that the models stand a reasonable chance of cross-validating. Of the five factors. neuroticism was the only factor

Table 17

Expected Cross-Validation Index and bootstrap output for Models 1-4 with General Health as the criterion

			Bootstrap Analysis				
Model	q/df	ECVI (90% CI)	Ho:χ2 (sd)	χ2 (sd)	GFI (sd)	CFI (sd)	RMSEA (sd)
1	96/94	.56 .507:.623	4212.71 (272.79)	325.14 (40.04)	.89 (.04)	.95 (.01)	.06 (.01)
2	58/47	.29 .256:.330	2693.18 (242.38)	149.56 (33.27)	.94 (.04)	.96 (.01)	.05 (.01)
3	66/39	.35 .311:.402	2981.11 (152.36)	156.19 (23.25)	.94 (.02)	.96 (.01)	.07 (.01)
4	29/7	.096 .092:.114	1359.66 (102.68)	17.28 (7.62)	.99 (.00)	.99 (.01)	.04 (.02)

Note. Model 1 = Stress Moderator Model with T1 Controls: Model 2 = Stress Moderator Model without T1 Controls: Model 3 = Stress/Health Behaviour Mediator Model with T1 Controls: Model 4 = Stress/Health Behaviour Mediator Model without T1 Controls: q = Number of parameters: df = degrees of freedom: ECVI = Expected Cross-Validation Index: Ho:χ2 = Independence Model Chi-Square: χ2 = Chi-Square: sd = Standard Deviation: GFI = Goodness of Fit Index: CFI = Comparative Fit Index: RMSEA = Root Mean Square Error of Approximation: CI = Confidence Interval.

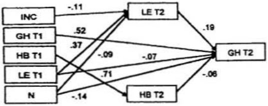

Figure 4a: Model 1 (Interaction Model with Controls)

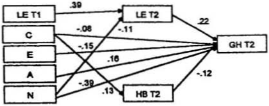

Figure 4b: Model 2 (Interaction Model without Controls)

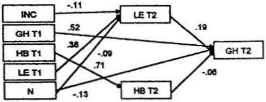

Figure 4c: Model 3 (Mediator Model with Controls)

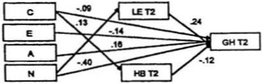

Figure 4d: Model 4 (Mediator Model without Controls)

Figure 4. Summary of significant path analysis parameter estimates with general health (GH) as the criterion. Interpretation of the abbreviations is as follows: Inc = Income; GH = General Health; T1 = Time 1; T2 = Time 2; HB = Health Behaviours; LE = Life Events; N = Neuroticism; C = Conscientiousness; A = Agreeableness; E = Extraversion.

to predict general health. Neuroticism was also found to predict life events. Model 2 will now be analyzed.

<u>**Model 2: Stress Moderator Model without Time 1 Controls**</u>

Overall / Incremental Fit and Power. The Satorra-Bentler Chi-Square statistic was found to be nonsignificant ($\chi 2$[47. N = 706] = 86.51. ns; see Table 16). The Goodness of Fit Index was found to be .98. In addition, each of the incremental measures were found to be above .90 (i.e., Comparative Fit Index = .98. Robust Comparative Fit Index = .99. Incremental Fit Index = .98). The Root Mean Square Error of Approximation value suggested that the model provided a close fit to the data (i.e., Root Mean Square Error of Approximation .035: confidence interval = .023 : .046). The exceedance probabilities test indicated that the null hypothesis of a close fit could not be rejected ($\underline{p}$ = .989). Power for this test was found to be 1.

Model Comparisons. The theoretical model was next compared to the saturated structural and independence models. When Model 2 was compared to the saturated model ($\chi 2$ [29. N = 706] = 57.75. $\underline{p}$ < .001). the difference in chi-squares and degrees of freedom ($\chi 2$ [18. N = 706] = 28.76. ns) was found to be nonsignificant. Further support for Model 2 was found when compared to the independence model ($\chi 2$ [91. N = 706] = 2506.98. $\underline{p}$ < .000). The difference in chi-squares and degrees of freedom ($\chi 2$ difference [44. N = 706] = 2420.47. $\underline{p}$ < .000) was found to be significant. suggesting that Model 2 provides a more adequate explanation of the data than the independence model.

Expected Cross-Validation and Bootstrap Simulations. The Expected Cross-Validation Index was found to be .29 and well within the bounds of the 90% confidence interval (i.e., .256 ; .330; see Table 17). To assess the stability of the overall and incremental fit measures, a bootstrap analysis, with 65 resamplings, was conducted (see Table 17). As in the main analyses, chi-square was found to be significant. Unlike the original analyses, the significant mean chi-square failed to replicate the Satorra-Bentler Chi-Square statistic found in the main analyses (i.e., $\chi 2[47, N = 706] = 55.35$, ns). The second overall measure, the Goodness of Fit Index, was found to be stable, though attenuated. The resampling analysis also suggested that, although somewhat attenuated, the Comparative Fit Index was relatively stable (i.e., mean Comparative Fit Index = .96). And last, the mean Root Mean Square Error of Approximation (.05) was found to meet Browne and Cudeck's criterion (i.e., .05).

Parameter Estimates. Examination of the individual path coefficients (see Figure 4b) indicated that time 2 life events (+), time 2 health behaviours (-), conscientiousness (-), agreeableness (+), extraversion (-), and neuroticism (-), all predicted time 2 general health scores. Interestingly, agreeableness was found to be positively related to time 2 general health scores suggesting that highly agreeable individuals tend to experience more negative symptoms, counter to the directional hypothesis. Examination of the correlation between agreeableness and time 2 general health indicated that the relationship was initially negative as expected. This latter finding suggests that the predictor set may be suppressing irrelevant variance in the agreeableness scores. The variables in this equation accounted for approximately 33% of the variance in the criterion.

As predicted, time 1 life events (+), income (-), and neuroticism (-) were found to be related to the time 2 life events outcome, explaining 17% of the variance. And last, conscientiousness (+) was found to be the only predictor of time 2 health practices. Approximately 2% of the variance in time 2 health practice scores was explained.

Taken together, the findings indicate that the model was structurally acceptable. As in the previous analyses, the model appears to have a good chance of replicating in a new sample. In addition, unlike the first analysis with the control variables, four of the five factors predicted general health. Interestingly, agreeableness was positively related to health status suggesting a statistical problem called a suppressor effect.

Model 3: Stress/Health Behaviour Mediator Model with Time 1 Controls

Overall / Increment Fit and Power. The Satorra-Bentler Chi-square statistic was found to be significant ($\chi 2[39, N = 706] = 109.16$, $p < .000$: see Table 16). Contrary to this, the Goodness of Fit Index was found to be .98. Examination of the incremental measures supported the overall Goodness of Fit Index statistic (i.e., Comparative Fit Index = .97, Robust Comparative Fit Index = .97, Incremental Fit Index = .97). The Root Mean Square Error of Approximation was found to be .053 and within the 90% confidence interval (i.e., .042 : .064). The exceedance probabilities test indicated that the null hypothesis of close fit could not be rejected ($p = .326$). Statistical power was found to be .99.

Model Comparisons. Model 3 was compared to both the saturated structural and independence models. The chi-square difference between Model 3 and the saturated model ($\chi2[23, N = 706] = 100.41$, $p < .000$) was not significant ($\chi2$ difference[16, N = 706] = 15.06, ns), suggesting that the theoretical model provides a more parsimonious explanation to the data.

Model 3 was next compared to the independence model ($\chi2[91, N = 706] = 2878.32$, $p < .000$). The difference in chi-square values was significant ($\chi2$ difference [52, N = 706] = 2762.85, $p < .000$), indicating that the theoretical model better explains the observed covariances than the independence model.

Expected Cross-Validation and Bootstrap Simulations. The Expected Cross-Validation Index was found to be .35 (confidence interval = .311 : .402: see Table 17). Overall, the bootstrap estimates paralleled the findings obtained in the main analyses (see Table 16). The average chi-square was found to be higher, though still significant, than the original estimate. However, the mean Goodness of Fit Index and Comparative Fit Index were above the .90 threshold, though somewhat attenuated. And last, the Root Mean Square Error of Approximation was found to be .065.

Parameter Estimates. Figure 4c presents the standardized estimates for each of the path coefficients. As Figure 4c indicates, time 1 (-) and time 2 life events (+), time 2 health behaviours (-), time 1 general health (−), and neuroticism (-) were all significant in predicting the time 2 general health criterion. Approximately 46% of the variance in the general health criterion was accounted for. When the time 2 health behaviour output was examined, time 1 health behaviour (+) was found to be the only significant predictor of the criterion. Fifty-two percent of the variance in the time 2 health behaviour criterion was explained.

And last, all three of the independent variables, time 1 life events (+), neuroticism (-), and income (-), predicted the time 2 life events criterion. The output revealed that 18% of the variance in time 2 life event scores was explained.

The results from this set of analyses indicated that the model provided a good description of the data; the fit statistics were found to be at appropriate levels, and when compared to the nontheoretical models, was found to be superior. When the paths coefficients were examined, neuroticism was found to be the only factor to predict general health.

The next model to be analyzed is Model 4, the Stress/Health Behaviour Mediator Model without the Time 1 controls. The four models will then be compared in terms of the total variance per model explained. The data will then be reanalyzed using the subgrouping method.

Model 4: Stress/Health Behaviour Mediator Model without Time 1 Controls

Overall / Incremental Fit and Power. Examination of the overall fit measures revealed the Satorra-Bentler Chi-Square statistic to be nonsignificant ($\chi 2[7, N = 706]$ =

8.87, ns); the Goodness of Fit Index (i.e., .99) value paralleled this finding (see Table 16). In addition, each of the incremental measures were found to be above .9 (i.e., Comparative Fit Index = .99, Robust Comparative Fit Index = .99, Incremental Fit Index = .99). And last, the Root Mean Square Error of Approximation was observed to be .02 and within its 90% confidence interval (i.e., .000 ; .055). The exceedance probabilities test failed to reject the null hypothesis of a close ($\underline{p}$ = .905) and perfect fit ($\underline{p}$ = .20) suggesting that fit was perfect. Statistical power was found to be .63.

Model Comparisons. To provide a further assessment of fit. Model 4 was next compared to both the saturated structural model and the independence model. The saturated model yielded a nonsignificant chi-square value (i.e., $\chi 2$ [0, N = 706] = 0, ns) and when compared to the theoretical model, the difference ($\chi 2$ difference [7, N = 706] = 9.74, ns) was also nonsignificant. The theoretical model was also compared to the independence model ($\chi 2$ [28, N = 706] = 1324.42, $\underline{p}$ < .001). The difference between both competing models was significant ($\chi 2$ difference [21, N = 706] = 1314.68, $\underline{p}$ < .001).

Expected Cross-Validation and Bootstrap Simulations. The expected probability of replicating Model 4 in a new sample was found to be .096 (Expected Cross-Validation Index: confidence interval = .092 ; .114). The results from the bootstrap analysis provided further support for the overall model (see Table 17). Both chi-square (mean $\chi 2$ = 17.28, $\underline{p}$ = .09) and Goodness of Fit Index coefficients (i.e., mean Goodness of Fit Index = .99) suggested that the model provided an excellent fit to the data. In addition, the mean Comparative Fit Index was found to be .99. Similarly, the Root Mean Square Error of Approximation (i.e., mean = .04), though attenuated, still approximated a close fit.

Parameter Estimates. Time 2 life events (+), time 2 health behaviours (-), extraversion (-), neuroticism (-), conscientiousness (-), and agreeableness (+) were all found to predict the criterion; 33% of the variance in time 2 general health scores was accounted for (see Figure 4d). Once again, agreeableness was found to be positively related to time 2 general health, suggesting the presence of a suppressor variable(s). Openness to experience failed to predict the criterion.

Examination of the time 2 life events criterion indicated that neuroticism (-) was predictive of the criterion with 3% of the variance accounted for. And last, when the time 2 health behaviours criterion was examined, conscientiousness (+) was found to be the only predictor with 2% of the variance accounted for.

In summary, the results indicated that model 4 fit the data and when compared to models 1, 2, and 3, stood the best chance of replicating, at least with a sample of the same size. As in model 2, conscientiousness, extraversion, agreeableness, and neuroticism were found to predict health status, thereby providing further support for the hypotheses. As outlined in the planned analyses, the next section will compare the four models to each other in terms of the total variance accounted for per model.

Overall Model Comparisons

The last set of analyses compared each of the four models based on the generalized multiple R-squared. The results of the model comparison tests can be found in Table 18.

Table 18

Four model comparisons based on the W-Test (Specht, 1975) with T2 general health as the criterion

Comparison	**W**	**df**
Model 1 vs. Model 2	652.90**	15
Model 3 vs. Model 4	754.68**	18
Model 1 vs. Model 3	3.47	15
Model 2 vs. Model 4	108.07**	18

Note. Model 1 = Stress Moderator Model with T1 Controls: Model 2 = Stress Moderator Model without T1 Controls: Model 3 = Stress/Health Behaviour Mediator Model with T1 Controls: Model 4 = Stress/Health Behaviour Mediator Model without T1 Controls: df = Degrees of Freedom: W = W-test result.

As Table 18 indicates, the first two comparisons, Model 1 vs. Model 2 and Model 3 vs Model 4 found both time 1 models (i.e., 1 and 3) to account for more of the variance in the three criterion variables combined. In addition, when the interaction model with the time 1 controls (i.e., Model 1) was compared to the mediator model with time 1 controls (i.e., Model 3), no difference in the generalized multiple R-squared was observed. Based on this latter comparison, the control variable stress/health behaviour mediation model (i.e., Model 3) is the preferred model. In addition, with an Expected Cross-Validation Index of .35, Model 3 has a greater chance of replicating than the control variable stress moderation model (i.e., Model 1: Expected Cross-Validation Index = .56). And last, the no control stress interaction model (i.e., Model 2) differed from the no control mediator model (i.e., Model 4). Overall, Model 3 appears to be the most robust model.

To determine if the subgrouping method is more sensitive in detecting moderation effects, the data will now be reanalyzed using this method.

Subgrouping Analyses

The subgrouping method was also used to test for interaction effects with general health serving as the health status criterion. The first analysis tested the time 1 general health control variable stress interaction model. In the first, unconstrained parameter run, chi-square was found to be significant for the overall model ($\chi 2[64, N = 706] = 134.54, \underline{p}<.001$). The Goodness of Fit Index (i.e., .97) and the incremental measures (i.e., Comparative Fit Index = .97, Incremental Fit Index = .97) were found to be strong, as well as the Root Mean Square Error of Approximation (i.e.. .04). The Root Mean Square Error of Approximation was found to be within the bounds of the 90% confidence interval (i.e.. .030 : .049).

The model was then rerun, with all five cross-groups constraints imposed on the data. As in the previous analyses, no significant differences were observed across both groups for each of the parameters. The difference in chi-square was found to be nonsignificant ($\chi 2$ difference [5. N = 706]=1.62. ns). Chi-square ($\chi 2$[69. N = 706] = 136.17. $p < .001$). the Goodness of Fit Index (i.e.. .97). and the remaining measures (i.e.. Comparative Fit Index = .97. Incremental Fit Index = .97. Root Mean Square Error of Approximation = .037. Root Mean Square Error of Approximation 90% confidence interval = .028 ; .046) failed to show any major changes.

These analyses were repeated for the no control interaction model. The unconstrained solution provided a good overall fit to the data ($\chi 2$[14. N = 706]=14.02. $p > .05$: Goodness of Fit Index = .99. Comparative Fit Index =1. Incremental Fit Index = 1. Root Mean Square Error of Approximation = .002: Root Mean Square Error of Approximation confidence interval = .000: .025). In addition. there was no difference between the chi-squares ($\chi 2$ difference[5. N = 706]= .82. ns). For the constrained solution. chi-square was not significant ($\chi 2$ [19. N = 706] = 14.83. ns). The Goodness of Fit Index (i.e.. .99) and the remaining measures were similar to those found in the constrained solution (i.e., Comparative Fit Index = 1. Incremental Fit Index = 1. Root Mean Square Error of

Approximation = .000. Root Mean Square Error of Approximation 90% confidence interval = .000 : .0251).

Like the product-term moderation analyses (i.e.. Models 1-4). no interaction effects were detected using the subgrouping method.

Overall Summary

The findings presented in this chapter can be summarized as follows. Across each of the analyses. the theoretical model provided a more adequate explanation of the data than either the saturated or independence model. In each case. save the Satorra-Bentler chi-square statistic. the fit measures were generally over .90: the bootstrap simulations tended to support these conclusions. To provide a further estimate of model stability. the Expected Cross-Validation Index was calculated for each model. As seen in Table 17. the Expected Cross-Validation Index favoured the least parameterized model. Model 4. the no control variable stress/health behaviour mediation model. However. as Browne (1999) points out. given a large sample. the Expected Cross-Validation Index tends to favour highly parameterized models. It should be kept in mind that Model 4 has fewer degrees of freedom than the other models. As is well known. degrees of freedom is inversely related to model fit: the greater the degrees of freedom. in general. the worse the fit. and the fewer the degrees of freedom (e.g.. saturated model 4). in general. the better the fit. Despite this. the Expected Cross-Validation Index confidence interval band was wider than the confidence interval for Model 3, the no control variable mediator model; Model 3 also accounted for more of the overall variance.

As hypothesized, the time 1 control models (i.e., Models 1 and 3) predicted more of the overall variance than their no control counterparts. In general, the control variables tended to wipe out the effects that the five-factors had on time 2 general health and health behaviours. The exception was neuroticism. In all four models, neuroticism was found to predict both time 2 life events and general health.

None of the remaining five factors predicted the outcome when the time 1 variables were included in the models. However, in the no control models (i.e., Models 2 and 4), extraversion, neuroticism, agreeableness, and conscientiousness were significant in predicting time 2 general health, while conscientiousness predicted the health behaviour criterion. Openness to experience failed to predict any of the time 2 general health or health behaviour variables. Examination of the standardized beta for agreeableness suggested a suppressor effect. For the other three factors (i.e., conscientiousness, neuroticism/stability, extraversion), high scores were associated with lower illness scores.

To determine which of the four models is the most parsimonious, a series of W-tests were conducted. The results suggested that the mediation model with the time 1 controls provides the best explanation. The control variable stress moderation (i.e., Models 1) and stress/health behaviour mediation (i.e., Model 3) models were found to explain more of the variance than either the no control variable stress moderation model (i.e., Model 2) and the no control stress/health behaviour mediation model (i.e., Model 4). When the time 1 interaction model was compared to the control variable stress/health behaviour mediator model (i.e.. Model 3). there was no difference in overall multiple R-squared. Because Model 3 (i.e.. control variable mediator model) has fewer parameters than Model 1 (i.e., the control variable stress interaction model). the more parsimonious Model 3 is preferred. The Expected Cross-Validation Index estimates suggested that while the no control variable stress/health behaviour mediator model (i.e.. Model 4) stands the best chance of replicating in an independent sample. it nonetheless (1) has fewer parameters. (2) would in all probability not replicate as well given a larger sample. and (3) is overparameterized relative to the other three models. Nonetheless. Model 4 is theoretically interesting given that four of the five factors were related to time 2 general health. These latter results are described more fully in the Discussion section. The Expected Cross-Validation Index estimates also support the preference of Model 3 over Model 1 even though the latter had a narrower Root Mean Square Error of Approximation confidence interval than the former. Put differently. because Model 3 has a smaller Expected Cross-Validation Index than Model 1. it stands a better chance of cross-validating in a new sample. Based on the data. Model 3 is the preferred model.

Final Summary

While variable. the models presented in this chapter were found to be structurally sound. The models were also shown to be superior to their respective nontheoretical models and stood a reasonable chance of replicating with a new sample of the same size.

When the models were analyzed without the control variables, four of the five factors predicted general health. However, when the control variables were incorporated into the models, neuroticism was found to be the only variable to predict the general health dependent variable. Thus, these findings provide some support to both sides of the variance versus theory debate. These findings were corroborated by the subgrouping method as well. Model 3, the stress/health behaviour mediator model with the control variables was found to be statistically and parsimoniously the preferred model.

The next section of the planned analyses will look at the third component or composite health measure, physician utilization. The results section will then conclude by examining a series of template models.

RESULTS 5:

PATH ANALYSES WITH

PHYSICIAN UTILIZATION (PU) AS THE CRITERION

Overview

Based on the overall and incremental measures of fit. as well as comparison with both saturated structural and independence models. each of the four models provided a good fit to the data. Examination of the Expected Cross-Validation Index statistics once again suggested that Model 4 (i.e.. no control variable stress/health behaviour mediator model) holds the greatest chance of cross-validating in a new sample relative to the other models. When each of the parameter estimates were assessed. neuroticism was the only variable of the five factors to predict the time 2 physician utilization criterion. This effect vanished when the time 1 controls were implemented in Models 1 (i.e.. control variable stress moderator model) and 3 (i.e.. control variable stress/health behaviour mediator model). Once again. neuroticism and conscientiousness were found to predict time 2 life events and health behaviours in the no control models. When the control models were evaluated. neuroticism but not conscientiousness remained significant. The inter-model comparisons revealed that Model 3 (i.e.. no control variable stress/health behaviour mediator model) was the preferred model.

Model 1: Stress Moderator Model with Time 1 Controls

Overall / Incremental Fit and Power. The Satorra-Bentler Chi-Square statistic was found to be significant ($\chi 2$ [94, N = 706] = 148.35, p < .000: see Table 19). Conversely, the Goodness of Fit Index statistic suggested that Model 1 provided a good fit to the data (i.e., .97). In addition, the incremental fit measures (i.e., Comparative Fit Index = .97, Robust Comparative Fit Index = .97, Incremental Fit Index = .97) and Root Mean Square Error of Approximation (i.e., .039: 90% confidence interval = .032 ; .047) also suggests that Model 1 provides a good fit to the data. The exceedance probabilities test once again found the null hypothesis of close fit to be nonsignificant And last, statistical power was found to be 1.

Model Comparisons. The theoretical model was next compared to both the saturated structural and independence models. The saturated model was found to differ significantly from 0 ($\chi 2$[68, N = 706] = 158.21, p < .001). However, the difference in chi-squares was nonsignificant ($\chi 2$ difference [26, N = 706] = 38.72, ns). Given this finding, the data suggests that the theoretical model offers a more parsimonious explanation of the data.

The theoretical model was next compared to the independence model ($\chi 2$ [171, N = 706] = 3458.70, p < .000). The difference in chi-squares was found, as expected, to be significant ($\chi 2$ difference [77, N = 706] = 3261.77, p < .001), indicating that Model 1 provides a better explanation of the data than the baseline model.

Table 19

Measures of fit for Models 1-4 with physician utilization as the criterion

Model	χ^2	S-Bχ2	GFI / IFI	CFI / RCFI	RMSEA	RMSEA CI
1	196.93	148.35	.97/.97	.97/.97	.039	.032 : .047
2	86.51	55.35	.98/.98	.98/.99	.035	.023 : .046
3	107.64	103.32	.98/.97	.97/.97	.050	.039 : .061
4	9.74	8.87	.99/.99	.99/.99	.024	.000 : .055

Note. Model 1 = Stress Moderator Model with T1 Controls: Model 2 = Stress Moderator Model without T1 Controls: Model 3 = Stress/Health Behaviour Mediator Model with T1 Controls: Model 4 = Stress/Health Behaviour Mediator Model without T1 Controls: χ2 = Chi-Square: S-Bχ2 = Satorra-Bentler Chi-Square: GFI = Goodness of Fit Index: IFI = Incremental Fit Index: CFI = Comparative Fit Index: RCFI = Robust Comparative Fit Index: RMSEA = Root Mean Square Error of Approximation: CI = Confidence Interval.

Expected Cross-Validation and Bootstrap Simulations. To estimate the degree to which Model 1 would replicate in a new sample, the Expected Cross-Validation Index was calculated and found to be .55 (90% confidence interval = .500 : .614). The model chi-square remained significant over 65 replications (see Table 20). In addition, the mean Goodness of Fit Index was found to be .89 suggesting that the model could be improved by adding or deleting one or more parameters. However, the mean Comparative Fit Index suggested that, while attenuated, the model provides a good fit to the data. The Root Mean Square Error of Approximation was close to the .05 criterion (i.e., .06).

Parameter Estimates. When the critical ratios for the time 2 physician utilization dependent variable were examined, sex (+) and time 1 physician utilization (+) were found to be the only predictors of the criterion, with approximately 34% of the variance being explained (see Figure 5a). None of the five-factors were significant. Once again, time 1 health behaviour (+) was found to be the only significant predictor of time 2 health behaviour with approximately 52% of the variance in health behaviour scores being accounted for. And finally, time 1 life events (+), income (-), and neuroticism (-) were related to time 2 life events. Eighteen percent of the variance in time 2 life event scores was accounted for.

Overall, the results generally paralleled the findings obtained in the restriction of activity chapter: the structure of the model 1 was found to be statistically acceptable and when compared to the nontheoretical models, was preferred. Model 1 also stands a reasonable chance of cross-validating in a new sample based on both the Expected

Table 20

Expected Cross-Validation Index and bootstrap output for Models 1-4 with physician utilization as the criterion

			Bootstrap Analysis				
Model	q/df	ECVI (90% CI)	Ho: $\chi 2$ (sd)	$\chi 2$ (sd)	GFI (sd)	CFI (sd)	RMSEA (sd)
1	96/94	.55 .500:.614	3717.26 (260.09)	308.17 (38.31)	.899 (.03)	.94 (.01)	.06 (.01)
2	58/47	.29 .256:.330	2436.89 (239.21)	149.56 (33.27)	.94 (.02)	.96 (.01)	.05 (.01)
3	66/39	.34 .301:.389	2487.02 (134.21)	147.38 (22.93)	.95 (.02)	.95 (.01)	.06 (.01)
4	29/7	.09 .092:.114	1108.72 (94.98)	17.28 (7.62)	.99 (.00)	.99 (.01)	.04 (.02)

Note. Model 1 = Stress Moderator Model with T1 Controls: Model 2 = Stress Moderator Model without T1 Controls: Model 3 = Stress/Health Behaviour Mediator Model with T1 Controls: Model 4 = Stress/Health Behaviour Mediator Model without T1 Controls: q = Number of parameters: df = Degrees of Freedom: ECVI = Expected Cross-Validation Index: Ho:$\chi 2$ = Independence Model Chi-Square: $\chi 2$ = Chi-Square: GFI = Goodness of Fit Index: CFI = Comparative Fit Index: CI = Confidence Interval; RMSEA = Root Mean Square Error of Approximation: SD = Standard Deviation.

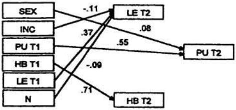

Figure 5a: Model 1 (Interaction Model with Controls)

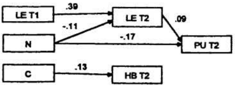

Figure 5b: Model 2 (Interaction Model without Controls)

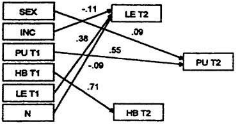

Figure 5c: Model 3 (Mediator Model with Controls)

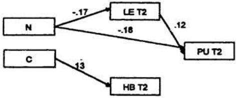

Figure 5d: Model 4 (Mediator Model without Controls)

Figure 5. **Summary of significant path analysis parameter estimates with physician utilization as the criterion. Interpretation of the abbreviations is as follows: Sex = Sex of Subject; INC = Income; PU = Physician Utilization; T1 = Time 1; T2 = Time 2; HB = Health Behaviour; LE= Life Events; N = Neuroticism; C = Conscientiousness.**

Cross-Validation Index and the bootstrapping simulations. None of the five factors were found to predict the physician utilization dependent variable. However, neuroticism did predict increased levels of life events suggesting that individuals who score high on a measure of neuroticism also tend to choose or create the context for negative events to occur. The next set of analyses examines the same model but without the control variables.

Model 2: Stress Moderator Model without Time 1 Controls

Overall / Incremental Fit and Power. Both the Satorra-Bentler Chi-Square statistic ($\chi 2$ [47, N = 706] = 55.35, ns) and the Goodness of Fit Index (i.e., .98) suggested that Model 2 provided a good fit to the data (see Table 19). The incremental fit measures were also strong, providing further support for the theoretical model (i.e., Comparative Fit Index = .98, Robust Comparative Fit Index = .99, Incremental Fit Index = .98). In addition, the Root Mean Square Error of Approximation was found to be .035 and within the 90% confidence interval (i.e., .023 : .046). Once again, the exceedance probabilities test indicated that the null hypothesis of a close fit could not be rejected (p = .989). Statistical power was found to be very strong (i.e., 1).

Model Comparisons. The first test compared the theoretical model with the saturated structural model ($\chi 2$ [29, N = 706] = 57.75, $p < .001$). The comparison yielded a chi-square difference of 28.76 with 18 degrees of freedom ($p > .05$). The second test compared the theoretical model with the independence model ($\chi 2$[91, N = 706] =

2260.96, p < .001). The difference in chi-square was found to be significant ($\chi 2$ difference [44, N = 706] = 2174.452, p < .000).

Expected Cross-Validation and Bootstrap Simulations. Cudeck and Browne's Expected Cross-Validation Index was found to be .29 (90% confidence interval = .256 : .330: see Table 20). Examination of the mean fit estimates over 65 replications provided some support for the initial findings. While the Satorra-Bentler Chi-Square statistic was found to be nonsignificant in the main analysis, the mean uncorrected chi-square was significant. This is consistent with the uncorrected chi-square value obtained in the original analysis (chi-square [47] = 86.51, p > .05). In addition, both the Goodness of Fit Index and Comparative Fit Index, while somewhat attenuated, were found to be in the mid .90s. The Root Mean Square Error of Approximation was found to be .05 (i.e., close fit).

Parameter Estimates. The critical ratios for each of the path coefficients were next examined (see Figure 5b). As can be seen from Figure 5b, time 2 physician utilization was predicted by both neuroticism (-) and time 2 life events (−): approximately 5% of the variance was accounted for by the variables in this equation. In addition, both neuroticism (-) and time 1 life events (+) were found to predict time 2 life events, while accounting for 17% of the variance. And last, conscientiousness (+) was found to be the only predictor of time 2 health behaviours. Approximately 2% of the variance in the criterion was accounted for.

As in the previous analysis, the model was statistically acceptable and found to be the preferred model when compared to both the saturated and independence models. Neuroticism was the only five-factor model variable to predict the physician utilization dependent variable. Neuroticism also predicted life events while conscientiousness was related to health behaviours. To assess the effects of the models without the five factors by life event interaction terms. models 3 and 4 will now be evaluated.

Model 3: Stress/Health Behaviour Mediator Model with Time 1 Controls

Overall / Incremental Fit and Power. The Satorra-Bentler Chi-Square statistic was found to be significant ($\chi 2$ [39. N = 706] = 103.32. $\underline{p} < .000$: see Table 19). The Goodness of Fit Index was found to be within an acceptable range (i.e.. .98). Furthermore. each of the incremental measures suggested that relative to the alternative model. Model 3 provided a good fit to the data (i.e.. Comparative Fit Index = .97. Robust Comparative Fit Index = .97. Incremental Fit Index = .97). In addition. the Root Mean Square Error of Approximation was found to be .050 and within the 90% confidence interval (i.e.. .039 : .061). The exceedance probabilities test indicated that the null hypothesis of a close fit was not rejected ($\underline{p} = .48$). Statistical power was found to be .99

Model Comparisons. As in the previous analyses. the theoretical model was found to provide a better explanation of the data than either the saturated structural or independence models. The difference in chi-squares between the theoretical model and the saturated model ($\chi 2$ [23. N = 706] = 87.45. $\underline{p} < .001$) was found to be nonsignificant

($\chi 2$ difference[16, N = 706] = 20.19, ns). And last, the theoretical model was found to differ significantly from the independence model ($\chi 2$[91, N = 706] = 2390.67, p < .000) with a chi-square difference of 2283.03 and degrees of freedom equal to 52 (p < .001).

Expected Cross-Validation and Bootstrap Simulations. The Expected Cross-Validation Index was found to be .34 (confidence interval = .301 : .389; see Table 20). The bootstrap simulation results provided further support for the overall and incremental fit indices obtained in the main analysis. While the mean chi-square was found to be significant, the Goodness of Fit Index and the Comparative Fit Index mean coefficients were both in the mid .90s (i.e., .95). Examination of the mean Root Mean Square Error of Approximation (i.e., .06) suggested that the theoretical model provides a close fit to the data.

Parameter Estimates. Figure 5c presents the parameter estimates for each of the path coefficients in Model 3. Examination of the critical ratios for the time 2 physician utilization measure indicated that both sex (+) and time 1 physician utilization (+) were the only variables to predict the criterion: 34% of the variance in the time 2 scores were accounted for. When the time 2 life events criterion was examined, time 1 life events (+), income (-), and neuroticism (-) were found to be significant. Eighteen percent of the variance in the time 2 scores was explained by the variables in this equation.

And last, time 1 health practices (+) was found to predict time 2 health practices, with 52% of the variance explained. Both conscientiousness and openness failed to predict any variance over and above the time 1 variable.

Overall, the data indicate that Model 3 was found to be structurally within acceptable limits of model fit. Model 3 was also found to have a reasonable chance of cross-validating in a new sample. When the actual beta weights were evaluated, none of the five factors predicted physician utilization although neuroticism did predict life events over and above income and time 1 life events.

The next set of analyses will be conducted with Model 4. This will be followed by a comparison of the four models. The last section of this chapter will present the results using the subgrouping method.

Model 4: Stress/Health Behaviour Mediator Model without Time 1 Controls

Overall / Incremental Fit and Power. The Satorra-Bentler Chi-Square statistic ($\chi 2$ [7, N = 706] = 8.87, ns) and the Goodness of Fit Index (i.e., .997) indicated that Model 4 provided an excellent fit to the data (see Table 19). Examination of the incremental indices corroborated both coefficients of overall fit (i.e., Comparative Fit Index = .997, Robust Comparative Fit Index = .998, Incremental Fit Index = .997). In addition, the Root Mean Square Error of Approximation was found to be .024 and within the 90% confidence interval (i.e., .000 : .055). The exceedance probabilities test indicated that the null hypotheses of both close (p = .905) and perfect (p = .204) fits could not be rejected. Statistical power was found to be .63.

Model Comparisons. The chi-square difference tests provided support for the overall structure of the model. The saturated model ($\chi 2$[0, N = 706] = 0, ns) failed to differ from

Model 4 ($\chi 2$ difference [7, N = 706] = 9.74, ns). In addition, when Model 4 was compared to the independence model ($\chi 2$ [28, N = 706] = 1079.09, $p < .001$), the difference in chi-squares was found to be significant ($\chi 2$ difference [21, N = 706] = 1069.35, $p < .001$).

Expected Cross-Validation and Bootstrap Simulations. The Expected Cross-Validation Index was found to .096 and within the 90% confidence interval (i.e., .092 : .114; see Table 20). The bootstrap simulations once again corroborated the main findings. The mean chi-square was found to be nonsignificant, as in the main analyses. In addition, the Goodness of Fit Index and the Comparative Fit Index were found to be very high (i.e., .99). And last, the Root Mean Square Error of Approximation, though somewhat higher (i.e., .04), was found to be less than Cudeck and Browne's .05 criterion.

Parameter Estimates. Figure 5d presents the parameter assessments for each of the path coefficients. As can be seen from Figure 5d, both time 2 life events (+) and neuroticism (-) were found to be the only predictors of time 2 life events; approximately 5% of the variance in the time 2 criterion was explained. In addition, neuroticism (-) was found to predict the time 2 physician utilization dependent measure (3%). And last, conscientiousness (+) was the only variable to predict the time 2 health behaviour variable. Two percent of the variance in time 2 health behaviour scores was explained.

The results indicated that Model 4 is sound structurally. When the regression weights were examined, neuroticism was the only variable of the five factors found to predict physician utilization. Neurotici sm also predicted life events while conscientiousness was related to health behaviour.

To determine which model is the preferred model in terms of the amount of total variance explained per model. the four models will now be compared using the W-test.

Overall Model Comparisons

The W-test was calculated for each of four model comparisons (see Table 21). As Table 21 suggests. the findings provide support for several of the primary hypotheses. When Model 1 (i.e.. interaction with time 1 controls) was compared with Model 2 (i.e.. interaction with no controls). the analysis revealed a significant W-Test coefficient. In this case. Model 1 is preferred given the extra variance accounted for with the addition of the time 1 variables.

The second comparison was between the control variable stress/health practice mediator model (i.e.. Model 3) and the no control variable stress/health behaviour mediator model (i.e.. Model 4). As in the first comparison. the W-test was found to be significant suggesting that Model 3 is to be preferred. The third comparison was between Models 1 and 3. As the results suggest. Model 3 is preferred given that fewer parameters were required. The last comparison involved the no control models (i.e.. Models 2 and 4). As might be expected. given that time 1 life events remained in the model. the models differed significantly from each other. In the latter instance. Model 2 is thus the preferred model.

Overall. Model 3 is to be preferred. The model comparisons suggested that the stress/health behaviour mediator model without controls is the best model in terms of the

Table 21

Four model comparisons based on the W-Test (Specht, 1975) with physician utilization as the criterion

Comparison	W	df
Model 1 vs. Model 2	750.65**	15
Model 3 vs. Model 4	856.26**	18
Model 1 vs. Model 3	3.56	15
Model 2 vs. Model 4	112.42**	18

Note. Model 1 = Stress Moderator Model with T1 Controls: Model 2 = Stress Moderator Model without T1 Controls: Model 3 = Stress/Health Behaviour Mediator Model with T1 Controls: Model 4 = Stress/Health Behaviour Mediator Model without T1 Controls: W = W-Test result: df = Degrees of Freedom.
** $p < .001$.

total variance explained per model. The last set of analyses will reassess the four models using the subgrouping method.

Subgrouping Analyses

The first analysis examined the time 1 stress interaction model without any cross-group constaints for time 2 physician utilization. Save the normal chi-square test statistic ($\chi 2[64, N = 706]=132.85$, $p <.001$), the Goodness of Fit Index (.97), and the incremental fit measures, the overall comparison was found to be reasonable (i.e., Comparative Fit Index = .97, Incremental Fit Index = .97). The Root Mean Square Error of Approximation was found to be .039 and within the 90% confidence interval (i.e., .030 : .048). The next step entailed rerunning the same model for both groups with the big five factors constrained to be equal across groups. Examination of the output indicated that each of the constraints were correctly imposed: there were no significant differences among the parameter estimates. The chi-square difference ($\chi 2$ difference$[5, N = 706] = 4.09$, ns) was not significant. The chi-square for the constrained model was found to be significant ($\chi 2[69, N = 706] = 136.93$, $p < .001$). The Goodness of Fit Index (i.e., .97) and the incremental measures were similar to those found in the unconstrained solution (i.e., Comparative Fit Index = .97, Incremental Fit Index = .97).

The interaction model without the time 1 controls was then tested. As in the previous analyses, the overall fit for the unconstrained solution was excellent ($\chi 2[14, N = 706] = 14.02$, ns; Goodness of Fit Index = .995), as were the incremental measure coefficients (i.e., Comparative Fit Index = 1, Incremental Fit Index = 1). The Root Mean Square Error of Approximation was found to be exceptionally good at .002 and within the 90% confidence interval (i.e., .000: .036). The constrained model was then run. While all constraints were found to be correctly imposed, none of the constraints were significant. In addition, the difference in the chi-squares was found to be nonsignificant ($\chi 2$ difference[5, N = 706] = 3.73, ns).The overall fit measures for the constrained model failed to show any appreciable change (i.e., $\chi 2$[19, N = 706] = 17.75, ns; Comparative Fit Index = 1, Incremental Fit Index = 1, Root Mean Square Error of Approximation = .000, Root Mean Square Error of Approximation 90% confidence interval = .000 : .031).

As in the main analyses, no moderation/interactive effects were detected using the subgrouping method.

Final Summary

Each of the models provided a good fit to the data; this was partially supported by the simulations. The overall structure for each of the models was further supported when compared to both the saturated structural and independence models. In all cases, the theoretical model provided a better explanation of the covariance matrix than either of the alternative models. As in the previous analyses, the time 1 control models (i.e., Models 1 and 3) accounted for a greater portion of the variance than the no control models. In the no control models, neuroticism was found to be the only big-five predictor of time 2 physician utilization and life events; conscientiousness was found to predict time 2 health behaviours. However, these effects were erased when the time two controls were incorporated into the model. Neuroticism was the only big five factor to have a residual effect when the time 1 variables were controlled. That is, neuroticism had an effect over and above time 1 life events. These findings were validated by use of the subgrouping method.

When the four models were compared, the control variable mediator model (i.e., Model 3) once again was the preferred model. When Model 3 was compared to the interaction model with the time 1 controls (i.e., Model 1), no difference was observed. As expected, both Models 1 and 3 differed significantly from their no control variable counterparts. As in the previous comparisons, when Model 1 (i.e., the control variable stress moderator model) was compared to Model 3 (i.e., the control variable stress/health practices mediator model), the latter had a smaller Expected Cross-Validation Index. Once again, Model 3 is the preferred model.[76]

General Summary: Models 1 - 4 for each of the Time 2 Health Status Criteria

Four models were compared across three health status criteria, restriction of activities, general health, and physician utilization. With few exceptions, in each case, the four models were found to meet the criteria for model acceptance. While Model 4, the no control mediator model, was found to have the greatest chance of cross-validating in a

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[76] For each model and health criterion, components of Models 1-4 were replicated in an informal analysis using SPSS 7.5 for Windows. There were few differences across programs further suggesting that the models were correctly specified.

new sample. Model 3 (i.e., control variable mediator model) accounted for more of the variance in the criteria. The bootstrap statistics suggested that, in general, each of the four models were relatively stable in terms of model acceptance. The subgrouping analyses supported the main interaction modeling findings.

In keeping with the planned analyses, the next chapter provides a *Templated Summary* of the Models 3 and 4 results across each of the three dependent variables by combining each of these models, minus the nonsignificant paths found in the original analyses. The purpose of these analyses was to determine if the significant paths or beta weights in both models would hold without the nonsignificant paths. Because these analyses are essentially model generation strategies or post hoc assessments (Joreskog & Sorbom, 1993), they need to be replicated with a new sample of subjects (MacCallum, Roznowski, & Necowitz, 1992). The template analyses also provide an additional assessment of the variance versus theory debate.

RESULTS 6:

Template Analyses

Overview

The original model 3s and 4s (summaries for models 3 and 4 can be found in Figures 6 and 7) were reconfigured or templated creating two respecified models. The results from these analyses provide support for both of the new models. As the Discussion section will elaborate, model selection may depend on the extent to which one incorporates autoregressive variables into one's models.

Template Models. The results from the previous analyses suggested that model 3 was the most parsimonious of the models that accounted for most of the overall variance. The results from these analyses also indicated that several paths were nonsignificant although several distinct patterns were evident. To determine if these significant paths would hold when reconstructed or respecified into a modified configuration of relationships, an elaboration of Model 3 was developed that took each Model 3 output (i.e., restriction of activities, general health, physician utilization) into account. The only difference between the respecified model and the original Model 3 is that the general health composite is seen as causal to both physician utilization and restriction of activities (see e.g., Andersen, 1995). While no causal direction was hypothesized between restriction of activities and physician utilization, a covariance between the variables was predicted. The templated Model 4 was similarly treated.

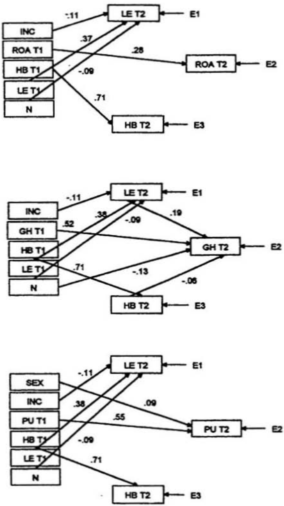

Figure 6. Summary of significant Model 3 parameter estimates for each health status criterion variable.

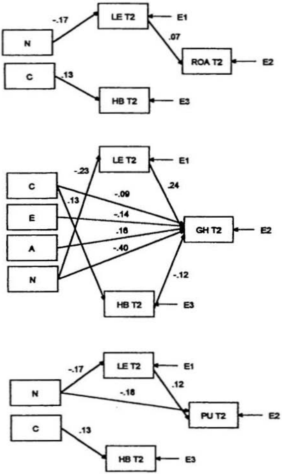

Figure 7. Summary of significant Model 4 parameter estimates for each health status criterion variable.

Figures 8 and 9 summarizes the significant paths for the reconfigured Models 3 and 4.[77] Examination of the output suggested that, with the exception of the Satorra-Bentler Chi-Square statistic ($\chi2[43, N = 706] = 130.41$, $p < .00$), Model 3 provided a good fit to the data (i.e., Goodness of Fit Index = .97, Comparative Fit Index = .96, Robust Comparative Fit Index = .95, Incremental Fit Index = .96, Root Mean Square Error of Approximation = .058, Root Mean Square Error of Approximation confidence interval = .048 ; .068). With Model 3, it appears that the relationship between neuroticism and physician utilization may be mediated by general health, that conscientiousness and time 2 health behaviours may be mediated by time 1 health behaviours, that general health may mediate the relationship between time 2 life events and both physician utilization and restriction of activities, that physician utilization may mediate the relationship between life events and restriction of activities, and that restriction of activities may mediate the relationship between time 2 life events and physician utilization. As Figure 8 indicates, each of the path coefficients were significant. The data suggests that general health may mediate the relationship between neuroticism and time 2 physician utilization and restriction of activities.

For the respecified Model 4, overall fit was found to be excellent (Satorra-Bentler $\chi2$ [16, N = 706] = 17.87, $p = .33$: Goodness of Fit Index = .99). In addition, the Incremental Fit Index (.99), Robust Comparative Fit Index (.99), and the Root Mean

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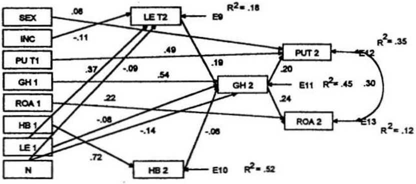
[77] It was originally thought to include physician utilization and restriction of activity variables in each of the four path models. However, this would have made estimation difficult with the parameter to subject ratio exceedingly small.



<u>Figure 8</u>. Revised Model 3 path diagram and parameter estimates.

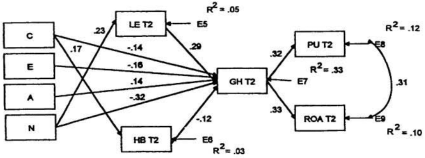


Figure 9. Revised Model 4 path diagram and parameter estimates. Interpretation of the abbreviations is as follows: C = Conscientiousness; E = Extraversion; A = Agreeableness; N = Neuroticism; T1 = Time 1; T2 = Time 2; LE = Life Events; HB = Health Behaviours; GH = General Health; PU = Physician Utilization; ROA = Restriction of Activities; Sex = Sex of Subject; Inc = Income.

Square Error of Approximation (.02: confidence interval = .000:.054) all provided respectable values. Comparatively, the Root Mean Square Error of Approximation confidence interval was wider for Model 4 than Model 3. Examination of the path coefficients for Model 4 indicated that all paths, save the time 2 life events to time 2 physician utilization, time 2 life events to time 2 restriction of activities, and the neuroticism to physician utilization relationship, were all significant (see Figure 9). With Model 4, each of the four factors appear to have a direct impact on general health while both conscientiousness and neuroticism may also transmit effects through time 2 health behaviours and life events, respectively. However, the relationship between conscientiousness and general health appears to be partly mediated by time 2 health behaviours.

Final Summary

The results provide support to both hypothesized models. Overall fit was good and most of the path coefficients were significant. The findings once again point to the complexities of the variance versus theory debate, suggesting that the control variables tend to erase many of the person to health relationships even when the relationships are theorized. This last set of analyses concludes the planned analyses. The discussion now follows.

Discussion

The purpose of this dissertation was to examine the relationship of the five-factor model of personality to health, life events, and health behaviours. Based on the causal primacy hypothesis, two questions were evaluated. First, to what extent are the five factors related to health status? And second, how are the five-factors related to health status? To answer these questions, a series of models were constructed, tested, and subsequently compared with other competing models.

Two overarching sets of hypotheses were developed for each of the models. The primary hypotheses focused on non-process and path analytic between model comparisons, as well as parameter predictions. It was expected that with both model types, the full or control variable models would account for more of the variance than the restricted or no control variable models. It was also predicted that the full interaction/stress moderation models would explain more of the variance than the full direct effect or stress/health behaviour mediator models.

Several parameter hypotheses were also developed. In general, it was expected that (1) the autoregressive variables (e.g., health behaviours) would have a stronger impact on the criteria than the nonautoregressive variables (i.e., the five factors): it was not clear to what extent the nonautoregressive variables would effect the dependent variables, (2) the effect of life stress on health status would be moderated by the five-factors, (3) conscientiousness and openness to experience would be positively related to health behaviours, (4) life events would be positively related to health behaviours, (5) life events and health behaviours would be positively and negatively related to health status, respectively, and (6) each of the five-factors would be inversely related to negatively valenced health status measures. As this chapter will show, several of these predictions were supported, albeit with qualification.

Several secondary predictions were also constructed. The first was that the physician utilization and restriction of activity questions would load on two separate, though correlated components. The remaining variables, positive and negative affect, the one-item general health measure, chronic conditions, and perceived physical symptom variables would load on one to two correlated components. No specific predictions were made with respect to component content. In general, the results indicated that the data could be described by three components, two of which supported the hypotheses.

The discussion will proceed by first addressing the primary findings, followed by a presentation concerning the personality-health status relationship. The discussion will then proceed by addressing the implications and then the strengths and limitations of the present research. The dissertation will conclude by commenting on several issues raised during the course of this research with suggestions for future study.

Primary Findings

Correlational Findings. Examination of the correlations revealed several expected and new findings. For example, time one and time two life events were negatively correlated with conscientiousness, agreeableness, and emotional stability (i.e., neuroticism) suggesting that individuals who are planful and systematic as well as trusting, altruistic, and stable, tend to experience or create fewer negative events. This contradicts past research which has shown only neuroticism to be related to negative life events (e.g., Magnus, Diener, Fujita, & Pavot, 1993). In addition, both life events measures were related to time one and time two health practices, illness behaviour, as well as several physical (e.g., chronic conditions), and psychological measures of health (e.g., general health composite).

Interestingly, while openness to experience was correlated with time one health behaviours, it was not correlated with the time two measure, suggesting that its effect may be short-term, at least with respect to general health behaviour. Furthermore, conscientiousness, agreeableness, and neuroticism were correlated with both time one and time two health behaviours, suggesting that individuals who scored high on each of these measures also tended to report engaging in more health behaviours. The latter findings extend previous research (e.g., Booth-Kewley & Vickers, Jr., 1994) by suggesting that several of the five-factors are linked to global as well as specific measures of health behaviours. In addition, both time one and two health behaviours were correlated with several objective (e.g., physician usage frequency, physician utilization composite, activity questions) and subjective measures of health (e.g., positive affect, symptom intensity).

As expected, the five factors were moderately correlated with each other, thus supporting Gordon Allport's suggestion that personality traits are interconnected (Allport, 1961). Openness to experience was correlated with both positive and negative affect, as well as time one physician utilization frequency, and time one and two general health (i.e., composite), with the latter representing new five-factor findings. The openness to experience to physician utilization relationship needs to be further assessed given that it failed to correlate with time two physician utilization frequency.

As predicted, conscientiousness was found to be related to positive and negative affect, time one and two chronic conditions, the time 1 activity questions, physical symptoms, the 1-item general health question, and the time one and two general health composites. The latter relationships extend past research by suggesting that conscientiousness may be related to other health related measures in addition to affect (Watson & Clark, 1992), and longevity (Friedman, Tucker, Tomlinson-Keasey, Schwartz, Wingard, & Criqui, 1993). For example, contrary to past research (Costa, Jr. & McCrae, 1987a), the present study found conscientiousness to be inversely related to time one and two physical symptoms. In research by Costa, Jr. and McCrae (1987a), conscientiousness was found to be unrelated to a measure of physical symptoms. One explanation is that there was insufficient statistical power to test their hypotheses.

In general, extraversion was correlated with each of the subjective health status variables (i.e., 1-item general health question), but not the objective measures (e.g., chronic conditions). Similar findings were observed for agreeableness. While agreeableness was correlated with the subjective health status measures, it failed to correlate with the objective measures, with the exception of the time one days in bed question, and the time one chronic conditions measure. As with the other factors (e.g., openness to experience), agreeableness may have a short-term effect or be linked to specific effects (e.g., hostility and coronary heart disease: e.g., Costa, Jr., McCrae, & Dembroski, 1989). Further research is needed to verify this.

Neuroticism appeared to be the most consistent personality factor of the five to be related to health status and the health-related measures. For example, neuroticism was related to physician utilization frequency, the physician utilization composite, chronic conditions, the time one restriction of activities composite, as well as each of the subjective health status measures.

Overall, the correlational analyses provided tentative support for several of the parameter hypotheses. The analyses also suggested that the five-factors are related to several other health status, health behaviour, and life event variables (e.g., general health). However, as the following will discuss, when the effects of the five-factors and control measures were simultaneously assessed, several of these relationships disappeared. A subsequent question then becomes, how should the data be interpreted. This issue will be addressed in a latter section.

Non-Process Models. The results provided modest support for several of the primary hypotheses, specifically the inter-model comparisons, and to some extent, the parameter hypotheses. Across each of the health status variables, the full direct effects model was found to account for as much or more of the variance in the health status criterion as the other three models. As was also expected, the autoregressive variables had the strongest impact on each of the criteria than the nonautoregressive variables. What was not clear. was the extent to which the autoregressive variables would impact on the relationships between the nonautoregressive predictors and the outcome. In most cases, inclusion of the autoregressive variables erased or attenuated the effects of the five-factors on health status. Across each of the health status measures. neuroticism appeared to have the most consistent effect although some of these relationships disappeared when the controls were added. Thus. while the correlational analyses suggested that personality is linked to health status. these relationships were subsequently reduced when a broad model of personality and several statistical controls were considered.

The results also suggested that. and with some qualification. the effects of personality on health status tend to be somewhat redundant. direct. and noninteractive. For example. while several of the five-factors were found to be correlated with various health status measures. some but not all of these effects disappeared when each of the five factors were considered in the regression analyses. In addition. while a number of significant interactions were observed in the data. these appear to be due to sampling error. In many of the cases. when the restricted interaction model was compared to the restricted main effects model. and the restricted interaction model was compared to the full interaction model. no differences emerged between full and restricted models. strongly suggesting that the additional variance accounted for by the interactions was trivial. In addition. with 13 dependent measures. 130 interactions and with four significant interactions. the probability that a number of Type 1 errors occurred was one in twenty. Therefore, the results suggest that the observed interactions were due to chance.

The results also suggested that personality was more related to the subjective as opposed to the objective health status measures, at least with respect to the restricted direct effect and interaction models. For example, conscientiousness, extraversion, agreeableness, and neuroticism where found to be related to both the single-item and composite general health status measures. The five factors were also related to both positive and negative affect (see e.g., McCrae & Costa, Jr., 1991a). However, several of these relationships were reduced in magnitude when the control variables were added. Of further interest was the modest though positive effect of openness to experience and extraversion on positive affect. The former relationship was found across each of the four models and unlike the other variables, remained significant even when controls were added. This suggests that the effects of personality on health status may in part, depend on the qualitative nature of the criterion. Contrary to past research, extraversion did not remain significant when the full interaction model was tested. However, it was significant in three of the four models even when the full direct effects model was tested. (Costa, Jr. & McCrae, 1980). These findings suggest that while the effects of extraversion and openness to experience on well-being may be modest, the relationships warrent further investigation.

Conversely, and with few exceptions, personality was not related to the objective measures of health status or more specifically, illness behaviour (i.e., restriction of activities) and sick-role behaviour (i.e., physician utilization). For example, none of the five factors were linked to physician utilization when assessed within the framework of the full direct effects and interaction models. Interestingly, across each of the four models, agreeableness was found to predict both chronic conditions and physical symptoms, suggesting that individuals who are more agreeable tend to experience more symptoms and chronic conditions. As Costa, Jr. and McCrae (1995a) point out, being too agreeable may bring on adverse consequences. Such problems may arise because the person may pay little attention to their own interests. However, the correlational analyses suggested that agreeableness was unrelated to chronic conditions but negatively related to symptoms; thus, the data suggests that at least with the regression output, the effects of agreeableness on both criteria were probably due to statistical suppression (see Tabachnik & Fidell, 1989). The interpretation of the agreeableness to symptoms relationship remains unclear given the negative correlation but positive beta weight.

Process Models. Support was also found for the general structure of the path models. In all cases, model fit was found to range from good to excellent across both the main and bootstrapped analyses. The results also indicated that the theoretical models were preferable to both saturated and independence models, suggesting that the implied covariance matrix was superior to both of these baseline comparison models. One interpretation of these findings is that the analyses failed to distinguish among theoretically useful models. However, given that the present study represents a step forward in five-factor research, such findings are actually quite useful in building theoretical bridges (MacCallum, Wegener, Uchino, & Fabrigar, 1993).

Across each health status variable, the control variable stress/health behaviour mediator model (i.e., Model 3) was found to account for most of the variance with a minimum number of parameters. In addition, when compared to the control variable stress moderator model (i.e., Model 1), Model 3 was found to have a smaller expected cross-validation index and confidence interval suggesting that it would have a greater chance of cross-validating in a new sample.

With the exception of an openness to experience by life events interaction with restriction of activities serving as the criterion (i.e., Model 2: no control variable stress moderator model), no other moderator effects were detected. Given the number of interaction term hypotheses tested across each of the three criterion variables, this finding was in all likelihood spurious. Furthermore, this effect was found only when the corrected maximum likelihood standard error was interpreted (i.e., robust estimator). The non-robust maximum likelihood estimate failed to reach significance. [78] And third, the effect disappeared when the time one variables were accounted for.

As in the previous section, the most consistent finding was that the autoregressive variables had the strongest impact on their respective time two counterparts, than the five-factors or demographic and socioeconomic status variables. When restriction of activities served as the criterion, none of the five-factors were found to be significant.

[78] EQS outputs both corrected and uncorrected critical ratios. To simplify the results, the uncorrected estimates were not reported. However, in the vast majority of cases, the results were similar as were the results of the regression analyses.

Interestingly, time two life events and health behaviours did not predict the restriction of activities criterion with the exception being in Model 4, the no control variable stress/health behaviour mediator model. With Model 4 (i.e., the no control variable stress/health behaviour mediator model), when the time one life events variable was omitted from the analyses, time two life events was found to predict the restriction of activities criterion suggesting that time one life events was more related to the criterion than time two life events. Once again, the relationship between time one life events and the outcome appears to be due to a suppressor effect given its negative beta weight.

Similar findings were observed when the physician utilization composite variable served as the criterion variable. As in the previous analyses, time one physician utilization had the strongest impact on time two physician utilization. In models one (i.e., control variable stress moderator model) and three (i.e., control variable stress/health behaviour mediator model), neuroticism was found to have a weak indirect effect on time two physician utilization through life events.

Consistent with the extant literature (e.g., Booth-Kewley & Vickers, Jr., 1994), conscientiousness was found to predict time two health behaviour in models two (i.e., no control stress moderator model) and four (i.e., no control variable stress/health behaviour mediator model). However, this effect was erased when the time one health behaviour variable was controlled. Several explanations may be offered to account for this observation. First, the conscientiousness variable was confounded with health behaviours. However, examination of the conscientiousness scale adjectives do not indicate the presence of item overlap (Booth-Kewley & Vickers, Jr., 1994). Second, conscientiousness is unrelated to health behaviours and any relationship between the two is spurious. This second hypothesis appears untenable given that previous research has linked both variables (e.g., Booth-Kewley & Vickers, Jr., 1994). And third, that time one health behaviours mediates the relationship between conscientiousness and time two health behaviours. Given that health behaviours tend to be less stable than personality, both conceptually and empirically, this appears plausible despite the high test-retest correlation of the health behaviour measure. This issue will be addressed in more detail in a subsequent section.

Furthermore, while openness to experience was correlated with time one and time two health behaviours, it failed to predict the health behaviour outcome in each of the four models. Based on previous research, while openness to experience may be correlated with both specific (e.g., Booth-Kewley & Vickers, Jr., 1994) and global measures of health behaviours (i.e., present study), the extent to which it predicts health behaviours six months later, when other factors are included, appears limited. Research may need to validate these findings with shorter time intervals. As predicted, both income and neuroticism were found to predict the time two life events dependent measure (see e.g., Magnus, Diener, Fujita, & Pavot, 1993). Neuroticism was found to predict time two life events over and above the time one life events control, suggesting that individuals who scored high on the measure of neuroticism reported more problems than those who were found to have lower scores.

Interestingly, when the general health composite served as the criterion, four of the five factors (i.e., conscientiousness, extraversion, agreeableness, neuroticism) were found to predict the criterion in the no control variable stress moderator and the stress/health behaviour models. In addition, both neuroticism and conscientiousness were related to time two life events and health behaviour, respectively. These latter findings replicate and extend past research (e.g., Booth-Kewley & Vickers, Jr., 1994; Magnus, Diener, Fujita, & Pavot, 1993). Furthermore, both time two life events and health behaviours were positively and negatively related to time two general health, respectively. These latter findings remained significant when the time one control variable models were assessed. However, neuroticism was found to be the only big five variable to predict the health status criterion. Overall and across each of the four models, neuroticism was found to be the most consistent predictor of health status, more so than conscientiousness, extraversion, agreeableness, and/or openness to experience. The finding that neuroticism is linked to subjective health status but not objective health status supports Stone and Costa, Jr.'s (1990) contention of neuroticism as a distress-prone personality trait. That is, individuals who score high on a measure of neuroticism, tend to report more symptoms of physical illness. These symptoms may partly result from their exposure to a greater number of life events. Examination of the time two general health composite variable regressions suggested that the five factor to general health status relationships were mostly due to the positive affect variable (i.e. five regression effects), followed by the one-item general health variable (i.e., four effects), as well as physical symptom intensity (i.e., two effects) and negative affect (i.e., one effect).

Based on the overall path model findings, two template models were constructed and analyzed. In general, the findings from the templated control variable stress/health behaviour mediator model (i.e., Model 3) provided support for each of the reconstructed paths. In general, the results suggested that neuroticism affects general health status directly, and indirectly through life events. In turn, general health was found to be related to both physician utilization and restriction of activities. These latter findings support previous research by Andersen (1995) who argues that need is causally connected to physician utilization. In the Model 4 analysis (i.e., no control model), the data suggested that conscientiousness, extraversion, agreeableness, and neuroticism are related to general health and that conscientiousness and neuroticism are related to time two health behaviour and life events, respectively. In addition, the results support the notion that general health (e.g., need) may partly mediate the neuroticism to physician utilization relationship.[79] Given the data driven nature of these latter findings, the results from each of these analyses need to be replicated.

As expected, the 10 health status variables for each of waves one and two were found to be explained by three moderately correlated components. That is, each of the physician utilization and restriction of activity questions loaded on two separate components;

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[79] See Andersen (1995) for a general discussion of these models.

unexpectedly, the chronic conditions variable was found to load on both time one and time two physician utilization components suggesting that the nature of the physician visits was at least partially based on various chronic conditions (i.e., validation). The third component was comprised of both positive and negative affects, physical symptoms, and general health. Because this factor was comprised of both psychological (i.e., affect) and physical (i.e., symptoms) aspects of health, this factor was labelled general health (see Ware, Jr., 1986). Examination of the hyperplane count for at least two of the factors (i.e., general health, restriction of activities) strongly suggested that simple structure was approximated. While the physician utilization component had a low zero loading structure, the component was conceptually interpretable. Statistically, there were also near zero loadings in the other components. Theoretically, the findings were for the most part, as predicted.

Overall, the findings from the present study question the view that the five factors are *intimately* linked to health status and behaviour, although some effects were found that are consistent with the literature. In the latter case, neuroticism appears to be the most robust component of the five factors. However, as the next section will suggest, personality's impact appears to be modest, subtle, and complex.

Does Personality Affect Health Status?

The present study had considered a number of theoretical issues, one of which concerned the theory versus variance debate. From the variance perpective, it was pointed out that autoregression may in part or fully account for the effects of personality on health status, while maximizing the variance in the criterion. Support for the theory view would be found to the extent that the predictions were met. Examination of the regression and modelling analyses tended to support these expectations. That is, from the variance perspective, the data suggested that personality had little though some effect on health status, sick-role, and illness behaviours. For the most part, neuroticism was the best predictor of the five factors. From the theory viewpoint, personality was found to have a greater number of linkages with health status, and to a lesser extent physician utilization.

At this point, it would be premature to conclude that the five factor's effect on health status, sick-role or illness behaviours is trivial or nonexistent. While neuroticism tended to be the strongest predictor and although these relations were of modest size in some analyses, the findings from the study suggest that there may be other five factor effects. Several reasons justify this contention. Methodologically, even when autoregression is considered, the five-factors were still linked to other health status variables. For example, apart from the modelling analyses, the results of the regression analyses found that neuroticism was related to the one-item general health measure, physical symptoms and negative affect, while agreeableness was associated with physical symptoms, and extraversion as well as openness to experience were related to positive affect. These effects were found even after several variables were controlled for.[80] In a similar vein,

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[80] See Scheier, Carver, and Bridges, 1994 for a similar discussion related to dispositional optimism.

there may be specific facet effects (i.e., components for each of the five factors) in addition to domain effects (i.e., the five factors). While it was not possible to test for any such effects, research suggests that the more specific facets of the model may be connected to health status above those effects accounted for by the more global five-factor markers (see e.g., Axelrod, Widiger, Trull, & Corbitt, 1997; Dunkley, Blankstein, & Flett, 1997; Velting & Liebert, 1997). Several methodological and statistical issues need to be considered as well when determining the impact of the five-factors on health status, including but not limited to, measurement error (Judd, Jessor, & Donovan, 1986), the time between the lagged variables (Gollob & Reichardt, 1987), and the type of data (e.g., interval versus ordinal data: Gowan, Riordan, & Gatewood, 1999).

A variety of theoretical and conceptual issues need to be considered as well, especially with respect to autoregression. For example, according to Hertzog and Nesselroade (1987), use of autoregression may be contraindicated in some cases, especially those where the first-order variable is more state oriented. Given a more state oriented variable, the assumption of temporal stability of the autoregressive longitudinal model may be called into question. While the health outcome measures were not trait or state based, the health outcome measures are conceptually as well as empirically more transient, labile, or less stable than personality but not state like (see West & Graziano, 1989). Based on this line of reasoning, autoregression may be of questionnable use in some health related studies. A second case where autoregression would be contraindicated would be in those cases where such variables would be impossible to measure, such as or mortality (e.g., Friedman, Tucker, Schwartz, Martin, Tomlinson-Keasey, Wingard, & Criqui, 1995). In these instances, personality (e.g., conscientiousness) was found to be related to the criterion.

A second theoretical argument focuses more on the interpretation of the between model comparisons (i.e., control versus no control models). One interpretation of the data has been presented. Specifically, it was suggested that the five-factors have a modest effect on health outcome and practice, at least when the nonautoregressive models were considered. A second interpretation is that the time one autoregressive variables may have mediated the five-factor and time two health status relationships. One assumption of the mediation hypothesis is that the relation between a predictor (e.g., personality) and outcome (e.g., health) would disappear once the mediator is introduced into the analysis. Two effects were noted to support this assertion. First, in a number of the no control variable analyses (i.e., regression, structural equation modelling), the five-factors were found to be related to health status (e.g., general health). However, when the controls were implemented, these relationships tended to disappear or diminish in magnitude. Note that the time one to time two health relationships did not disappear but that the effects of personality did. Therefore, the impact of the five-factors on future health status may be mediated by initial health status. In this case, given the stable nature of personality (see e.g., Costa, Jr. & McCrae, 1980; West & Graziano, 1989), there may be some primacy underlying the causal primacy hypothesis of personality.

While these arguments suggest that various methodological and theoretical issues be considered when examining the impact of personality or more specifically, the five-factors on health status, the data does have some empirical basis in the literature. For example, because the five-factors had little effect on the more objective health, sick-role and illness behaviour measures, the data supports Stone and Costa, Jr.'s (1990) contention of a distress-prone personality construct. No support was found for a disease-prone personality (Booth-Kewley & Friedman, 1987).

In general, it is suggested here that researchers need to untangle the theoretical, methodological, and statistical complexities before minimizing the significance of the five-factors, or more generally, personality, as trivial influences in matters of health. The next section will describe some of the implications arising from the present research.

Implications

The present study gives rise to several practical or clinical implications. The following is developed based on the premise that, within reason, the five-factor model is a useful set of personality constructs applicable within both basic and applied (e.g., clinical) contexts.

Based on the biopsychosocial model, three implications evolve from this research (see Taylor, 1991). Given that the five factors were found to be variously related to general health, the first implication is that prior to diagnosis and treatment, assessment needs to incorporates biological, social, and psychological elements. It is at the psychological level where the impact of the five-factor model may be most felt, although for some constructs of the model (i.e., agreeableness and extraversion), the social component maybe tapped into as well. For example, some research suggests that the five-factor measurement system, in particular the NEO-PI-R (Costa, Jr., & McCrae, 1992a) may benefit clinicians (e.g., Ben-Porath & Waller, 1992; Costa, Jr., 1991; Costa, Jr., & McCrae, 1992c; Fagan, Wise, Schmidt, Jr., Ponticas, Marshall, & Costa, Jr., 1991; McCrae & Costa, Jr., 1991b; Miller, 1990; Muten, 1991). According to Costa, Jr. (1991) and McCrae (1991), there are several benefits associated with use of the five-factor system in clinical practice: (i) the five-factor system may be useful at the diagnostic stage; (ii) the system may aid in the development of therapist empathy; (iii) the system may aid the therapist in selecting an appropriate treatment for the client; (iv) the system may help the therapist and client by identifying client strengths; (v) the system may help to predict treatment outcome, duration, and course of therapy; (vi) because the five-factor system is based on a variety of emotional, interpersonal, and motivational styles, it has direct relevance to several clinical disorders; and (vii) unlike most instruments used in clinical practice, the five-factor system provides the therapist with a comprehensive tool for obtaining a global picture of the client (see also Ben-Porath & Waller, 1992 for a discussion on these issues). Essentially, treatment could be based, in part, on the outcome of this personality assessment. Social and biological assessment would also be indicated.

The second implication is that treatment should be holistic in nature (i.e., biological, social, psychological). Depending on the assessment process and the therapeutic model, the focus of treatment could be aimed at various points in the causal chain. For example, at the level of personality (i.e., psychological), treatment could be focused on altering specific maladaptive behaviour patterns (e.g., neurotic). As Zuckerman (1992) and Eysenck (1997) have pointed out, behaviour is partly a function of learning. Given this well founded assumption, treatment could be focused on increasing, for example, levels of extraversion, openness, and emotional stability, as each have been linked to well-being. Several therapeutic models could be implemented. Self-regulation theory may be especially useful here. By self-monitoring and learning new adaptive behaviours that are functionally equivalent, new consequences could be formed to maintain the new behaviour. For example, because an extravert's behaviour may be linked to attention or activity seeking, the open person's behaviour to sensation seeking, and the emotionally stable person's behaviour to approach tendencies, it may be useful to teach appropriate ways for the introverted, closed minded, and neurotic individual to develop new skills to meet their needs that are functionally equivalent to their maladaptive behaviours. The new skills may then be naturally supported by their *new* environments. At another level in the causal chain, the patient or client could be assisted (e.g., education) in developing more positive coping strategies (e.g., problem-solving) or health practices to help prevent or alleviate distress or increase well-being or general health. As the present study suggests, conscientiousness may have some connection with health behaviours. Such interventions would be particularly useful to those who lack emotional stability. As the present study found, those who scored high on a measure of neuroticism tended to experience more negative life events. As is well known, emotionality or neuroticism tends to be related to increased use of emotion-based coping strategies (McCrae & Costa, Jr., 1986). Thus, any intervention would be geared towards changing behaviour to a healthy level of emotional stability as well as a strong sense of conscientiousness, extraversion, agreeableness, and openness to experience. In the latter cases, both conscientiousness and agreeableness were found to be negatively related to life events while openness to experience and extraversion were related to positive affect. Emphasis could also be placed on developing both communicative and interpersonal skills in order to facilitate a more *agreeable* personality structure.

At the social level, intervention sites may also vary. Interventions may be set up in the workplace, at home, at school, or even nationally and internationally. The national level could be effected through legislation, intergovernmental cooperation, or by a healthy public policy set up with opportunities to develop a healthy five-factor structure or behaviour relevant to healthy living. Given that the five-factor model has been replicated cross-culturally, the effects may extend internationally through the consistent application of assessment and treatment strategies. Regardless of the level of intervention, efforts would be aimed at health promotion where personal control or empowerment would be encouraged.

Biologically or medically, practitioners need to consider a variety of medical and psychiatric issues that may be contributing to the behavioural problem. As past research has shown, the five- factors have also been variously related to psychopathology. For example, empirically, several studies have found or suggested linkages between the five factor system and various forms of psychopathology (e.g., Axelrod, Widiger, Trull, & Corbitt, 1997; Avia, Sanz, Sanchez-Bernardos, Martinez-Arias, Silva, & Grana, 1995; Bagby, Costa, Jr., McCrae, Livesley, Kennedy, Levitan, Levitt, Joffe, & Young, 1999; Bagby, Taylor, & Parker, 1994; Cappeliez, 1993; Dunkley, Blankstein, & Flett, 1997; Fagan, Wise, Schmidt, Jr., Ponticas, Marshall, & Costa, Jr., 1991; Han, Weed, & McNealy, 1996; Hendriks, Hofstee, & De Raad, 1999; Kirmayer, Robbins, & Paris, 1994; Mongrain, 1993; Trull & Sher, 1994; Wiggins & Pincus, 1989; Widiger & Trull, 1997; Wise, Fagan, Schmidt, Ponticas, & Costa, Jr., 1991). For example, in one study, Wiggins and Pincus (1989) conducted a factor analysis in which data from two measures of the big five, as well as the Personality Adjective Checklist, and the Minnesota Multiphasic Personality Inventory were analyzed. The resulting solution found that avoidant, histrionic, schizoid, and narcissistic personality disorders all loaded on the same factor as *extraversion*. On factor two, borderline, passive-aggressive, narcissistic, antisocial, compulsive, dependent, and avoident personality disorders all loaded on the *neuroticism* factor. Factor three was comprised of *agreeableness*, love (Interpersonal Adjective Scale - Big 5), and dependent, antisocial, paranoid, and narcissistic personality disorders. Factor four was made up of both *conscientiousness* markers, as well as compulsive, antisocial, and passive-aggressiveness personality disorders. And last, factor five was made up of both *openness to experience* scales and schizotypal personality disorder.

Given the model's ties to psychopathology, medication may be indicated conjointly with psychotherapy, depending on the assessment findings and subsequent diagnosis. Periodic assessment of the five factors at follow-up may indicate treatment success, failure, or no change. Clinicians will need to be aware of any connections to physical health as well. As past research has suggested, agreeableness has been moderately related to hostility, a factor implicated in coronary heart disease (Costa, Jr., McCrae, & Dembroski, 1989). Conscientiousness has also been associated with all cause mortality (Friedman, Tucker, Tomlinson-Keasey, Schwartz, Wingard, & Criqui, 1993) as has mental health, a component found to predict time two health in the present study.

The third implication is related to the practitioner-client relationship. While none of the factors were found to be linked to physician utilization, with the exception of neuroticism, and this latter relationship disappeared when controls were implemented, it may be useful to speculate on some possible connections. Specifically, it was found that individuals with high scores on the measure of neuroticism tended to visit their physician more often. One implication is that such individuals may amplify their symptoms but present with no underlying illness. Treatment wise, symptom reduction methods may assist such patients through various modalities including relaxation training or problem-solving. While not related to physician use in the present study, conscientiousness has been associated with medication adherence (Christensen & Smith, 1995). Instilling in patients a sense of conscientiousness may assist in symptom reduction as well as the basis of the disorder.

While more research is needed (see Summary and Conclusions) with regard to the specifics of the big five and the health status connection, some of these suggestions are currently in place (e.g., assessment) while others await future consideration (e.g., public policy). This research partly validates some of these activities. Given the present day concerns surrounding health care funding, such recommendations may prove cost effective in the long run.

The next section will discuss the strengths and limitations of the present research. The dissertation will conclude by proposing several recommendations for further research.

Strengths and Limitations

According to Sudman (1976), the credibility of a small sample (or any sample) can be assessed according to the degree of generalizability (i.e., geographic spread, discussion of limitations, use of special populations), sample size, sample execution, and use of resources. To determine the degree of generalization for a given sample, the number of locations (i.e., spread), a discussion of sampling limitations, as well as use of any special populations, all need to be considered. To increase the variability of the sample, the present study collected data from several populations or organizations from St. John's and the surrounding area. Ideally, it would have been useful to compare each of the models by organization to determine the impact of site on model selection. However, because some of the organizations were small, it was necessary to combine these samples to increase statistical power. Nonetheless, in comparison to a random sample of Newfoundland and Labrador residents, the study sample was similar in several respects (e.g., age), though not equivalent.

According to Sudman (1976), generalizability is enhanced to the extent that its findings are comparable to previous researches. As the previous discussion pointed out, much of the univariate and bivariate data replicated past research. However, given the exploratory nature of the research as well as the use of a nonrandom sample, several of the multivariate expectations diverged in both the non-process and process analyses. In other words, because the present study appears to be the first to test these multivariate hypotheses, there is little comparison upon which to base the degree of replication. The safest conclusion is that the findings would be generalizable to other samples with similar attributes (e.g., education: see Cook & Campbell, 1979). Nonetheless, some of the regression analyses had replicated past research (e.g., positive/negative affect; see e.g., Watson & Clark, 1992).

The second determinant is sample size. Overall, the analyses suggested that ample power was available to test each of the models. While overall power was found to be .63 when the no control variable stress/health behaviour mediator model was analyzed (i.e., process Model 4), this level appeared to be sufficient to test the hypotheses. For example, the results from each of the no control stress moderator model analyses (i.e., Model 2), which had ample power, were similar to that of Model 4. In addition, standard regression analyses where power is less demanding than that of structural equation modelling, also replicated the path model four findings. Furthermore, the nonsignificant paths in the model fours appeared to be due more to the nature of the health status criterion than to any concerns related to power. That is, personality appears to be more related to subjective than objective health status. This general finding was observed in several of the analyses. Thus, sample size appears to be appropriate for the study's design.

A third criterion is based on the degree to which the sampling was properly executed. In general, the present study meets this criterion. As discussed in the method section, several steps were taken to increase the response rates at both waves of data collection (e.g., personal appeal, survey design). While wave one had a less than desirable return, it was nonetheless within an expected 20% range as noted by Jackson (1995). The response rate for wave two was almost double that of wave one. The second wave return rate may in part be explained by the incentive offered for their wave two participation. Some research also indicates that subsequent waves of prospective or longitudinal data collection tends to experience less attrition (see e.g., Harway, 1984), suggesting a more general phenomenon.

The last criterion proposed by Sudman (1976) involves the extent to which maximum use is made of available resources. Funding was partially provided by the Department of Psychology. In addition, the Departmental vehicle was used when necessary and possible. In the latter case, the vehicle was not always available which made tracking of the questionnaires difficult. In other cases, it was not possible to obtain exact totals of the number of workers available for testing per site. In still another case, one organization failed to distribute the phase two questionnaires, even after several phone calls were made to the individual in charge of the distribution. Furthermore, at time one of the study, verbal permission was given to sample the stores in two of the City malls. However, because written permission was not provided to the researcher, neither of the stores were sampled. At other times, appointments were cancelled by the organization. Despite these problems. a relatively large number of surveys were collected based on limited resources (e.g.. funding). Given the scope of the project. all attempts were made to make the best possible use of the resources.

One other strength of the present study. but not discussed by Sudman (1976). involves the inclusion of several comparative or alternative research models. According to Cliff (1983). support for a model does not mean that the model is the true model: the data merely suggests that it failed to be disconfirmed. To maximize support for a given model. several other models or theories must be ruled out as alternative explanations. For example. while each of the four path models were found to provide adequate fits to the data. the no control variable stress/health behaviour mediator model (i.e.. Model 4) appeared to provide the best fit. However. Model 4 had the fewest degrees of freedom of the four models. suggesting that fit was partially dependent on the number of constrained parameters or paths fixed to zero. To assist in the model selection process. the models were further compared based on the generalized multiple R-squared. Based on this criterion. comparison of the models indicated that. as previously discussed. the models with the time 1 controls explained more of the variance than the models with no controls. Thus. comparison of several models helped to rule out a number of alternative models.

In a similar vein. the present study goes beyond previous research by having embedded the five factors into a broad biopsychosocial framework. For example. several demographic and socioeconomic status. personality. as well as several objective and subjective health status variables were incorporated into the models. To increase the generalizability as well as to facilitate a first understanding of the mechanisms that link the five-factors to health status. a nonstudent sample. two mediator variables. life stress and health behaviours. were also considered. As the findings demonstrate. when placed within the context of a broad multivariate model. the bivariate relations do not necessarily hold. For example, the data suggested that the five factors do not moderate the relationship between objective life stress and health status. However. the data does suggest that neuroticism has a direct and indirect effect on general health and a partial indirect effect on physician utilization. The data further suggests that neuroticism may have a direct effect on physician utilization. but only in cases where time one controls have not been implemented. Examination of a less than complex framework may not have led to these insights. Therefore. the present study advances current research focusing on both explanation and description.

One concern that may be raised is that each of the non-process and process models omitted several variables such as coping and social support. creating what researchers call. a *specification error*. To minimize this concern. three key issues should be considered. First. it was unrealistic to incorporate all potentially relevant variables in the models given methodological. statistical. and subject demands. The present study incorporated several of the more relevant variables identified by past and present research. Obviously, incorporation of these variables meant that other variables had to be left out. Conversely, it is not clear what effect these omissions had on the results. One possibility is that inclusion of such variables as perceived social support would have a zero effect over and above the five factors and the time one controls given the potential overlap among several of these variables (e.g., perceived support, distress). However, given a different configuration of the variables, the opposite may be plausible (e.g., non-primacy based). [81] In a positive vein, the results presented herein provide new data for further examination. Future research would consider the present findings and build new models that account for these relationships.

A second potential limitation is concerned with the effects of measurement error. As previously discussed, the present study assumes that each of the variables are measured without error, a dubious assumption at best. According to several researchers (e.g., Dunlap & Kemmery, 1988), by failing to account for measurement error in the observed variables, one maybe under- or overestimating the magnitude of the parameter effects. Conversely, a trivial percentage of error in the indicators may have only a negligible effect on the outcomes when compared to a model that corrects for error.

The effects of measurement error may be even more problematic with product-term interactions. For example, to calculate the reliability of a product-term coefficient, one simply multiplies the reliability of the predictor by the reliabilty of the moderator, assuming that the variables are uncorrelated (Dunlap & Kemery, 1988). Assuming a zero correlation between the predictor and moderator, and with each reliability set at .8, this product-term reliability would be .64. When extended to the present study, the product-

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[81] Overlap is used in the the broadest sense to mean confounding, and variables that may be causally related but for analytical purposes, were included as statistical controls.

term reliability, for example, of the extraversion by life events interaction is much lower (i.e., .34). Calculation of the remaining product-term reliabilities would yield similar findings.

The effects of low product-term reliability may be problematic when interpreting the significance of the interaction to outcome parameters. According to Dunlap and Kemmery (1988), when comparing a less than reliable product-term to a reliable interaction term, the latter has a greater probability of achieving statisical significance. Ping (1994) adds that the use of ordinary least squares regression may under- or overestimate the significance of an interaction term. However, the pattern or nature of the interaction may be preserved.

Because of statistical concerns, the present study did not take into account measurement error. As indicated in the introduction, an attempt was made to estimate the percentage of error in each of the single indicator latent variables through a sensitivity analysis. Estimation of the parameters among and within the main effects and interaction terms tended to inflate the between variable correlations (i.e., multicollinearity), yielding uniterpretable parameter estimates. A decision was therefore made to use observed variable path analysis. At best, the present study provides a conservative estimate of the personality by personality and the personality by life stress interaction or moderator effects, although in the former case, the effects of measurement error may not be as problematic given their stronger individual reliabilities. Research using the multiple indicators within a latent variable path analysis approach will need to validate these findings.

A third issue focuses on the interpretation of the models given the nonsignificant parameter estimates. That is, to what extent are the models useful despite several nonsignificant parameters? The issue is subject to several considerations. First, the models have been shown to be useful heuristic frameworks in past personality and health research (i.e., causal primacy: see e.g., Wiebe & McCallum, 1986). Thus, accordingly, one study does not invalidate the paradigm. Before the models are rejected, it is important to consider (1) the effects of measurement error (2), the fact that a specific equation within the overall model may still be significant (e.g. time two life events) and useful, (3) that the effects of personality on health status may depend on the extent to which the autoregressive variables are incorporated into the research design: (4) the time interval between the waves of data collection, and (5) the finding that neuroticism impacted on general health despite the implementation of controls. Ideally, it would have been useful to incorporate or to reduce the four path models to one model with each of the three health status variables (i.e., general health, restriction of activities, physician utilization) included as correlated dependent measures. However, this would have substantially increased the number of parameters, reduced power, and made parameter estimation difficult, if not impossible. Therefore, a decision was made to analyze each health status variable and model separately. The templated analyses provided an example of these relationships, but with fewer parameters.

A fourth issue concerns the impact of subject mortality as an alternative explanation for at least part of the present findings. The analyses revealed that individuals who participated in only the first phase of the study were less conscientious, tended to have experienced more negative life events and restricted activities at wave one. Essentially, subject mortality implies that the results or part of, were due to a restricted range of scores in the subject variables. While acknowledging the potential significance of this problem (see Cook & Campbell, 1979), the impact appears to be minimal. First, the mean differences of the variables for those who stayed in versus those who did not participate in phase two were found to be small, suggesting that the differences may have occurred by virtue of the large sample size. And second, several of the relations found in the present study among the variables have been observed in previous researches (e.g., Magnus, Diener, Fujita, & Pavot, 1993).

The next section will conclude the discussion by summing up the findings and providing suggestions for future research.

SUMMARY AND CONCLUSIONS

The objectives of this research were two-fold. First, to what extent are the five-factors related to health status? To evaluate this question, several direct effect and personality by personality interaction models were developed and tested. The second objective was to assess how the five factors are related to health status, through mediation, moderation, both, or neither. Using both negative life events and health behaviours, several observed variable path analytic models were tested in structural equation modelling format.

In answering the first question, the results suggest that personality operates independently, as opposed to interactively in effecting health status although it was suggested that mediation may exist. The findings also suggest some redundancy amongst the five factors. In addition, the five factors appear to be related to subjective health status as opposed to objective health status but that these relationships become attenuated when several controls are implemented. Neuroticism appears to be the most consistent predictor of health status (e.g., general health, negative affect) suggesting that it operates in accordance with Stone and Costa, Jr.'s (1990) notion of a distress-prone personality. Overall, the regression analyses stressed the importance of accounting for other variables (i.e., personality, controls) when interpreting correlational data. Extraversion and openness to experience were also significant predictors of positive affect.

The results from the path analyses paralleled and added to the previously discussed regression analyses. In general, while personality was correlated with the proposed mediators (i.e., life events, health behaviours), the five factors had little effect on the mediators when the health status outcome was objective (e.g., physician utilization, restriction of activities). However, the five factors were linked to general health when no controls were implemented although neuroticism still predicted general health when the control models were tested. In each of the path analyses, Model 3, the no control variable stress/health behaviour mediator model, was found to be the most parsimonious when interpreted in conjunction with the generalized multiple R-squared. Subgrouping analyses confirmed the product-term analyses.

Theoretically, the main as well as the template analyses suggested that while model selection may be chosen based on statistical criteria, research suggests that models without any autoregressive paths be given significant weight.

The theory versus variance debate, implications and the strengths and limitations of the present study were also discussed. In general, the results provide several new insights into how personality, or more specifically, the five-factor model, is related to various health status measures.

The results from the present study suggests several avenues for future research, many of which have just been discussed. For example, one possibility is to examine how other variables may mediate the personality to health status relationship. For example, research could examine the mechanisms that link, for example, agreeableness and conscientiousness to negative life events. At a general level, such mechanisms may include, from the cognitive perspective, problem solving and appraisal; at the physiological level, immune system and cardiovascular reactivity; and at the interpersonal level, social support. Similarly, one may start from the models presented herein and build in greater levels of complexity such as attitudinal and behavioural intentions and link such variables to health behaviours and health status. In doing so, one could link the five factors to such models as Ajzen and Fishbein's (1980) Reasoned Action Model. In developing these models or research programs, one could vary the health status variable, research design (e.g., experimental/correlational, control level, time lag), statistical design (e.g., latent variable analysis), as well as the domain and facet components of the five-factor model (e.g., Neuroticism domain - vulnerability facet). For example, it may be beneficial to vary the lag between waves of data collection. The present study set a lag of six months. It may be useful to assess for any effects across, for example, a three month lag. However, given a shorter interval, the researcher must consider the effects of a shorter lag on the variation of a given variable (e.g., life events). One interesting application would be to incorporate the five-factor model as well as life events, into population health research projects as potential risk factors. Given the greater subject variability in such studies, it would be useful to determine the extent to which the five factors predict health status and other behaviours, on top of other risk factors. As was pointed out in the introduction, one reason for the reemergence of personality in health research was the finding that traditional risk factors do not fully account for the variation in health status.

In conclusion, the results suggest that the impact of the five-factors on health status may be moderated in part by the degree of autoregression considered, as well as the nature of the criterion variable. Neuroticism appears to be the most robust variable of the five-factor model. While the present study replicated several past researches, it also shed new light on the complexities associated with use of a multivariate model of personality set within a biopsychosocial context. Future research will need to further the usefulness of the five-factor model of personality in health-related research contexts. The dissertation provided one step in understanding the two questions discussed herein.

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Appendix A

Table A1

Examples of descriptors used by researchers to describe each of the five factors

Author(s)	Factor / Descriptors
Digman & Inouye (1986)	**Extraversion**: gregarious. seclusive, energetic, happy. outspoken, lethargic. self-minimizing. verbally fluent. assertive. submissive. eccentric. restless. impulsive. fearful. tense. curious. adaptable. socially confident
John (1990)	**Agreeableness**: sympathetic. kind. warm. appreciative. affectitonate. soft-hearted. generous. trusting. helpful. forgiving. pleasant. good-natured. friendly. cooperative. gentle. unselfish. praising. sensitive. fault-finding. cold. unfriendly. quarrelsome. hard-hearted. unkind. cruel. stern. thankless. stingy
Norman (1963)	**Conscientiousness**: Fussy-careless. responsible-undependable. scrupulous-unscrupulous. persevering-quitting
John (1990)	**Neuroticism**: tense. anxious. nervous. moody. worrying. touch. fearful. high-strung. self-pitying. temperamental. unstable. self-punishing. despondent. emotional. stable. calm. contented. unemotional
Digman & Inouye (1986)	**Openness to Experience**: outspoken. lethargic. submissive. eccentric. planful. mannerly. knowledgeable. perceptive. imaginative. verbal. original. curious. adaptable. sensible. socially confident. rigid. esthetically sensitive

Appendix B

Pretest information and analyses for each of Samples 1, 2, and 3

METHOD AND RESULTS - SAMPLE 1

Forty-eight students (12 men, 36 women, 4 did not specify sex; mean age = 23.38 years, standard deviation = 6.12) from a second year course in psychology voluntarily participated in the first wave of a two-wave pretest study. During the first wave students completed McCrae and Costa, Jr.'s (1985) 80 bipolar adjective checklist, a mood adjective checklist (i.e., The Memorial University of Newfoundland Mood Scale: McNeil, 1986), and the Hopkins Symptom Checklist (Derogatis, Lipman, Rickels, Uhlenhuth, & Covi, 1974).

Six weeks later, 36 of the same students completed a number of measures including the same 80-item adjective checklist (McCrae & Costa, Jr., 1985), the Brief Symptom Inventory (BSI: Derogatis & Melisaratos, 1983), a modified 50-item checklist of acute and chronic conditions as derived from the Severity of Illness Scale (Illness: Wyler, Masuda, & Holmes, 1968), the Alameda County Health Practices Inventory (Berkman & Breslow, 1983), and eight questions which were developed for this sample which dealt with disability, and physician and hospital utilization. Table B1 presents the correlations of the variables against the five factors.

METHOD AND RESULTS - SAMPLE 2

Forty students (13 men. 26 women. 1 unidentified: mean age = 22.87. standard deviation = 5.14) from a different second year course in psychology participated as the second pretest sample. Subjects completed a number of measures including McCrae and Costa. Jr.'s (1985) 80-item adjective checklist, the Life Experiences Scale (LES: Sarason. Johnson. & Siegel. 1978), the Brief Symptom Inventory (BSI: Derogatis & Melisaratos. 1983: as discussed in sample one section). and the same eight questions regarding objective health and health care utilization as administered in sample 1/wave 2. The correlations for each of the variables as they relate to the five factors can be found in Table B2.

METHOD AND RESULTS - SAMPLE 3

Ninety-three (33 men. 60 women; mean age = 22.41. standard deviation = 4.97) subjects participated in this sample. Approximately 68 subjects were undergraduate students from a different second year course in psychology and 25 were psychology graduate students. To increase the power of the analyses. data from both groups were combined for purposes of analysis.

Subjects completed a number of questionnaires in class. including McCrae & Costa. Jr.'s (1985) 80-item adjective checklist. the Memorial University of Newfoundland Mood Scale (McNeil. 1986). a modified 50-item Severity of Illness Checklist (Illness: Wyler et. al.. 1968). a 12-item somatization checklist taken from the Hopkins Symptom Checklist

(Derogatis et. al., 1974), a 1-item general health question (Segovia, Bartlett, & Edwards, 1989), a 2-item measure of disability (Disability: e.g., number of days sick in past 2 months), and 12 questions pertaining to both physician and hospital utilization, all taken in some form from the Canada Health Survey (Statistics Canada, 1981), and the National Centre for Health Statistics (1979). Correlations were computed for each of the health measures in relation to the five factors and can be found in Table B3.

Table B1

Correlations for sample 1

	The Five Factors				
	N	E	O	A	C
Variables	T1/T2	T1/T2	T1/T2	T1/T2	T1/T2
Vigor (T1)	-.47**/ -.49**	.36*/ .26	.29*/ .18	.19/ .31	.11/ .24
Neg. Mood (T1)	.23/ .45**	-.09/ -.05	-.15/ -.09	-.03/ .01	-.04/ .06
Pos. Mood (T1)	-.51**/ -.31	.31*/ .38*	.39**/ .50**	.35*/ .49**	.23/ .39*
Somatization (T1)	.13/ .35*	-.02/ -.16	.15/ -.23	-.33*/ -.31	-.12/ -.17
Anxiety (T1)	.18/ .27	.03/ -.34	.09/ -.34	-.20/ -.39*	-.35*/ -.33
Depression (T1)	.36*/ .54	-.26/ -.36*	-.27/ -.48**	-.35*/ -.32	-.39**/ -.25
Obses. Comp. (T1)	.21/ .34	-.09/ -.27	-.00/ -.37*	-.36*/ -.42*	-.34*/ -.26
Int. Sens. (T1)	.39**/ .59**	-.13/ -.34	-.08/ -.33	-.34*/ -.56**	-.26/ -.25

(table continues)

Total Hop. (T1)	.30*/ .48**	-.13/ -.33	-.04/ -.39*	-.38**/ -.49**	-.33*/ -.28
Illness (T2)	.21/ .23	.23/ .24	-.05/ -.07	-.02/ .03	-.24/ -.29
Somatization (T2)	.31/ .37*	-.16/ -.03	-.11/ -.15	-.29/ -.22	-.14/ -.16
Depression (T2)	.35*/ .52**	-.09/ -.35	-.14/ -.31	-.24/ -.31	-.19/ -.30
Anxiety (T2)	.19/ .34*	-.07/ -.14	.08/ -.08	-.24/ -.26	-.16/ -.30
Total BSI (T2)	.37*/ .55**	-.13/ -.26	-.09/ -.26	-.32/ -.35*	-.21/ -.34*
Activity (T2)	-.11/ -.27	.07/ .09	.37*/ .37*	.03/ .18	.29/ .15
Alcoh. vol. (T2)	-.28/ -.21	.03/ -.19	.06/ .10	-.14/ -.20	-.09/ -.23
Smoking (T2)	-.00/ -.01	-.07/ -.01	.09/ .03	.22/ .16	.04/ .15
Hours of Sleep (T2)	-.18/ -.14	.19/ .26	.29/ .39*	.23/ .27	.29/ .14

Note. T1 = Time 1; T2 = Time 2; N = Neuroticism; E = Extraversion; O = Openness to Experience; C = Conscientiousness; A = Agreeableness; Neg. Mood = Negative Mood; Pos. Mood = Positive Mood; Obses. Comp. = Obsessive Compulsiveness; Int. Sens. = Interpersonal Sensitivity; Total Hop. = Total Distress, Hopkin's Checklist; Alcoh. Vol. = Volume of Alcohol Intake. Significance levels for all correlations and across all 3 samples are two-tailed. *$p < .05$. **$p < .01$.

Table B2

Correlations for sample 2

	The Five-Factors				
Variables	**N**	**E**	**O**	**A**	**C**
Somatization	.39*	-.27	.26	-.14	-.19
Depression	.58**	-.54**	-.03	-.26	-.44**
Anxiety	.48**	-.08	-.27	-.31	-.20
Total BSI	.58**	-.36*	.17	-.29	-.34
Negative Events	.06	-.08	.09	-.07	-.04

Note. N = Neuroticism: E = Extraversion: O = Openness to Experience; A = Agreeableness; C = Conscientiousness; BSI = Total Distress.
*$p < .05$. **$p < .01$.

Table B3

Correlations for sample 3

Variables	The Five Factors N	E	O	A	C
Illness	.19	-.08	.03	.12	-.07
Somatization	.34**	.01	.06	.06	-.09
Vigor	-.22*	.24*	.25	.25*	.25*
Positive Mood	-.15	.09	.13	.18	.18
Negative Mood	.33**	-.15	-.02	-.08	-.18
Disability	.22**	.09	-.09	-.01	-.11
General Health	-.39	.01	.17	-.04	.15
Sex (M = 1; F = 2)	.22*	.06	.04	.22*	.17

Note. N = Neuroticism: E = Extraversion: O = Openness to Experience:
A = Agreeableness: C = Conscientiousness: M = Males: F = Females.
*$p < .05$. **$p < .01$

Appendix C

EVENTS IN THE PAST "6" MONTHS
(Negative Life Events Checklist)

INSTRUCTIONS: Here is a list of events that may happen to anyone. Have you experienced any of them in the past "6" months? If yes, simply place a check mark (✔) in the space beside the event in question.

___(1) Failed school or training program

___(2) Problems in school

___(3) Moved to a worse neighbourhood

___(4) Widowed

___(5) Divorced

___(6) Separated

___(7) Other broken love relationship

___(8) Death of a loved one (family or close friend)

___(9) Stillbirth or miscarriage

___(10) Death of a pet

___(11) Demoted or changed to a less responsible job

___(12) Laid off (temporarily)

___(13) Business failed

___(14) Trouble with boss

___(15) Out of work over a month

___(16) Trouble with in-laws

___(17) Serious illness of family member

___(18) Financial status a lot worse (loss of large amount of money, unusually heavy debts or expenses, etc.)

___(19) Foreclosure of mortage or loan (e.g., car, house, furniture, etc.)

___(20) Fired

___(21) Been in court

___(22) Detention in jail or other correctional institution

___(23) Been arrested

___(24) Law suit or legal action

___(25) Loss of driver's licence

___(26) Major catastrophes or crises in neighbourhood/community (e.g., fire, crime, changes in neighbourhood, etc.)

Appendix D

THE BRIEF SYMPTOM INVENTORY
(Perceived Physical Symptoms Inventory)

INSTRUCTIONS: This scale consists of "7" statements that describe different symptoms. Please read each item and then write in the appropriate answer in the space next to the statement. Indicate to what extent **THAT PROBLEM HAS BOTHERED OR DISTRESSED YOU DURING THE PAST WEEK INCLUDING TODAY.** Please use the following 0, 1, 2, 3, 4 scale.

0 = **NOT DISTRESSED AT ALL**
1
2 = **MODERATE DISTRESS**
3
4 = **EXTREMELY DISTRESSED**

___ (1) Faintness or dizziness

___ (2) Pains in the heart or chest

___ (3) Nausea or upset stomach

___ (4) Trouble getting your breath

___ (5) Hot or cold spells

___ (6) Numbness or tingling in parts of your body

___ (7) Feeling weak in parts of your body

Appendix E

CHRONIC CONDITIONS CHECKLIST

INSTRUCTIONS: Below is a list of chronic conditions (for this research, **CHRONIC** means that the conditions has been presents for 3 months or more). **PLEASE PLACE A CHECK MARK NEXT TO THOSE CONDITIONS THAT YOU HAVE EXPERIENCED DURING THE PAST 6 MONTHS. NOTE ONCE AGAIN THAT ALL RESPONSES WILL BE KEPT CONFIDENTIAL.**

___ (1) Anemia

___ (2) Allergy (of any kind)

___ (3) Arthritis, rheumatism

___ (4) Asthma

___ (5) Cancer

___ (6) Cerebral Palsy

___ (7) Diabetes

___ (8) FEMALES: Dysmenorrhea (menstrual problems)

___ (9) Emphysema or chronic bronchitis

___ (10) Epilepsy

___ (11) Heart Disease

___ (12) Hemorrhoids (piles)

___ (13) High blood pressure

___ (14) Ear infection

___ (15) Kidney disease (stones, etc.)

___ (16) Mental illness

___ (17) Missing arm (s) or leg (s)

___ (18) Missing finger (s) or toe (s)

___ (19) Paralysis of any kind

___ (20) MALES: Prostate disease

___ (21) Recurring backaches

___ (22) Recurring headaches

___ (23) Stomach ulcer

___ (24) Thyroid trouble or goitre

___ (25) Tuberculosis (all forms)

___ (26) Hernia

___ (27) OTHER:
Please Specify: ______________

Appendix F

ADJECTIVE CHECKLIST (Five-Factor Model Adjective Checklist)

<u>INSTRUCTIONS</u>: Below are a number of **TRAIT** dimensions. Please rate yourself on each dimension by circling the most applicable number which **GENERALLY** describes you.

PLEASE DO NOT LEAVE OUT ANY ANSWERS. THANK YOU.

Practical	1	2	3	4	5	6	7	8	9	**Impractical**
Prefer Variety	1	2	3	4	5	6	7	8	9	**Prefer routine**
Calm	1	2	3	4	5	6	7	8	9	**Worrying**
Unfair	1	2	3	4	5	6	7	8	9	**Fair**
Trusting	1	2	3	4	5	6	7	8	9	**Suspicious**
Selfless	1	2	3	4	5	6	7	8	9	**Selfish**
Cultured	1	2	3	4	5	6	7	8	9	**Uncultured**
Proud	1	2	3	4	5	6	7	8	9	**Humble**
Businesslike	1	2	3	4	5	6	7	8	9	**Playful**
Emotionally Unstable	1	2	3	4	5	6	7	8	9	**Emotionally stable**
Conventional	1	2	3	4	5	6	7	8	9	**Original**
Artistic	1	2	3	4	5	6	7	8	9	**Unartistic**
Uncurious	1	2	3	4	5	6	7	8	9	**Curious**
Aloof	1	2	3	4	5	6	7	8	9	**Friendly**
Forgiving	1	2	3	4	5	6	7	8	9	**Vengeful**
Independent	1	2	3	4	5	6	7	8	9	**Conforming**
Persevering	1	2	3	4	5	6	7	8	9	**Quitting**
Cheerful	1	2	3	4	5	6	7	8	9	**Serious**
Creative	1	2	3	4	5	6	7	8	9	**Uncreative**
Simple	1	2	3	4	5	6	7	8	9	**Complex**
Talkative	1	2	3	4	5	6	7	8	9	**Quiet**
Unenergetic	1	2	3	4	5	6	7	8	9	**Energetic**
Active	1	2	3	4	5	6	7	8	9	**Passive**
Untraditional	1	2	3	4	5	6	7	8	9	**Traditional**
Unfeeling	1	2	3	4	5	6	7	8	9	**Passionate**
Inhibited	1	2	3	4	5	6	7	8	9	**Spontaneous**
Ruthless	1	2	3	4	5	6	7	8	9	**Soft-hearted**
Reliable	1	2	3	4	5	6	7	8	9	**Undependable**
Submissive	1	2	3	4	5	6	7	8	9	**Dominant**
Manipulative	1	2	3	4	5	6	7	8	9	**Straight-forward**
Hardy	1	2	3	4	5	6	7	8	9	**Vulnerable**

(checklist continues)

Open-minded	1	2	3	4	5	6	7	8	9	**Narrow-minded**
Irritable	1	2	3	4	5	6	7	8	9	**Good-natured**
Uncooperative	1	2	3	4	5	6	7	8	9	**Helpful**
Timid	1	2	3	4	5	6	7	8	9	**Bold**
Down-to-earth	1	2	3	4	5	6	7	8	9	**Imaginative**
Conservative	1	2	3	4	5	6	7	8	9	**Liberal**
Unadventurous	1	2	3	4	5	6	7	8	9	**Daring**
Late	1	2	3	4	5	6	7	8	9	**Punctual**
Comfortable	1	2	3	4	5	6	7	8	9	**Self-conscious**
Even-tempered	1	2	3	4	5	6	7	8	9	**Temperamental**
Courteous	1	2	3	4	5	6	7	8	9	**Rude**
Objective	1	2	3	4	5	6	7	8	9	**Subjective**
Aimless	1	2	3	4	5	6	7	8	9	**Ambitious**
Affectionate	1	2	3	4	5	6	7	8	9	**Reserved**
Careless	1	2	3	4	5	6	7	8	9	**Careful**
Self-disciplined	1	2	3	4	5	6	7	8	9	**Weakwilled**
Not envious	1	2	3	4	5	6	7	8	9	**Envious/Jealous**
Callous	1	2	3	4	5	6	7	8	9	**Sympathetic**
Gullible	1	2	3	4	5	6	7	8	9	**Cynical**
Antagonistic	1	2	3	4	5	6	7	8	9	**Acquiescent**
At ease	1	2	3	4	5	6	7	8	9	**Nervous**
Hardworking	1	2	3	4	5	6	7	8	9	**Lazy**
Stubborn	1	2	3	4	5	6	7	8	9	**Flexible**
Not lonely	1	2	3	4	5	6	7	8	9	**Lonely**
Emotional	1	2	3	4	5	6	7	8	9	**Unemotional**
Generous	1	2	3	4	5	6	7	8	9	**Stingy**
Disorganized	1	2	3	4	5	6	7	8	9	**Organized**
Imperceptive	1	2	3	4	5	6	7	8	9	**Perceptive**
Sober	1	2	3	4	5	6	7	8	9	**Fun loving**
High-Strung	1	2	3	4	5	6	7	8	9	**Relaxed**
Unanalytical	1	2	3	4	5	6	7	8	9	**Analytical**
Critical	1	2	3	4	5	6	7	8	9	**Lenient**
Retiring	1	2	3	4	5	6	7	8	9	**Sociable**
Scrupulous	1	2	3	4	5	6	7	8	9	**Lax**
Not impulse ridden	1	2	3	4	5	6	7	8	9	**Impulse ridden**
Self-reliant	1	2	3	4	5	6	7	8	9	**Helpless**
Warm	1	2	3	4	5	6	7	8	9	**Cold**
Negligent	1	2	3	4	5	6	7	8	9	**Conscientious**
Task oriented	1	2	3	4	5	6	7	8	9	**Person oriented**
Ignorant	1	2	3	4	5	6	7	8	9	**Knowledgeable**
Broad interests	1	2	3	4	5	6	7	8	9	**Narrow interests**

(*checklist continues*)

Disagreeable	1	2	3	4	5	6	7	8	9	**Agreeable**
Loner	1	2	3	4	5	6	7	8	9	**Joiner**
Sloppy	1	2	3	4	5	6	7	8	9	**Neat**
Impatient	1	2	3	4	5	6	7	8	9	**Patient**
Deliberate	1	2	3	4	5	6	7	8	9	**Thoughtless**
Secure	1	2	3	4	5	6	7	8	9	**Insecure**
Self-pitying	1	2	3	4	5	6	7	8	9	**Self-satisfied**

Appendix G

THE HEALTH PRACTICES INVENTORY
(The Alameda Health Practices Index)

(1) How often do you engage in **EACH** of the following leisure-time activities? Indicate your answer for **EACH** item by checking (✔) once of the three choices (i.e., never, sometimes, or often).

(a) **SMIMMING/WALKING:** ___ never; ___ sometimes; or ___ often
(b) **PHYSICAL EXERCISE:** ___ never; ___ sometimes; or ___ often
(c) **SPORTS:** ___ never; ___ sometimes; or ___ often
(d) **GARDENING:** ___ never; ___ sometimes; or ___ often
(e) **FISHING/HUNTING:** ___; never; ___ sometimes; or ___ often

(2) How often do you smoke cigarettes? Indicate your answer by checking (✔) the appropriate choice.

___ (a) I have smoked in the past, and I still do.
___ (b) I have smoked in the past, but no longer do so.
___ (c) I have never smoked.

(3) Please indicate your height and weight (to the best of your knowledge).

(a) Weight = ___ (pounds)
(b) Height = ___ (inches)

(4) How often do you drink each of the following types of alcohol? Indicate your answer by checking (✔) one of the following 4 choices for **EACH** kind of alcohol.

(a) **WINE:** ___ never; ___ less than once a week; ___ once or twice a week; or ___ more than twice a week
(b) **BEER:** ___ never; ___ less than once a week; ___ once or twice a week; or ___ more than twice a week
(c) **LIQUOR:** ___ never; ___ less than once a week; ___ once or twice a week; or ___ more than twice a week

(checklist continues)

(5) When you drink wine, beer, or liquor, how many drinks do you usually have at a sitting? Indicate your answer by checking (✔) one of the four choices for **EACH** type of alcohol.

(a) **WINE:** ___ never; ___ 1 or 2 drinks; ___ 3 or 4 drinks; or ___ 5 plus drinks

(b) **BEER:** ___ never; ___ 1 or 2 drinks; ___ 3 or 4 drinks; or ___ 5 plus drinks

(c) **LIQUOR:** ___ never; ___ 1 or 2 drinks; ___ 3 or 4 drinks; or ___ 5 plus drinks

(6) How many hours of sleep do you **USUALLY** get a night? Indicate your answer by checking (✔) one of the following choices:

(a) ___ 6 hours or less
(b) ___ 7 hours
(c) ___ 8 hours
(d) ___ 9 hours or more

Appendix H

The PANAS
(The Positive and Negative Affect Schedule)

INSTRUCTIONS: This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you have felt this way during the PAST FEW WEEKS. Use the following scale to record your answers:

1 = **VERY SLIGHTLY OR NOT AT ALL**
2 = **A LITTLE**
3 = **MODERATELY**
4 = **QUITE A BIT**
5 = **EXTREMELY**

___(1) Interested

___(2) Distressed

___(3) Excited

___(4) Upset

___(5) Strong

___(6) Guilty

___(7) Scared

___(8) Hostile

___(9) Enthusiastic

___(10) Proud

___(11) Irritable

___(12) Alert

___(13) Ashamed

___(14) Inspired

___(15) Nervous

___(16) Determined

___(17) Attentive

___(18) Jittery

___(19) Active

___(20) Afraid

Appendix I

Demographics Questionnaire

(SOME QUESTIONS ABOUT YOU AND YOUR WORK)

The next few questions will help to relate information on your health to that of other people in Canada with similar backgrounds. Please be assured that, like all other information you provide, your answers to these questions will be kept in the **STRICTEST OF CONFIDENCE.**

(1) Please tell us your Sex (check ✔): Male ___ Female ___

(2) What is your Age: ___

(3) What is your current Marital Status (Please check ✔) ?:

___ (i) Married ___ (iv) Widowed

___ (ii) Common-law ___ (v) Separated

___ (iii) Single (never married) ___ (vi) Divorced

(4) What is the **LEVEL OF EDUCATION** you have received (check more than one if necessary; e.g., university and college)?:

___ (i) One or more graduate degrees ___ (ii) University degree

___ (iii) University degree unfinished ___ (iv) Community College diploma

___ (v) Community College unfinished ___ (vi) High school diploma

___ (vii) Partial high school school (completed 10th or 11th grade) ___ (viii) Junior high school (completed 7th through 9th grade)

___ (ix) Less than 7 years of school

(checklist continues)

(5) This question has 2 components:

(i) What is your occupation:______________________________________

(ii) What are your most important duties or activities related to your occupation?____

____

(6) Now, the last topic. Although many health expenses are covered by provincial insurance programs, there still continues to be a relationship between a person's health status and income. We would appreciate your honesty in answering the following question.

(i) What is the best estimate of the total income, before taxes, of all household members from all sources (e.g., all wages, salaries, pensions and allowances), during the past year? Was the total household income...

___ $10,000 or less

___ between $10,000 and $20,000

___ between $20,000 and $30,000

___ between $30,000 and $40,000

___ between $40,000 and $50,000

___ between $50,000 and $60,000

___ between $60,000 and $70,000

___ between $70,000 and $80,000

___ More than $80,000

Appendix J

Letter of Introduction

Dear Friend:

The problem of stress as it relates to illness and health care utilization has received widespread attention during the past few years, not only in Canada, but also abroad. Many factors have been found to contribute to poor health status, and health care usage, but one very important question remains unanswered: How do all these contributing factors interact or related to each other in determining who becomes ill and makes use of specific health care services, such as visiting a doctor?

To help answer this very important question, I am very interested in and would be most grateful for your participation. In brief, the study involves filling out a number of suveys 2-3 times during the next year. Each set of questionnaires takes no longer that 15-20 minutes to complete. The first set has been enclosed with this cover letter. In order to increase the accuracy of the results, it is important that the questionnaires be fully completed and returned within 1-2 weeks of the time you receive them. A place for dropping off the surveys will be provided for you convenience. PLEASE BE ASSURED THAT ALL RESPONSES WILL BE KEPT CONFIDENTIAL WITH NO IDENTIFYING MARKS BEING PLACED ON ANY OF THE ANSWER SHEETS. THE DATA YOU PROVIDE WILL BE AGGREGATED WITH THE DATA I OBTAIN FROM OTHER OCCUPATIONS SO THAT NO ONES QUESTIONNAIRES CAN EVER BE IDENTIFIED. ONLY I WILL HAVE ACCESS TO THE DATA.

FOR YOUR KIND PARTICIPATION, YOU WILL RECEIVE A COPY OF THE RESULTS AND A CERTIFICATE OF PARTICIPATION. PLEASE, ONCE AGAIN LET ME STRESS THE IMPORTANCE OF YOUR PARTICIPATION IN THIS STUDY. TO DETERMINE HOW THE CONTRIBUTING FACTORS TO POOR HEALTH RELATE TO EACH OTHER, ONLY YOU CAN PROVIDE THE INFORMATION NEEDED TO ANSWER THIS IMPORTANT QUESTION. YOUR TIME WOULD BE MOST APPRECIATED. THANK YOU.

Sincerely

David Korotkov, PhD Candidate,
Project Director

Appendix K

Example Follow-up Letter

Dear Friend:

My name is David Korotkov and I am currently working on my Ph.D.. As part of my graduation requirements I am required to complete a Ph.D. dissertation research project. The topic I have selected concerns health and health care utilization.

The reason that I am writing to you is to solicit you participation in helping me to complete my degree requirements by filling out a number of survey questions (which should take about 15-20 minutes) twice (with the possibility of a third session) over the next year. The first phase is currently in operation; the second and third phases are spaced 6 months apart. YOUR PARTICIPATION WOULD BE GREATLY APPRECIATED. Please note that all participation is voluntary. Also note that your name was randomly selected from the University telephone directory; all responses will be kept in the strictest of confidence with the data that I receive from other occupations (so no one will ever know which questionnaire is yours).

Once again, please let me stress the importance of your participation. If you have any questions, I can be reached at 737-8495. Thank-you for your time.

Sincerely,

Dave Korotkov,
Ph.D. Candidate

Appendix L

Self-Generated Code Form

Phase __

Dear Participant:

Should you decide to participate, you will find several questionnaires attached to this cover sheet. Please read all questions and do not leave out any questions.

In order to match you questionnaires from phase I with you questionnaires from phase II (April/May 1995), could you please generate a code (THIS CODE WILL ONLY BE KNOWN TO YOU, SO THERE IS NO ONE WHO WILL KNOW WHO YOU ARE; also, the consent form on the previous page will be separated from this and all other sheets) by answering the following questions:

- (1) The 2 digits representing the month of your birth are:__________
  (e.g., January = 01; February = 02; March = 03, etc.)

- (2) The 2 digits of the date of your birth are: __________________
  (e.g., 25th of January = 25; 2nd of March = 02, etc.)

- (3) The number of digits in your mother's first name:____________
  (e.g., Kimberly = 08; Eva = 03, etc.)

This information will make up your code, which again, is known ONLY to you. Anonymity and confidentiality are guaranteed and participation in this project is voluntary. PLEASE DO NOT DETACH THIS COVER SHEET. Once again, thank-you for your time.

Sincerely

David Korotkov,
Ph.D. Candidate,
Project Director

Appendix M

Consent Form

Code #: __________

Dear Participant:

To be sure that the conditions of this project are clear to you, could you please read the following, fill it out and sign where it is indicated: (1) I understand that I may refrain from answering any questions; (2) I understand that I am free to withdraw at any time and have my answers destroyed; (3) I understand that my name will not be linked directly to my questionnaire(s) from the various sessions/phases of this project; (4) MY ANSWERS WILL BE TREATED AS CONFIDENTIAL MATERIAL; (5) I agree to answer the questions asked to the best of my knowledge or opinion; and (6) I will be given a certificate of participation at the completion of this research project. There will be 2-3 phases of this project scattered over the course of a year. Please note that this sheet will be separated from all other sheets which follow. All materials will be kept by ONLY the project director, David Korotkov.

____

Please print and sign name

____

David Korotkov, Project Director of the
Stress, Health Practices, and Well-being Project

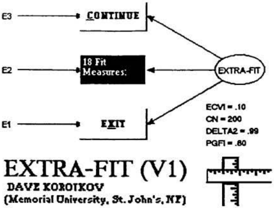
Could you please provide a name and phone number of a relative or close friend who you know where you can be reached in the future if you should move (Please be assured that confidentiality will be maintained):

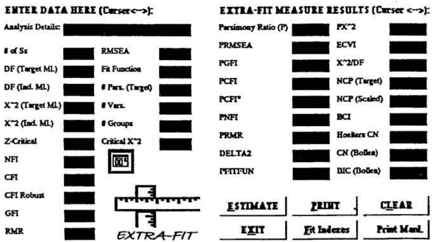
Name: ________________________

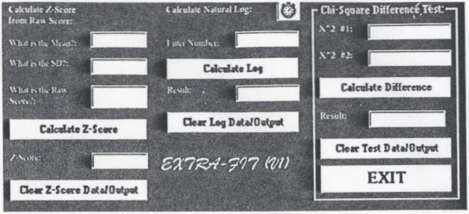
Telephone: (   ) - ______________

Appendix N

Extra-Fit Program Information



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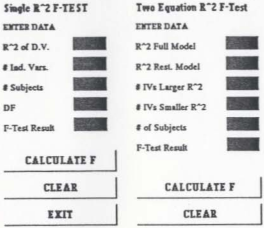
What is the Mean?:
What is the SD?:
What is the Raw Score?:
Calculate Z-Score
Z-Score:
Clear Z-Score Data/Output
Calculate Natural Log:
Enter Number:
Calculate Log
Result:
Clear Log Data/Output
EXTRA-FIT (V1)
Chi-Square Difference Test:
X^2 #1:
X^2 #2:
Calculate Difference
Result:
Clear Test Data/Output
EXIT


PRMSEA
PGFI
PCFI
PNFI
PRMR
Delta2
PFITFUN
ECVI
NCP (Target)
NCP (Scaled)
BCI
Hoelter's CN
CN (Bollen)
BIC
Exit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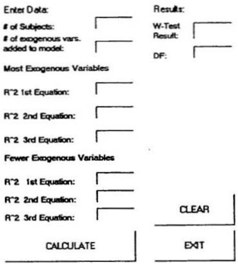
ENTER DATA
R^2 of D.V.
Ind. Vars.
Subjects
DF
F-Test Result
CALCULATE F
CLEAR
EXIT
Two Equation R^2 F-Test
ENTER DATA
R^2 Full Model
R^2 Rest. Model
IVs Larger R^2
IVs Smaller R^2
of Subjects
F-Test Result
CALCULATE F
CLEAR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# of exogenous vars. added to model:
Most Exogenous Variables
R^2 1st Equation:
R^2 2nd Equation:
R^2 3rd Equation:
Fewer Exogenous Variables
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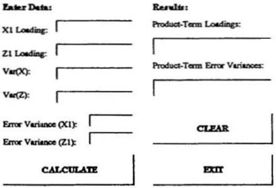
R^2 2nd Equation:
R^2 3rd Equation:
Results:
W-Test Result:
DF:
CLEAR
CALCULATE
EXIT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X1 Loading:
Z1 Loading:
Var(X):
Var(Z):
Error Variance (X1):
Error Variance (Z1):
Results:
Product-Term Loadings:
Product-Term Error Variances:
CLEAR
CALCULATE
EXIT