

UNIVERSITY OF CANTERBURY

**The Relationship Between Neuroticism and Health Outcomes:
The Effects of Vigilance and Conscientiousness**

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Meg Elston

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Research Supervisors:

Dr Roeline Kuijer, University of Canterbury

Dr Andrew Vonasch, University of Canterbury

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Abstract

The effect of neuroticism on health has been debated throughout health research. Many studies indicate negative effects of neuroticism finding it to be related to risky health behaviours, worse self-rated health, somatic complaints and higher mortality. However, there has been the proposal of healthy neuroticism in that when combined with vigilance or conscientiousness, neuroticism may result in better health. The present research recruited two samples; a New Zealand sample ($N = 336$) and a United States sample ($N = 199$), to complete an online survey about their personality, health status and a body vigilance questionnaire, including two vigilance factors, sensation awareness belief and change awareness belief. Mediation, moderation and moderated mediation analyses were conducted for both samples. The New Zealand sample found one mediation effect which suggested that higher neuroticism is related to higher sensation awareness belief, which in turn is related to poorer physical health and one significant moderation effect where conscientiousness moderated the relationship between neuroticism and mental health. The United States sample found two mediation effects which suggested that higher neuroticism is related to higher sensation awareness belief, which in turn is related to poorer mental health and poorer sleep and one significant moderation effect where conscientiousness moderated the relationship between neuroticism and physical health. No significant moderated mediation effects were found for either sample. Limitations, implications and future directions are discussed.

The Relationship Between Neuroticism and Health Outcomes: The Effects of Vigilance and Conscientiousness

Neuroticism is one of the “Big Five” personality traits. It is typically defined by negative attitude in response to threat or frustration (Lahey, 2009). There is debate in the literature regarding the relationship between neuroticism and health. There are many studies that have focussed on the negative effects of neuroticism stating that those high in neuroticism, are more likely to participate in risky behaviour, have higher body mass indexes, report more somatic symptoms and chronic diseases and greater mortality (Lahey, 2009; Mroczek, Spiro & Turiano, 2009; Weston & Jackson, 2018). There is also discussion of the idea of healthy neuroticism suggesting that neuroticism coupled with high levels of conscientiousness or vigilance may result in better health outcomes (Weston & Jackson, 2018; Brickman, Yount, Blaney, Rothberg & De-Nour, 1996; Sutin et al., 2010). The present research further examines the relationship between neuroticism and health outcomes.

The Definition of Neuroticism

There is some debate over the definition of neuroticism but general agreement is that it mainly involves negative affect. It is also often categorised by irritability, anger, worry, sadness and vulnerability (Lahey, 2009). While some interpret neuroticism to emphasize negative affect, others focus more on the psychological aspects such as worry and rumination. Others may stress the importance of aspects such as psychophysiological stress and anxiety, while others focus on behavioural aspects such as recklessness and hostility (Friedman, 2019). Neuroticism has also been referred to as “emotional instability” (Najjab, Palka, & Brown, 2020). Individuals who are referred to as “emotionally stable” are often low in neuroticism and those high in neuroticism, are more likely to experience daily emotional stress and react more strongly to events (Weston & Jackson, 2018). Highly neurotic

individuals tend to feel, notice and report more symptoms and pain and experience more health-related anxiety (Anagnostopoulos & Botse, 2016). It has been found that those high in neuroticism report more somatic complaints and react to them more dramatically as they interpret them as threats to their health (Friedman, 2019).

Eysenck and Eysenck (1975) originally described those highly neurotic as “worriers” whose main characteristic was constant worrying about things that may go wrong and strong emotional responses of anxiety to these thoughts. Neurotics also tend to be self-critical, sensitive to criticism and can feel inadequate. Whereas people with low neuroticism, tend to have a mild and slow emotional response (Liu & Lin, 2019). Neuroticism tends to peak in late adolescence and decline slightly during adulthood (Lahey, 2009). Due to neuroticism’s definition it has been found to have a complicated relationship with health, studies have found both negative and positive effects of neuroticism.

The Negative Effects of Neuroticism

There have been many studies investigating the negative effects of neuroticism. Neuroticism has been linked to worse physical health outcomes (e.g. greater asthma diagnoses and mortality), worse self-reported health, poorer health outcomes when self-report measures are used and greater use of health services (Kitayama et al, 2018; Najjab et al., 2020; Shipley, Weiss, Der, Taylor & Deary, 2007; ten Have, Oldehinkel, Vollebergh & Ormel, 2005). It has been linked to several physical health problems such as cardiovascular diseases, eczema, asthma and irritable bowel syndrome as well an increased number of somatic complaints and increased mortality (Lahey, 2009). Neuroticism has also been linked to health risk behaviours (e.g. alcohol consumption, drug use, sedentary lifestyles, unhealthy eating) which in turn results in worse health outcomes (Mroczek et al., 2009; Vollrath & Torgersen, 2002). High neuroticism has been related to poor sleep quality and increased

daytime sleepiness (Duggan, Friedman, McDevitt & Mednick, 2014). It has also been suggested that there may be a mediation link between neuroticism and health outcomes. For example, Liu and Lin (2019) found practicing meditation to be a mediator between neuroticism and health outcomes. Ploubidis and Grundy (2009) found the effect of neuroticism on health to be largely mediated by psychological distress and physical health.

One study examined the relationship between neuroticism and the prevalence of asthma. The study looked at all “Big Five” personality traits and a lifetime asthma diagnosis. Personality was measured at one point whereas asthma was recorded at three points across 54 years. The study followed a random sample of 10,317 individuals starting in 1957 with data collected in 1975, 1992, 2004 and 2011. Personality was measured using the 54-item Big Five Inventory in 1992 whereas asthma was measured using self-report in 1992, 2003 and 2011. Ultimately the study found that higher neuroticism scores were related to a greater risk of a lifetime asthma diagnosis (Najjab et al., 2020).

There has been suggestion that perhaps neuroticism leads to greater health risk behaviours such as excessive drinking which in turn, results in poorer physical health (Mroczek et al., 2009; Vollrath & Torgersen, 2002). A 21-year prospective cohort study conducted in Britain on 5424 adult individuals suggested that the relationship between neuroticism and health outcomes may be mediated by health risk behaviours. They found that neuroticism was related to higher mortality. However, when controlled for social class, education, smoking, alcohol consumption, physical activity and overall health, neuroticism was not related to mortality except for cardiovascular disease (Shiple et al., 2007). Perhaps mortality was due to other risk factors (such as smoking, alcohol, lesser health etc.) rather than neuroticism. However, it is also possible that socio-economic factors (such as class or education) may lead to health risk behaviours that in turn result in worse health, rather than neuroticism causing these risky behaviours (Shiple et al., 2007).

Another longitudinal study conducted a survival analysis using measures of neuroticism made in 1975 to predict mortality over 30 years in a group of older men, looked at risky behaviours, namely smoking and drinking behaviours and their relationship to neuroticism and mortality. The authors concluded that smoking explains 40% of the relationship between neuroticism and mortality, leaving a large amount unexplained suggesting that neuroticism may affect health in other ways than simply through risky health behaviour. However, they did not find drinking behaviours to be associated with mortality (Mroczek et al., 2009). A different study which used 683 university students as participants looked at health risk behaviours such as smoking, alcohol consumption, drug consumption and risky sexual behaviour and their relationship with high neuroticism. They found that those high in neuroticism were more likely to partake in multiple, risky behaviours and concluded neuroticism to have a negative impact on health (Vollrath & Torgersen, 2002).

Neuroticism has been related to both poor physical and mental health. A study examining changes in personality and health over a four-year period found that increases in neuroticism were related to poorer health. Participants were 11,105 adults with personality and health measures being recorded at baseline and the four year follow up. The follow up found that increasing neuroticism resulted in both poorer mental health and physical health (Magee, Heaven & Miller, 2013). Another longitudinal study looked at neuroticism in youth and its follow-up 40 years later. This study found that the impact of neuroticism on wellbeing was largely indirect through psychological and physical health issues (Gale, Booth, Möttus, Kuh & Deary, 2013).

Neuroticism has also been negatively associated with mental health conditions, namely anxiety and depressive disorders (Liu & Lin, 2019). It has been proposed that this may be due to the crossover of symptoms such as worry and sadness (Lahey, 2009). A meta-analysis found considerable effect sizes with neuroticism to mental disorders including mood

disorders ($d = 1.54$), somatoform disorders ($d = 1.20$), anxiety disorders ($d = 1.04$) and eating disorders ($d = 1.29$) (Malouff, Thorsteinsson and Schutte, 2005). A separate meta-analysis has found that neuroticism is highly correlated with mental health symptoms. This looked at the role of meditation and optimism as a mediator between neuroticism and depression and neuroticism and anxiety. They found that neuroticism was directly related to anxiety and depression, as well as practicing meditation having a mediating role (Liu & Lin, 2019). A separate mediation study found that neuroticism had an indirect effect on causes of mortality (somatic health, smoking, alcohol and psychological distress) and higher neuroticism being associated with a greater mortality risk. They found that the effect of neuroticism on mortality was largely mediated by psychological distress and somatic health (Ploubidis & Grundy, 2009).

Following the idea that neuroticism is related to poorer mental health, one study has found significant correlations between worry and neuroticism and that neuroticism was more related to anxiety than depression (Muris, Roelofs, Rassin, Franken & Mayer, 2005). While, Cervera et al., 2003 found neuroticism showed an increased risk in developing an eating disorder. It has also been found that individuals with schizophrenia scored higher on implicit neuroticism than the healthy controls (Suslow, Lindner, Kugel, Egloff & Schmukle, 2014). Another nine year follow up study examined 206 depressed elderly participants. The study looked at recovery from depression after nine years and found that low neuroticism was a predictor of recovery (Steunenberg et al., 2007).

Ultimately, many studies have repeatedly found negative effects of neuroticism. Neuroticism has been linked to a number of physical and mental conditions that result in worsened health outcomes (for example, greater mortality, slower recovery, greater prevalence of anxiety and depressive disorders). Many studies are quick to conclude that neuroticism itself results in poorer health outcomes, however, others propose that perhaps the

effects of neuroticism are indirect, such as the impact of neuroticism on wellbeing being largely indirect via psychological and physical health issues (Gale et al., 2013) or that neuroticism itself results in more risky health behaviours and those behaviours result in the worsened health (Vollrath & Torgersen, 2002). It has also been suggested that physiological factors may have a greater impact on one's health e.g. stress hormones and cholesterol have an impact on glucose levels and other factors of one's metabolism which is affected by what, when and how much someone eats and drinks (Friedman, 2019). The findings that support the idea of neuroticism resulting in poor health are significant, however the concept of healthy neuroticism has also been found in many studies.

Healthy Neuroticism

It is important to note that not all studies find negative outcomes or find very small effects of neuroticism. For example, there are studies that find no relationship between neuroticism and mortality (e.g., Huppert & Whittington, 1995; Iwasa et al., 2008) or between neuroticism and health behaviours (e.g., Atherton, Robins, Rentfrow & Lamb, 2014). Perhaps the relationship between neuroticism and health is more complicated than neuroticism simply resulting in worse health or increasing one's likelihood to partake in risky behaviours that in turn results in worse health for everyone or in all situations. Some authors have argued that high levels of neuroticism could even have a positive impact on health under certain circumstances (e.g., Friedman, 2000; Weston & Jackson, 2015; 2018): either through increased vigilance resulting in healthier behaviours in turn, better health or through the interaction with other personality traits, conscientiousness in particular.

Healthy neuroticism has been discussed more in recent literature since Friedman (2000) presented the idea that sometimes neuroticism can lead to better health outcomes (Friedman, 2019). Friedman (2019) discusses the idea that neuroticism can lead people down two paths. The first is a pessimistic and anxious path that causes people to turn to unhealthy

or risky behaviours and avoid assistance that could benefit and protect their health. This, in turn, creates a negative lifestyle and results in the negative effects of neuroticism. The second path is one in which neuroticism results in vigilance and body awareness which in turn results in better health and healthy neuroticism. Weston and Jackson (2018) described healthy neuroticism as being attentive, noticing changes and being more likely to seek medical attention when needed. Another study proposed neuroticism may have positive consequences as those who are highly neurotic are more likely to use health services when needed (ten Have et al., 2005). Their work examined the use of both primary care and specialised mental health care sectors and the use of a mental health contact and the number of mental health visits among those high in neuroticism. They found that mental health care users and primary care users tended to be higher in neuroticism (ten Have et al., 2005).

Vigilance. Vigilance has been proposed as one of the key mediating factors in forming healthy neuroticism, suggesting that vigilance is often needed to display the beneficial effects of neuroticism (Weston & Jackson, 2018). Vigilance refers to body awareness and being conscious of one's symptoms. It is often called body awareness rather than vigilance in health research. One study found that a short body awareness program found increased quality of life and self-efficacy, emotional improvements, decreased stress and an overall positive lifestyle change among its participants (Landsman-Dijkstra, Wijck, Groothoff, & Rispens, 2004). Body awareness has been related to a number of distressing bodily symptoms such as somatic complaints and anxiety (Cioffi, 1991). However, a meta-analysis which looked at body awareness, incorporated studies that examine pain. It was noted that mental distractions and attention focused on other mental tasks, were very beneficial in limiting pain (Mehling et al., 2009). It is important to note that very few studies have looked at vigilance and its relationship with personality. However, body awareness research has found that pain and awareness is related to higher neuroticism (Vinck, 1979).

Weston and Jackson's (2018) work examined the relationship between body vigilance and neuroticism to see their joint impact on health. The authors note that their study is the first to their knowledge that examines the role of vigilance in explaining the relationship between neuroticism and health. Their study used 1055 participants from an online participant panel assessing self-reported health, Body Mass Index, chronic condition status, a composite measure for health behaviours (diet, exercise, alcohol consumption, smoking and drug use), and adherence to medication. They hypothesized that neuroticism and body vigilance are related and that there is a significant effect of neuroticism on health through body vigilance. Weston and Jackson (2018) distinguished between two aspects of body vigilance: sensation awareness belief and change awareness belief. Sensation awareness belief refers to being aware of sensations and paying attention to sensations in one's body. Change awareness belief refers to being aware of and being able to predict changes in one's body. Neuroticism was significantly related to sensation awareness belief, but unrelated to change awareness. The study found partial support for healthy neuroticism via increased vigilance: people high in neuroticism scored higher on sensation awareness belief, which in turn was related to healthier behaviours. They did however find a negative result in that, those higher in neuroticism reported higher sensation awareness belief which in turn related to lower self-rated health.

Conscientiousness. Conscientiousness involves the concepts of following norms and rules, being plan and goal oriented, displaying good impulse control and delaying gratification (Bogg & Roberts, 2004). Conscientiousness has been found to be an important health related trait. On its own, conscientiousness has been found to predict healthy behaviours, better physical health and social relationships (Friedman, Kern, Hampson, & Duckworth, 2014). Greater conscientiousness has also been associated with lower levels of negative affect (Javaraš et al., 2012). A meta-analysis has suggested that conscientiousness

acts on health outcomes via social environmental factors (e.g. work), health behaviours and psychophysiological mechanisms (Bogg & Roberts, 2004). Conscientiousness has been related to a large number of traits that are related to positive health outcomes (e.g. hormone levels, marital stability, gene expression and socioeconomic status). Conscientiousness was found to be negatively associated with all risky health behaviours examined (e.g. tobacco use, diet and physical activity patterns, suicide excess alcohol and substance use, violence, risky sexual behaviour and dangerous driving) and positively associated with health benefitting behaviours (e.g. better diet and exercise habits, less risky sexual behaviour, less alcohol and drug use) (Bogg & Roberts, 2004). Conscientiousness has also been proposed as a key factor for healthy neuroticism.

Neuroticism and conscientiousness combined has been examined in the past and found to predict lower levels of inflammatory markers (Turiano, Mroczek, Moynihan & Chapman, 2013), less smoking and lower alcohol consumption (Turiano, Whiteman, Hampson, Roberts & Mroczek, 2012) with high conscientiousness and moderate to high neuroticism (Weston & Jackson, 2018). One study examined the relationship between the 'Big Five' personality traits and interleukin-6 (an inflammatory biomarker). They found those who were in the top 10% of the distribution of neuroticism or the bottom 10% of conscientiousness had around a 40% greater risk of exceeding relevant levels of interleukin-6 (Sutin et al., 2010). Interestingly, a follow up study was conducted to examine the possibility of 'healthy' neuroticism. Their follow up work found that those high in both conscientiousness and neuroticism had lower levels of interleukin-6, than people with varying levels of conscientiousness and neuroticism. They also found that those high in both conscientiousness and neuroticism had lower levels of BMI and chronic disease. They also noted that both high and low neuroticism had the same impact on the level of interleukin-6

and only the combination of high neuroticism and high conscientiousness resulted in lowered levels of interleukin-6 (Turiano et al., 2013).

Due to the found link between neuroticism and conscientiousness and their joint impact on health, more studies have been conducted to examine their effects. One study looked at the joint impact of neuroticism and conscientiousness on type 1 diabetes (Brickman et al., 1996). The authors state that previous work has found that personality factors such as self-esteem, competence, social function and adjustment all influence compliance behaviours in relation to type 1 diabetes. It is important to note, that most of these personality factors relate to neuroticism or conscientiousness, for example, neuroticism has been related to lower self-esteem (Lahey, 2009).

An earlier study by Weston and Jackson (2015), investigated the effects of neuroticism and conscientiousness on health behaviours, namely smoking, after the onset of chronic disease. Their study ($N = 7015$) found that after the onset of major chronic disease, high neuroticism coupled with high conscientiousness predicted less smoking. This combination (high neuroticism with high conscientiousness) was labelled healthy neuroticism. However, healthy neuroticism only influenced smoking after the onset of disease and not beforehand. The authors suggest that the relationship between personality and one's response to health problems differs to the relationship between personality and the onset of those health problems (Weston & Jackson, 2015).

One study, which aimed to examine the effects of neuroticism and conscientiousness, looked at renal deterioration. Their results found that renal deterioration progressed faster among those who were not high in conscientiousness and who were at the extreme low or extreme high in neuroticism. Ultimately, they concluded that those who had moderate levels of neuroticism and who were high in conscientiousness had renal deterioration times that were 12 years longer and therefore, better than average. The authors propose that this positive

effect may be due to better self-care, compliance and vigilance due to neuroticism and conscientiousness (Brickman et al., 1996).

Interestingly, both conscientiousness and neuroticism are associated with health-related social control. It has been suggested that those highly conscientious individuals, have their own internalized notions of responsibility and obligation to others rather than others trying to influence or improve their health (Tucker, Elliott & Klein, 2006). Also, that their 'healthier lifestyles' are simply qualities such as perseverance, self-discipline, goal-directedness, and deliberativeness, thus resulting in better health. However, those with higher neuroticism experience more attempts from others who are trying to influence or improve their health, however they generally display a negative response to this influence. They propose that both conscientiousness and neuroticism are related to social control in different ways (Tucker et al., 2006). This suggests that those with greater discipline, vigilance and conscientiousness results in greater health habits.

The Present Research

The present research continued the investigations into the relationship between health and neuroticism. It aimed to further examine the relationship between conscientiousness and neuroticism.

Firstly, the present study drew on the vigilance work by Weston and Jackson (2018) to examine both change awareness belief and sensation awareness belief and see their effects on health outcomes. It also examined the relationship between neuroticism and health to further investigate if vigilance is an important mediating factor between neuroticism and health. To my knowledge the study by Weston and Jackson (2018) was the first to examine the link between neuroticism, vigilance and health outcomes, and whilst some promising results were found, replication is needed. My first hypothesis was that the relationship between neuroticism and health outcomes would be mediated by vigilance.

Secondly, the present study aimed to look at the relationship between conscientiousness and neuroticism, to investigate further if high conscientiousness coupled with moderate to high neuroticism results in better health outcomes. I hypothesised that the relationship between neuroticism and health outcomes would be moderated by conscientiousness.

Lastly, this study investigated a possible moderated mediation effect of the joint effect of vigilance and conscientiousness on the relationship between neuroticism and health outcomes. I hypothesised that vigilance would mediate the relationship between neuroticism and health outcomes but only for participants high in conscientiousness.

To examine these hypotheses, two separate samples were recruited. The first study reports the findings of a New Zealand sample. The second study reports the findings of a United States sample. The aim was to replicate any significant findings from the first study in a second, separate, sample in order to show that findings were robust.

Study 1: New Zealand Sample

Method

Participants and Procedure

Three hundred sixty-nine participants were recruited. The inclusion criteria of this study were being an adult (18 years or older) and living in New Zealand. Of the 369 participants, 31 were removed due to incomplete data and one was removed for being under 18. This left a final sample of 336 participants: 25.6% ($n = 86$) were male, 73.8% female ($n = 248$), and 0.6% ($n = 2$) 'other'. Age varied between 18 and 78 years old, with the mean age being 28.10 years ($SD = 14.27$). Participants were also asked to select what ethnicities they identified with (they had the option to select more than one). Of the sample, 85.7% identified as New Zealand European ($n = 288$), 7.4% Māori ($n = 25$), 6% Asian ($n = 20$), 2.1% Pacific Peoples ($n = 7$), 0.6% Indian ($n = 2$), 0.3% Middle Eastern ($n = 1$), 6.8% European ($n = 23$)

and 5.7% Other ($n = 19$). Participants were also asked about their highest education, 3.3% did not finish high school ($n = 11$), 61% had finished high school ($n = 205$), 10.1% had a diploma ($n = 34$), 22% had a Bachelor's degree ($n = 74$), 3.3% had a Master's degree ($n = 11$) and 0.3% had a doctorate ($n = 1$). Participants were recruited either via social media advertisement on Facebook ($n = 219$) and had the option to enter to win one of four \$50 gift vouchers. The other participants ($n = 150$) were recruited via the University of Canterbury first year Psychology Department participant pool in exchange for course credit (for information sheets used, see Appendix A). The study was conducted online via Qualtrics and took approximately 20 minutes to complete. This study was reviewed and approved by the University of Canterbury Human Ethics Committee (see Appendix B).

Measures

Demographics. Demographic measures included questions about participants sex, age, ethnicity and highest education.

Personality. Personality Traits were measured using the Big Five Inventory (BFI) (John & Srivastava, 1999). This is a 44-item inventory that measures the Big Five traits: Neuroticism, Conscientiousness, Extraversion, Agreeableness and Openness. Responses are measured on a Likert scale from 1 (*disagree strongly*) to 5 (*agree strongly*). Many studies have found the BFI consistently valid and reliable (Fossati, Borroni, Marchione & Maffei, 2011; Worrell & Cross, 2004). For example, a study by Alansari (2016) found the BFI to be a brief measure of the Big Five but provide consistent reliable and valid results, they found neuroticism to have a Cronbach's alpha of .83 and conscientiousness had a Cronbach's alpha of .90. Although all 5 personality traits were measured in the survey for the current study, only the scales for Neuroticism and Conscientiousness were used. The neuroticism items looked at the facets anxiety (tense), angry hostility (irritable), depression (not contented), self-consciousness (shy), impulsiveness (moody) and vulnerability (not self-confident). The

eight items asked questions such as “gets nervous easily” and “worries a lot.” The conscientiousness items looked at the facets competence (efficient), order (organized), dutifulness (not careless), achievement striving (thorough), self-discipline (not lazy) and deliberation (not impulsive). The nine items include questions such as “does a thorough job” and “perseveres until the job is finished.” Cronbach’s alpha in the current study for neuroticism was .84 and .83 for conscientiousness.

12-Item Short-Form Health Survey. The SF-12 assessed health related quality of life in regards to physical and mental health. The physical health aspect looked at limitations in moderate and strenuous activities, pain interference and overall health ratings. The mental health component looked at energy and calmness levels, emotionality and social time. The questions were measured on various scales from not at all to very; and never to all of the time. The questions are all taken from the SF-36 health survey and is a short form of this survey as it assess the same 8 domains; physical functioning, role – physical, bodily pain, general health perceptions, vitality, social function, role – emotional and mental health (Ware, Kosinski and Keller, 1996). There is an algorithm that is used to create the physical and mental health component scores to compare to normative data. The mean score is 50, with scores over 50 indicating better mental or physical health than the mean and scores under 50 indicating worse mental or physical health than the mean (Shirley Ryan Ability Lab, 2013).

General Practitioner (GP) Consultations and Care Seeking. Participants were asked how often they visit their GP, with answers including less than once a year, once a year, twice a year and at least every couple of months. There were also two scenario questions i.e., “you’ve had a runny nose for two days now, how likely are you to go to the doctor?” and “you’ve had a sharp pain for over a week, how likely are you to go to the doctor?” With answers being measured on a 5 point Likert scale from 1 (*would definitely go*)

to 5 (*definitely wouldn't go*). The latter two items were combined and then averaged to form a scale measuring GP care seeking. The responses were reverse scored so that a higher score means higher likelihood of seeking care.

Body Mass Index (BMI). Participants were asked to report their height (in metres) and weight (in kilograms) which was used to calculate their BMI ($BMI = \text{kg}/\text{m}^2$). A BMI of less than 18.5 is underweight, 18.5-24.9 is a normal weight, 25-29.9 is overweight while and 30+ is obese.

Health Enhancing and Health Risk Behaviours. Eating behaviour, physical activity, sleep, smoking, alcohol use and drug use were measured.

Eating Behaviour. Eating behaviour was measured by asking participants on how many days in the past two weeks they: ate healthy amounts of food, ate in a balanced way with lots of fruits and vegetables, ate junk food (e.g. chocolate and sweets), overate and ate fast food (e.g. meat pies and McDonalds) with answers ranging from 1 (*every day*) to 5 (*less than once a week*). Some of the items were reversed scored so that higher scores refer to healthier eating. The 5 items were added to create an eating behaviour measure. Cronbach's alpha for this scale in the current study was .74 (based on Baker, Little & Brownell, 2003; see Kuijer & Boyce, 2012; Kuijer Boyce & Marshall, 2015).

Physical Activity. Physical activity was measured with two questions asking participants on how many days in the past 7 days they got 30+ minutes of moderate physical activity and on how many days they got 20+ minutes of vigorous physical activity (Ministry of Health, 2019). The items were combined and then averaged to form a scale.

Sleep Quality. Sleep quality was assessed with one item from the Pittsburgh Sleep Quality Index (PSQI) asking participants to rate the quality of their sleep in the past month (1 = worst possible quality, 10 = best possible quality) (Buysse, Reynolds, Monk, Berman & Kupfer, 1989).

Smoking. Smoking was measured by asking participants if they were smokers, ex-smokers or never smoked. Ex-smokers and non-smokers were combined into one variable. The responses were coded as 1 (*smokers*) and 2 (*non-smokers*).

Alcohol Use. Alcohol use was measured by asking participants how often they drank alcohol (never, once a month, up to 4 times a month, 2-3 days a week, 4-5 days a week and 6-7 days per week). If they did drink alcohol, they were also asked how many standard drinks containing alcohol they had on a typical day when drinking. The items were multiplied (days and amount) to create a measure of alcohol use.

Drug Use. Drug use was measured by asking “During the past month, how many times did you use illicit drugs?” (haven’t used, once, 2-3 times, several times) Less than 20% of the sample reported having used any drugs (9.8% once, 6.0% 2-3 times, 3.6% several times), hence it was decided to dichotomize the item and code responses as 1 (*not used in the past month*) and 2 (*used in past month*).

Outcomes measures for both studies are included in Appendix C, except for the BFI, SF-12 and sleep questionnaires due to copyright.

Vigilance. Body vigilance was measured using the questionnaire compiled by Weston and Jackson (2018). They compiled the scale using five existing vigilance scales; the Body Awareness Questionnaire (BAQ) (Shields, Mallory, & Simon, 1989), the Private Body Consciousness sub-scale of the Body Consciousness Questionnaire (PBCS) (Miller, Murphy, & Buss, 1981), the Scale of Body Awareness (SBA) (Hansell & Sherman, 1991), the Body Responsiveness Questionnaire (BRQ) (Daubenmier, 2005), and the Body Vigilance Scale (BVS) (Schmidt & Lerew, 1997). A factor analysis was conducted of the 38 items from the 5 scales, they extracted two factors with 35 items. The two factors were labelled Change Awareness Belief (18 items) and Sensation Awareness Belief (17 items). The change awareness factor was identified as the items reflected the idea that one could predict changes

in their body and included items such as “I know in advance when I’m getting the flu” and “I am very aware of changes in my body temperature.” The sensation awareness belief factor was identified as the items seemed to reflect that one thinks about the changes and feeling in their body and included items such as “I am sensitive to internal bodily tensions” and “I can often feel my heart beating” (see Appendix D for full scale). In the 35-item scale, most items are rated a scale from 1 (strongly disagree) to 5 (strongly agree), while some are rated from 1 (Never) to 5 (Always). The Cronbach’s alphas in the present study were $\alpha = .81$ for change awareness belief and $\alpha = .87$ for sensation awareness belief.

Analyses

Analysis consisted of mediation, moderation and moderated mediation analysis. All analyses were conducted using the PROCESS Macro for SPSS (Hayes, 2013). Age and sex were entered as covariates for all analyses. For the mediation analysis, unstandardized indirect effects were calculated for each of 10,000 bootstrapped samples. A 95% confidence interval was used by calculating the indirect effects at the 2.5th and 97.5th percentiles. To have obtained a significant result, the confidence intervals must not include zero.

A moderation variable affects the direction or strength between two variables. For the moderator analyses, the predictor variable (neuroticism), the moderator variable (conscientiousness) and the interaction term (neuroticism X conscientiousness) were entered in the model. Significant moderation effects were followed up with simple slope analyses at one standard deviation above the mean of the moderator, at the mean and at one standard deviation below the mean of the moderator.

The moderated mediation analysis (using model 8 from the PROCESS Macro) examined the effect of an independent variable on an outcome variable via a mediator variable depending on a moderator variable. A 95% percentile bootstrap confidence interval is created using 5000 bootstrap samples for the conditional indirect effect at -1 standard

deviation, 0 standard deviation and +1 standard deviation of the moderator. To have obtained a significant result the confidence intervals must not include zero (Hayes, 2013).

Results

Descriptive Analyses

Table 1 displays the means and standard deviations for the key variables in the study. Compared to normative data for the SF-12, the sample scored below average on mental health (i.e., below 50) and above average (i.e., above 50) on physical health. The average participant visited their GP between one and two times per year and would probably not seek care for a runny nose or sharp pain (the two hypothetical scenarios). The average BMI sat just inside the overweight range. Participants reported fairly healthy eating behaviours, moderate physical activity and above average sleep quality. While only 5.1% of participants were smokers, 19.3% reported using illicit drugs in the past month.

Table 1

Descriptive Results for Key Variables

	<i>M</i> (or <i>N</i>)	<i>SD</i> (or %)	Possible range
Mental Health Component (SF-12)	43.57	11.62	0-100
Physical Health Component (SF-12)	53.13	8.17	0-100
GP Consultations	2.66	1.09	0-4
GP Care Seeking	2.07	0.50	0-4
BMI	25.30	5.13	
Eating Behaviour	4.20	1.45	1-5
Physical Activity	4.27	1.90	1-8
Alcohol Use	7.18	5.20	1-36
Drug Use (in past month)	65	19.3%	
Sleep	6.30	1.80	1-10
Smoking (current)	17	5.1%	
Sensation Awareness Belief	2.96	0.65	1-5
Change Awareness Belief	3.35	0.55	1-5
Conscientiousness	3.57	0.67	1-5
Neuroticism	3.08	0.80	1-5

Table 2 presents the correlations between neuroticism, conscientiousness, and the two vigilance measures with age, sex and the health variables (correlations between the whole set of variables are displayed in Appendix E). Neuroticism was significantly negatively associated with age, the mental health component, physical activity, eating behavior, sleep, smoking, change awareness and positively associated with GP consultations, drug use and sensation awareness. Conscientiousness was significantly negatively associated with alcohol use and drug use but positively associated with sex, age, mental health component, eating behavior, physical activity, smoking and change awareness belief. Neuroticism and conscientiousness were also significantly negatively correlated.

Table 2*Correlations between Personality, Vigilance, Demographics and Health Variables*

	Neuroticism	Conscientiousness	Change Awareness	Sensation Awareness
Sex	0.08	0.23**	0.13*	0.09
Age	-0.34**	0.43**	0.06	-0.04
Mental Health Comp.	-0.67**	0.28*	0.11*	-0.10
Physical Health Comp.	0.00	0.07	0.03	-0.14*
GP Consultations	0.19**	0.02	0.05	0.14**
GP Care Seeking	0.01	0.03	-0.04	0.98
BMI	0.05	-0.02	0.04	0.08
Eating Behaviour	-0.37**	0.45**	0.14**	0.01
Physical Activity	-0.21**	0.17**	0.07	0.14*
Alcohol Use	0.01	-0.25**	-0.05	-0.02
Drug Use	0.19**	-0.25**	-0.02	0.09
Sleep	-0.23**	0.06	0.09	-0.07
Smoking (current)	-0.02	0.11*	0.01	-0.00
Sensation Awareness B.	0.16*	0.02	0.43**	
Change Awareness B.	-0.06	0.20**		
Conscientiousness	-0.30**			
Neuroticism				

Note: ** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed). Sex: 1 = male, 2 = female; Drug use: 1 = user, 2 = non-user; Smoking: 1 = smoker, 2 = non-smoker

Mediation

A series of mediation models were run to test the hypothesis that vigilance mediates the relationship between neuroticism and health related outcomes. In these analyses the two measures of body vigilance (sensation awareness belief and change awareness belief) were included as mediators. Separate analyses were run for each dependent variable. Because age and sex were related to some of the health variables (see Appendix E) and/or to the predictor or mediator variables (see Table 2) they were included as covariates in all analyses. The results are presented in Table 3.

Neuroticism was found to be a significant predictor of sensation awareness belief ($b = 0.13$, $t = 2.89$, $p = .00$) but not a significant predictor of change awareness belief ($b = -0.04$, $t = -1.14$, $p = 0.26$) (the 'a' paths in Table 3). No indirect effects of neuroticism through change awareness belief were found (i.e., all the confidence intervals for the indirect effect of change awareness included 0, see Table 3). As shown in Table 3, there was only one significant mediation effect through sensation awareness belief for the physical health component (indirect effect = -0.30 , $[-0.61, -0.05]$). This indirect effect suggests that higher neuroticism is related to higher sensation awareness belief, which in turn is related to, poorer physical health. Neuroticism was significantly related to many of the outcome variables (seen in the significant direct effects in Table 3) however, vigilance did not mediate the effect between them.

Table 3*Mediation Effects between Neuroticism and Health Outcomes for the New Zealand Sample*

	Total Effect		Direct Effect			Indirect Effect		a path	b path
	b	95%CI	b	95%CI		b	95%CI		
MHC	-9.23***	[-10.48, -7.98]	-9.09***	[-10.36, -7.81]	Total	-0.15	[-0.50, 0.15]	0.13**	-0.61
					Sense	-0.08	[-0.35, 0.15]		
					Change	-0.07	[-0.33, 0.08]		
PMC	-0.29	[-1.48, 0.90]	0.09	[-1.10, 1.29]	Total	-0.38	[-0.75, -0.09]	0.13**	-2.39**
					Sense	-0.30	[-0.61, -0.05]		
					Change	-0.08	[-0.36, 0.09]		
GP Consult	0.27***	[0.12, 0.42]	0.24***	[0.08, 0.39]	Total	0.03	[-0.01, 0.75]	0.13**	0.20*
					Sense	0.02	[-0.00, 0.07]		
					Change	0.00	[-0.01, 0.02]		
GP Care	0.01	[-0.07, 0.08]	0.00	[-0.07, 0.07]	Total	0.00	[-0.01, 0.03]	0.13**	0.01
					Sense	0.00	[-0.01, 0.02]		
					Change	0.00	[-0.01, 0.01]		
BMI	0.89*	[0.18, 1.60]	0.82*	[0.09, 1.54]	Total	0.07	[-0.09, 0.22]	0.13**	0.61
					Sense	0.08	[-0.03, 0.20]		
					Change	-0.01	[-0.09, 0.06]		
Eating	-0.26***	[-0.35, -0.16]	-0.25***	[-0.35, -0.16]	Total	-0.00	[-0.03, 0.02]	0.13**	0.01
					Sense	0.00	[-0.01, 0.02]		
					Change	-0.01	[-0.25, 0.01]		

Table 3 (continued)*Mediation Effects between Neuroticism and Health Outcomes for the New Zealand Sample*

	Total Effect		Direct Effect		Indirect Effect		a path	b path	
	b	95%CI	b	95%CI	b	95%CI			
Phys Act	-0.59***	[-0.86, -0.32]	-0.58***	[-0.85, -0.31]	Total	-0.01	[-0.09, 0.07]	0.13**	0.09
					Sense	0.01	[-0.04, 0.07]		
					Change	-0.02	[-0.08, 0.02]		
Alcohol	-0.45	[-1.16, 0.26]	-0.45	[-1.20, 0.27]	Total	-0.00	[-0.17, 0.16]	0.13**	-0.02
					Sense	-0.00	[-0.15, 0.14]		
					Change	0.00	[-0.07, 0.07]		
Drug ₁			0.45*	[0.05, 0.86]	Total	0.05	[-0.04, 0.15]	0.13**	0.34
					Sense	0.04	[-0.02, 0.13]		
					Change	0.00	[-0.04, 0.05]		
Sleep	-0.57***	[-0.83, -0.03]	-0.52***	[-0.79, -0.26]	Total	-0.05	[-0.13, 0.01]	0.13**	-0.25
					Sense	-0.03	[-0.06, 0.01]		
					Change	-0.02	[-0.04, 0.01]		
Smoking ₁			0.02	[-0.66, 0.70]	Total	-0.10	[-0.29, 0.07]	0.13**	-0.56
					Sense	-0.07	[-0.22, 0.07]		
					Change	-0.03	[-0.17, 0.05]		

₁ Total effects cannot be computed for dichotomous variables.

* p < 0.05, ** p < 0.01, *** p < 0.00

All analyses controlled for age and sex.

Moderation

Next, moderation analyses were conducted to examine if conscientiousness moderated the relationship between neuroticism and health outcomes. Separate analyses were again run for each dependent variable and sex and age were entered as covariates. The results for this analysis are presented in Table 4. Table 4 shows that there was a significant interaction effect for the mental health component. The interaction effect is displayed in Figure 1. Figure 1 shows that neuroticism was related to worse mental health for all participants, but that this relationship was strongest for those with low levels (1 SD below the mean) of conscientiousness ($b = -10.54$, $SE = .88$, $t = -11.94$, $p < .001$), less strong for participants with average levels of conscientiousness ($b = -.918$, $SE = .65$, $t = -14.25$, $p < .001$) and weakest for those with high levels (1 SD above the mean) of conscientiousness ($b = -7.81$, $SE = .81$, $t = -9.66$, $p < .001$). No other moderation effects were found.

Table 4 shows that low neuroticism and high conscientiousness were both independently related to healthier eating behaviours and greater physical activity.

Figure 1

Moderation Effect of Conscientiousness on Neuroticism and Mental Health Component

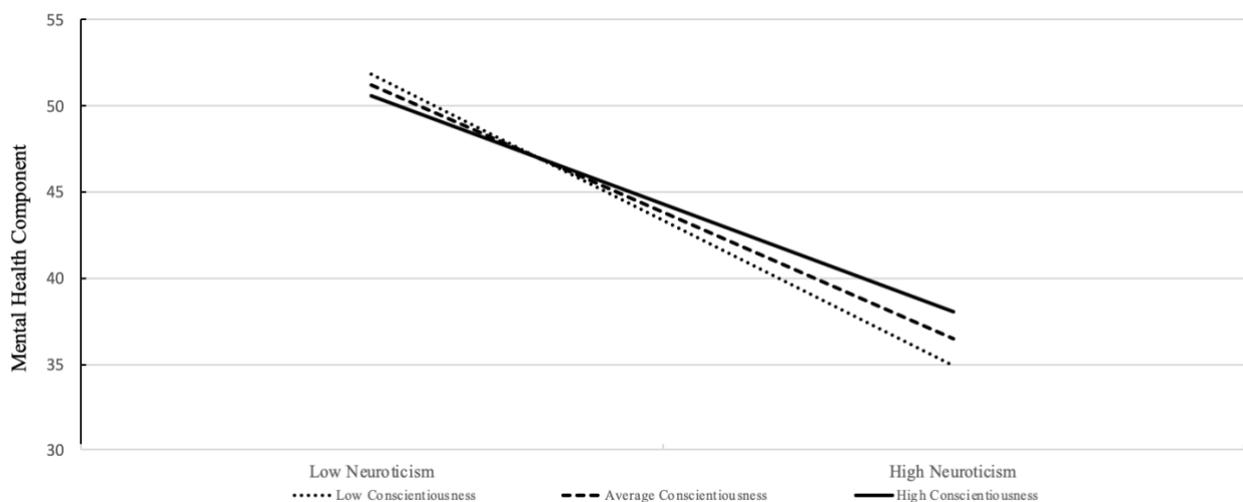


Table 4

Moderation Effects of Conscientiousness between Neuroticism and Health Outcomes for the New Zealand Sample

	Neuroticism			Conscientiousness			Interaction			R ₂	R ₂ Change
	b	S.E	t	b	S.E	t	b	S.E	t		
MHC	-9.18	0.64	-14.25***	0.70	0.82	0.86	2.03	0.82	2.49*	0.47*	0.01*
PMC	0.02	0.61	0.03	1.72	0.77	2.23*	1.26	0.77	1.63	0.37*	0.01
GP Consult	0.27	0.08	3.49***	0.04	0.10	0.36	-0.19	0.10	-1.88	0.10***	0.01
GP Care	0.01	0.04	0.22	-0.00	0.05	-0.04	0.03	0.05	0.62	0.01	0.00
BMI	0.86	0.37	2.31	-0.63	0.47	-1.34	-0.57	0.47	-1.21	0.08***	0.00
Eating	-0.20	0.05	-4.41***	-0.31	0.06	5.39***	0.11	0.06	1.95	0.30***	0.01
Phys Act	-0.46	0.14	-3.36***	0.62	0.17	3.62***	-0.08	0.17	-0.46	0.10***	0.00
Alcohol	-0.62	0.36	-1.69	-0.10	0.46	-2.16*	-0.43	0.46	-0.93	0.15***	0.00
Drug ₁	0.34	0.21	1.62 ₂	-0.49	0.26	-1.88 ₂	-0.42	0.28	-1.49 ₂		
Sleep	-0.57	0.13	-4.25***	0.06	0.17	0.37	0.32	0.17	1.89	0.07***	0.01
Smoking ₁	0.33	0.40	0.82 ₂	1.13	0.48	2.34* ₂	0.62	0.40	1.55 ₂		

₁ R₂ cannot be computed for dichotomous variables

₂ Z values are presented for dichotomous variables

* p < 0.05, ** p < 0.01, *** p < 0.00

All analyses controlled for age and sex.

Moderated Mediation

Finally, moderated mediation analyses were conducted to examine if vigilance mediated the relationship between neuroticism and health outcomes but only for those high in conscientiousness. The analysis displays an index for moderated mediation. If the 95% confidence interval of the effect does not include zero, there is evidence for moderated mediation. Separate analyses were again run for each of the dependent variables. None of the analyses found significant moderated mediation results.

Summary of Study 1 Findings

For the New Zealand sample, few significant mediation or moderation results were found. One significant mediation effect through sensation awareness belief was found for the physical health component. This effect suggested that higher neuroticism is related to higher sensation awareness belief, which in turn is related to poorer physical health. One significant moderation effect was also found for the mental health component. Those high in neuroticism tended to have the lower mental health scores. Those high in neuroticism and low conscientiousness seemed to have the lowest mental health scores. This interaction displayed that neuroticism is related to mental health and the relationship is slightly attenuated by high conscientiousness. No significant moderated mediation results were found.

Study 1: United States Sample

Method

Participants and Procedure

Two hundred and eighteen participants were recruited via Mechanical Turk. Participants had to be over 18 years old, English Speaking and in North America. Of these, 13 were removed for not finishing the study, 2 data sets were removed due to someone answering twice with different answers (this was spotted via their Mechanical Turk worker

ID), 4 were removed due to failing the attention checks. This left a final sample of 199 participants, 53.2% ($n = 106$) were male, 45.7% ($n = 91$) females and 1.1% ($n = 2$) other. Age varied between 18 and 72 years old ($M = 38.2$, $SD = 11.28$). The ethnic composition of participants was 76.3% White or Caucasian European (non-Hispanic) ($n = 151$), 5.1% Black/African American ($n = 10$), 6.6% Hispanic or Latino American ($n = 13$), 8.6% Asian American ($n = 17$), 1.5% Native or Indigenous American ($n = 3$) and 2% Other ($n = 4$). Participants were also asked their highest education, 0.5% had not finished high school ($n = 1$), 29.6% had a high school qualification ($n = 59$), 24.1% had an Associate's degree ($n = 48$), 36.7% had a Bachelor's degree ($n = 73$), 7.5 had a Master's degree ($n = 15$) and 1.5% had a Doctorate ($n = 3$). Participants were recruited via Amazon Mechanical Turk (for information sheets used, see Appendix A). They were each paid USD\$2 for their time. The study was conducted online via Qualtrics and took approximately 20 minutes to complete. This study was reviewed and approved by the University of Canterbury Human Ethics Committee (see Appendix B).

Measures

Demographics. Demographic measures included questions about participants sex, age, ethnicity and highest education.

Personality. Neuroticism and Conscientiousness were assessed with the same questions as in Study 1 (John & Srivastava, 1999). Cronbach's alpha for Neuroticism was .92 in the current study, and .91 for Conscientiousness.

12-Item Short-Form Health Survey. The SF-12 was again used to assess health related quality of life in regards to physical and mental health components.

Family Physician Consultations. Participants were asked how often they visited their family physician with answers ranging from less than once a year to at least every couple of months. They were also asked the same two scenario questions as used in Study 1,

i.e., “you’ve had a runny nose for two days now, how likely are you to go to the family physician?” and “you’ve had a sharp pain for over a week, how likely are you to go to the family physician?” 1 (*would definitely go*) to 5 (*definitely wouldn’t go*).

Body Mass Index. Participants were asked to report their height (in inches) and weight (in pounds).

Health Risk Behaviours. Smoking, diet, alcohol, drug use and physical activity were all measured with the same questions as in Study 1.

Eating Behaviour. For the eating behaviour measure, the consumption of fast food (e.g. meat pies, McDonalds) was reworded to suit American fast food items more (e.g. pizza, KFC and McDonalds). Cronbach’s alpha for the eating behaviour item scale was .71 in the current study (based on Baker et al., 2003; see Kuijer & Boyce, 2012; Kuijer et al., 2015).

Physical Activity. Physical activity was again measured using three questions. The first two components were combined to create a measure of physical activity using days per week (Ministry of Health, 2019).

Smoking. Smoking was measured by asking if participants if they are smokers, ex-smokers or never smoked. Ex-smokers and non-smokers were again combined into one variable.

Alcohol Use. Alcohol use was measured by asking participants how often they drank alcohol and they were also asked how many standard drinks containing alcohol they had on a typical day when drinking. The items were multiplied (days and amount) to create a measure of alcohol use.

Drug Use. Drug use was measured by asking during the past month, how many times they have used illicit drugs (haven’t used, once, 2-3 times, several times). Less than 8% of the sample reported having used any drugs, hence it was decided to dichotomize the item and

code responses as 1 (*not used in the past month*) and 2 (*used in past month*).

Sleep. Sleep was assessed with one item from the Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989).

Vigilance. Body vigilance was measured using the questionnaire developed by Weston and Jackson (2018). This measure saw the items being split into two factors; change awareness belief ($\alpha = .85$) and sensation awareness belief ($\alpha = .89$).

Analyses. Analysis consisted of mediation, moderation and moderated mediation analyses and were conducted the same as the New Zealand sample.

Results

Descriptive Analyses

Table 5 displays all the descriptive analysis for the key variables in the study. Similar to the New Zealand sample, the sample scored below average on mental health (i.e., below 50) and above average (i.e., above 50) on physical health. Also, the same as the New Zealand sample, the average participant visited their family physician between one and two times per year and would probably not seek care for a runny nose or sharp pain. The average BMI was just inside the overweight range. Participants reported less healthy eating and physical activity than the New Zealand sample however, reported better sleep quality. Unlike the New Zealand sample, only 7.5% reported using illicit drugs however, 15.5% were current smokers.

Table 5*Descriptive Results for Key Variables*

	<i>M</i> (or <i>N</i>)	<i>SD</i> (or %)	Possible range
Mental Health Component (SF-12)	44.01	13.43	0-100
Physical Health Component (SF-12)	52.60	8.04	0-100
GP Consultations	2.01	1.02	0-4
GP Care Seeking	2.01	0.60	0-4
BMI	26.47	6.30	
Eating Behaviour	3.76	0.71	1-5
Physical Activity	3.62	1.88	1-8
Alcohol Use	4.06	4.83	1-36
Drug Use (in past month)	15	7.5%	
Sleep	6.57	1.84	1-10
Smoking (current)	33	16.6%	
Sensation Awareness Belief	2.91	0.71	1-5
Change Awareness Belief	3.38	0.65	1-5
Conscientiousness	3.96	0.82	1-5
Neuroticism	2.61	1.06	1-5

Table 6 presents the correlations between neuroticism, conscientiousness and the two vigilance measures with age, sex and the health variables (correlations between the whole set of variables are displayed in Appendix F). Similar to the New Zealand sample, neuroticism was negatively correlated with age, the mental health component and sleep. It was also positively correlated with drug use and sensation awareness. Conscientiousness was negatively correlated with drug use and positively associated with age, the mental health component, eating behaviour, physical activity and change awareness belief. Unlike the New Zealand sample, conscientiousness was positively associated with sleep. Neuroticism and conscientiousness were significantly negatively correlated.

Table 6*Correlations between Personality, Vigilance, Demographics and Health Variables*

	Neuroticism	Conscientiousness	Change Awareness	Sensation Awareness
Sex	0.20**	-0.03	-0.05	0.08
Age	-0.19**	0.30**	-0.01	-0.10
Mental Health Comp.	-0.72**	0.55**	0.05	-0.29**
Physical Health Comp.	0.12	0.07	0.08	-0.03
GP Consultations	-0.08	0.08	0.04	0.08
GP Care Seeking	-0.06	0.10	0.09	0.10
BMI	-0.07	-0.03	-0.11	-0.09
Eating Behaviour	-0.12	0.29**	0.15*	0.00
Physical Activity	-0.14	0.18*	0.27**	0.08
Alcohol Use	0.07	-0.11	0.03	0.97
Drug Use	0.19**	-0.25**	-0.02	0.09
Sleep	-0.36**	0.20**	0.02	-0.28**
Smoking (current)	0.12	-0.02	0.03	-0.02
Sensation Awareness B.	0.27**	-0.05	0.55**	
Change Awareness B.	-0.05	0.27**		
Conscientiousness	-0.54**			
Neuroticism				

Note: ** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed). Sex: 1 = male, 2 = female; Drug use: 1 = user, 2 = non-user; Smoking: 1 = smoker, 2 = non-smoker

Mediation

Another series of mediation analysis were conducted, the same as the New Zealand sample. Age and sex were again entered as covariates. The results are presented in Table 7. Similar to the New Zealand sample, neuroticism was found to be a significant predictor of sensation awareness belief ($b = 0.17, t = 3.55, p = .001$) but not a significant predictor of change awareness belief ($b = -0.03, t = -0.61, p = 0.55$) (the 'a' paths in Table 7). Matching the New Zealand study, no indirect effects of neuroticism through change awareness belief were found. However, unlike the New Zealand sample, very few direct effects were found meaning neuroticism was not related to many of the outcome variables. This sample obtained two significant mediation effects through sensation awareness belief for the mental health component (indirect effect = -0.63 [-1.35, -0.16]) and sleep (indirect effect = -0.15 [-0.27, -0.04]). This indirect effect suggests that higher neuroticism is related to higher sensation awareness belief, which in turn is related to, poorer mental health and poorer sleep.

Table 7

Mediation Effects between Neuroticism and Health Outcomes in the United States Sample

	Total Effect		Direct Effect		Indirect Effect		a path	b path	
	b	95%CI	b	95%CI	b	95%CI			
MHC	-9.09***	[-10.35, -7.82]	-8.38***	[-9.70, -7.07]	Total	-0.71	[-1.36, -0.22]	0.17***	-3.67***
					Sense	-0.63	[-1.35, -0.16]		
					Change	-0.08	[-0.41, 0.21]		
PMC	0.66	[-0.44, 1.77]	1.05	[-0.11, 2.21]	Total	-0.38	[-0.89, -0.00]	0.17***	-1.90
					Sense	-0.31	[-0.85, 0.02]		
					Change	-0.06	[-0.32, 0.16]		
GP Consult	-0.09	[-0.23, 0.05]	-0.12	[-0.27, 0.03]	Total	0.03	[-0.02, 0.10]	0.17***	0.17
					Sense	0.03	[-0.02, 0.09]		
					Change	0.00	[-0.02, 0.02]		
GP Care	-0.03	[-0.12, 0.05]	-0.05	[-0.14, 0.04]	Total	0.01	[-0.02, 0.06]	0.17***	0.09
					Sense	0.02	[-0.01, 0.06]		
					Change	-0.00	[-0.01, 0.01]		
BMI	-0.26	[-1.14, 0.62]	-0.28	[-1.21, 0.65]	Total	0.02	[-0.28, 0.31]	0.17***	-0.06
					Sense	-0.01	[-0.28, 0.24]		
					Change	0.03	[-0.09, 0.20]		
Eating	-0.09	[-0.19, 0.01]	-0.07	[-0.17, 0.03]	Total	-0.02	[-0.06, 0.02]	0.17***	-0.07
					Sense	-0.01	[-0.05, 0.02]		
					Change	-0.01	[-0.03, 0.01]		

Table 7 (continued)*Mediation Effects between Neuroticism and Health Outcomes in the United States Sample*

	Total Effect		Direct Effect			Indirect Effect		a path	b path
	b	95%CI	b	95%CI		b	95%CI		
Phys Act	-0.30*	[-0.56, -0.04]	-0.26	[-0.53, 0.00]	Total	-0.04	[-0.16, 0.08]	0.17***	-0.10
					Sense	0.02	[-0.12, 0.07]		
					Change	-0.02	[-0.11, 0.06]		
Alcohol	-0.62	[-0.04, 1.28]	-0.46	[-0.24, 1.16]	Total	0.16	[-0.06, 0.48]	0.178**	0.90
					Sense	0.15	[-0.04, 0.46]		
					Change	0.01	[-0.06, 0.09]		
Drug ₁			-0.11	[-0.68, 0.46]	Total	0.01	[-0.24, 0.26]	0.17***	-0.01
					Sense	-0.00	[-0.23, 0.23]		
					Change	0.01	[-0.06, 0.11]		
Sleep	-0.68**	[-0.92, -0.44]	-0.52***	[-0.76, -0.27]	Total	-0.16	[-0.28, -0.06]	0.17***	-0.86***
					Sense	-0.15	[-0.27, -0.04]		
					Change	-0.16	[-0.09, 0.04]		
Smoking ₁			0.37	[-0.06, 0.79]	Total	-0.07	[-0.25, 0.09]	0.17***	-0.33
					Sense	-0.06	[-0.23, 0.08]		
					Change	-0.01	[-0.09, 0.04]		

₁ Total effects cannot be computed for dichotomous variables.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.00$

All analyses controlled for age and sex.

Moderation

Moderation analyses were conducted to examine if conscientiousness moderated the relationship between neuroticism and health outcomes. Sex and age were again entered as covariates. The results for this analysis are presented in Table 8. Table 8 shows that there was a significant interaction effect for the physical health component. Figure 2 shows the interaction effect. This shows that neuroticism is related to better physical health only for those with low ($b = 2.82$, $SE = .82$, $t = 3.43$, $p < .001$) or average ($b = 1.77$, $SE = .65$, $t = 2.82$, $p < .05$) conscientiousness. Participants with high conscientiousness ($b = 0.72$, $SE = .80$, $t = 0.90$, $p = 3.66$) had better physical health regardless of their levels of neuroticism. This suggests that low or average levels of conscientiousness can be compensated for by higher levels of neuroticism. No other moderation effects were found.

Figure 2

Moderation Effect of Conscientiousness on Neuroticism and Physical Health Component

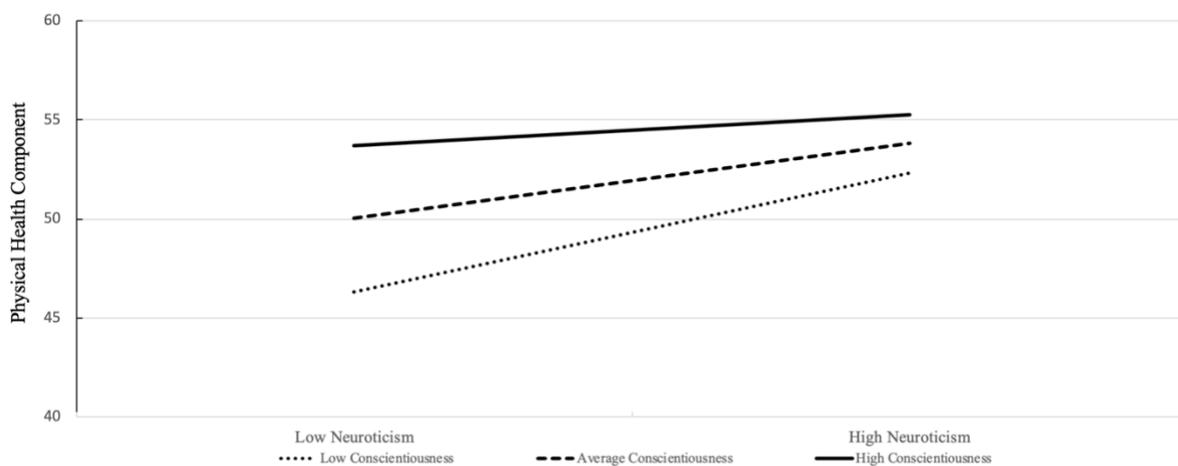


Table 8*Moderation Effects of Conscientiousness between Neuroticism and Health Outcomes for the United States Sample*

	Neuroticism			Conscientiousness			Interaction			R ₂	R ₂ Change
	b	S.E	t	b	S.E	t	b	S.E	t		
MHC	-7.73	0.73	-10.64***	3.36	0.99	3.41***	0.53	0.73	0.73	0.57***	0.00
PHC	1.77	0.63	2.82**	3.19	0.86	3.73***	-1.30	0.63	-2.06*	0.11***	0.02*
GP Consult	-0.76	0.08	-0.90	0.02	0.11	0.14	0.09	0.08	1.12	0.03	0.01
GP Care	-0.01	0.04	-0.20	0.05	0.07	0.79	0.03	0.05	0.62	0.01	0.00
BMI	-0.59	0.52	-1.15	-0.85	0.71	-1.21	-0.04	0.52	-0.09	0.02	0.00
Eating	0.03	0.06	0.54	0.33	0.07	4.36***	-0.09	0.06	-1.57	0.12***	0.01
Phys Act	-0.11	0.15	-0.79	0.52	0.20	2.54*	-0.06	0.15	-0.37	0.08*	0.00
Alcohol	0.41	0.39	1.05	-0.53	0.53	-1.00	0.00	0.39	0.01	0.06*	0.00
Drug ₁	-0.56	0.37	-1.50 ₂	-0.73	0.41	-1.80 ₂	-0.32	0.27	-1.20 ₂		
Sleep	-0.62	0.14	-4.38***	0.15	0.19	0.80	0.01	0.14	0.04	0.15***	0.00
Smoking ₁	0.36	0.24	1.50 ₂	0.15	0.30	0.51 ₂	-0.13	0.25	-0.53 ₂		

₁ R₂ cannot be computed for dichotomous variables

₂ Z values are presented for dichotomous variables

* p < 0.05, ** p < 0.01, *** p < 0.00

All analyses controlled for age and sex.

Moderated Mediation

Finally, moderated mediation analyses were conducted to examine if vigilance mediated the relationship between neuroticism and health outcomes but only for those high in conscientiousness. Separate analyses were again run for each of the dependent variables. Comparable to the New Zealand sample, none of the analyses found significant moderated mediation results.

Summary of Study 1 Findings

For the United States sample, similar to the New Zealand sample, very few significant mediation and moderation results were found. Two significant mediation effects through sensation awareness belief were found for the mental health component and sleep rating. This effect suggests that higher neuroticism is related to higher sensation awareness belief, which in turn is related to, poorer mental health and poorer sleep. One significant moderation effect was also found for the physical health component indicating that those low in neuroticism and low in conscientiousness had the lower physical health scores. Those high in conscientiousness had overall better physical health. No significant moderated mediation results were found.

Discussion

The present research aimed to explore three key hypotheses that related health outcomes to neuroticism. The first being that vigilance mediated the relationship between neuroticism and health outcomes. The second being that conscientiousness moderated the relationship between neuroticism and health outcomes. The third and final hypothesis was vigilance coupled with conscientiousness would have a mediator-moderator effect on health outcomes. Overall, the present research found very little support for the hypotheses.

Vigilance

The first hypothesis was that vigilance would mediate the relationship between neuroticism and health outcomes. In the current research, little support was found for mediation in either sample. In line with Weston and Jackson (2018), neuroticism was found to be significantly related to sensation awareness belief, but not to change awareness belief. This was true in both the New Zealand and the United States sample. This ruled out change awareness as a mediator. Weston and Jackson's (2018) finding of a relationship between sensation awareness belief and neuroticism was replicated in the present research. However, the present research indicated neuroticism is related to higher sensation awareness belief, which in turn, resulted in poorer health outcomes. Whereas Weston and Jackson (2018) found neuroticism was related to better health behaviours through sensation awareness belief. They determined this finding to be evidence towards the theory that neuroticism and vigilance are related.

The present research examined eleven dependent variables. Only one significant mediation result was found with sensation awareness in Study 1, and two in Study 2. Moreover, the findings were not replicated across the two studies. While the present research did not examine the exact same variables as Weston and Jackson (2018) who examined self-rated health and healthy behaviour, self-reported health was measured in the SF-12 and used for the physical and mental health scores. However, while some findings in this research were similar to Weston and Jackson (2018), the findings were not replicated across the New Zealand and United States samples. The New Zealand sample found one significant result for sensation awareness belief mediating the relationship between neuroticism and physical health which suggested that higher neuroticism is related to higher sensation awareness belief, which in turn is related to, poorer physical health. This is in line with Weston and

Jackson (2018) who found that those higher in neuroticism reported higher sensation awareness belief which in turn related to lower self-rated health.

While the United States sample found two significant findings for sensation awareness belief mediating the relationship between neuroticism and mental health and sleep. This again suggests that higher neuroticism is related to higher sensation awareness belief, which in turn is related to, poorer mental health and poorer sleep. It is possible that sensation awareness belief may result in poorer mental and physical health and poorer sleep habits due to making those individuals more aware of their body and feelings. Similar to the findings in Study 1, those higher in neuroticism reported higher sensation awareness belief which in turn, related to poorer mental health. This is in line with Weston and Jackson's (2018) finding of sensation awareness belief being related to lower self-rated health. However, Weston and Jackson did not examine sleep in their study.

Weston and Jackson (2018) found sensation awareness belief to be a significant mediator between BMI and neuroticism, something that was not replicated in the present research. They also found sensation awareness belief to be a significant mediator between chronic condition status and neuroticism which was not examined in the present research. Perhaps, it is most important to note that Weston and Jackson (2018) found support for healthy neuroticism. Sensation awareness belief was a significant mediator between healthy behaviour (a factor which included drug use, alcohol use, smoking, eating behaviour and physical activity) and neuroticism, which indicated that the indirect effect of neuroticism was positive. This suggested, that when a person's neuroticism leads to vigilance, that person acts in healthier ways. No significant mediation results were found for any of these variables in the present research.

Body awareness has been related to a number of distressing bodily symptoms such as somatic complaints and anxiety (Cioffi, 1991). It is possible that those who are more aware of

their bodily sensations, are more aware of the negative feelings in their body and in turn, report lower mental and physical health. Increased vigilance and attention towards the body may be why those who are more neurotic report more somatic complaints (Weston & Jackson, 2018).

Conscientiousness

The second hypothesis was that conscientiousness would moderate the relationship between neuroticism and health outcomes. Conscientiousness has been found in the past to be negatively associated with risky behaviours such as drug use and alcohol use and positively associated with health benefitting behaviours (Bogg & Roberts, 2004). This was supported in the present research, as conscientiousness was negatively correlated with these risk factors and positively correlated to eating and physical activity in both studies.

Both samples only found one significant moderation effect, for the New Zealand sample this was with mental health component as the dependent variable. High neuroticism was found to be related to poorer mental health. Neuroticism alone has been linked to many mental illnesses, such as anxiety and depression (Liu & Lin, 2019) therefore it is unsurprising that those high in neuroticism reported the lowest mental health scores. This relationship was strongest for participants with low levels of conscientiousness and weakest (but still highly significant) for participants with high levels of conscientiousness. These findings suggest that high levels of conscientiousness can attenuate the negative effect of neuroticism slightly. No support for healthy neuroticism was found as those who were high in both conscientiousness and neuroticism are not reporting the highest mental health scores. However, those high in both conscientiousness and neuroticism were slightly better off than those who were high in neuroticism and low in conscientiousness. High conscientiousness and moderate levels of neuroticism have been found to have a positive effect on health in past research (Brickman et al., 1996; Weston & Jackson, 2018). Conscientiousness is generally associated with healthier

behaviours and high conscientiousness has been associated with less negative affect (Javaras et al., 2012; Friedman et al., 2014).

In the United States sample, the one moderation effect was found with the physical health component. Conscientiousness on its own has been related to better physical health (Friedman et al., 2014) therefore it is to be expected that those high in conscientiousness had the greatest physical health scores. The moderation effect shows neuroticism is positively related to greater physical health but only for those with low or average levels of conscientiousness. Those with high levels of conscientiousness have the greatest physical health scores, regardless of their level of neuroticism. This suggests that low or average levels of conscientiousness can be compensated for by higher levels of neuroticism. This indicates support for the theory that high neuroticism and high conscientiousness interact in a positive and protective manner and supports the idea of healthy neuroticism. High neuroticism and high conscientiousness have been found to have positive effects on physical health in past research. For example, lower levels on an inflammatory biomarker (Sutin et al., 2010).

Moderated Mediation

The third and final hypothesis was vigilance coupled with conscientiousness would have a mediator-moderator effect on health outcomes. No evidence was found for moderated mediation in either sample. Given the very few mediation and moderation effects that were found in the separate mediation and moderation analyses, this is not surprising. The aim of this analysis was to explore the idea that vigilance would mediate the relationship between neuroticism and health outcomes but only for participants high in conscientiousness. While the present research did not find any significant findings with this analyses, future research should continue to explore this idea with different samples and studies.

Neuroticism and Health Outcomes

Both samples presented significantly lower mental health scores (43.57 for NZ and 44.01 for U.S) than average (50). However, both samples provided greater physical health scores than average (53.13 for NZ, 52.60 for U.S.). It is possible there may have been some participants with particularly low mental health scores which may have attributed to the lower than average mean. The New Zealand sample also reported being more physically active and had better eating behaviours than the United States sample.

Mental health was negatively correlated with neuroticism in both studies. Neuroticism has been negatively associated with mental health conditions and poorer mental health in previous research (Liu & Lin, 2019; Magee et al., 2013). Neuroticism was not significantly correlated with physical health in either study. This is in contrast with previous work, as neuroticism has been consistently related to poorer health outcomes and been linked to several physical health problems (Lahey, 2009). Neuroticism was not significantly correlated with BMI in either sample which was in line with the findings from Atherton et al., (2014) who found no relationships between neuroticism and health behaviours including BMI.

Alcohol use and smoking were not correlated with neuroticism in either sample. This is in contrast with a lot of previous work that has found those highly neurotic to be more likely to indulge in these risky behaviours. Neuroticism has been related to excessive drinking (Mroczek et al., 2009; Vollrath & Torgersen, 2002) and smoking (Mroczek et al., 2009; Shipley et al., 2007). However drug use was positively correlated with neuroticism in both samples. This is consistent with previous work which has examined drug use and found those higher in neuroticism are more likely to partake in drug use (Vollrath & Torgersen, 2002). Sleep was negatively correlated with neuroticism in both samples. This is consistent with previous work which has found high neuroticism has also been related to poorer sleep quality and increased daytime sleepiness (Duggan et al., 2014).

Neuroticism was significantly correlated with GP consultations in the New Zealand sample but not the United States sample. The New Zealand finding is in support of the findings by ten Have et al., (2005) which suggested that those who are highly neurotic are more likely to use health services when needed and seek medical attention. However, neuroticism was not significantly correlated with GP care seeking in either sample. Neuroticism has been consistently linked to riskier health behaviours and in turn, poorer health outcomes (Mroczek et al., 2009; Shipley et al., 2007; Vollrath & Torgersen, 2002). Eating behaviour was negatively correlated with neuroticism in the New Zealand sample but not in the United States. Neuroticism has been found to be related to higher eating disorder prevalence (Cervera et al., 2003). Physical activity was negatively correlated with neuroticism in the New Zealand sample but not in the United States. Neuroticism has been related in previous work to less physical activity (Shipley et al., 2007) and sedentary lifestyles (Mroczek et al., 2009).

Many of the findings were not replicated between Study 1 and Study 2. This suggests that what was found, was not overly robust. The New Zealand sample were more neurotic with better overall physical health, whereas the United States sample reported a higher mental health and sleep rating mean. Interestingly, the U.S and NZ samples displayed opposite mediation and moderation effects with the physical health component and mental health component. The New Zealand sample found a mediation effect with physical health component and moderation effect with the mental health component, while the United States sample found the opposite. It is possible these findings are due to variations in the samples. The main difference between the two samples is the mean age and gender difference ratio. The mean age for the New Zealand sample was 28.1 years and the mean age for the United States sample was older at 38.2 years. The New Zealand sample was 73.8% female whereas the United States 53.2% male. However, age and sex were controlled for in all analyses so it

will not have influenced the findings. It is possible these differences have influenced the differences in correlations however, as these analyses did not control for sex and age.

Limitations and Strengths

This research is not without its limitations. Weston and Jackson (2018) highlighted in their study that while it can be concluded that neuroticism is related to vigilance, it cannot be concluded that neuroticism causes vigilance. This is also a limitation to the present research. It cannot be concluded that sensation awareness belief causes higher neuroticism or that higher neuroticism causes sensation awareness belief. It can only be concluded that they are related. The present research used a cross-sectional design thus the causal pathways cannot be examined.

The present research also relied entirely on self-report measures. Neuroticism has also been consistently linked to poorer health outcomes when self-report measures are used (Kitayama et al., 2018). It is also possible participants rushed the questionnaire or did not answer it entirely truthfully. While attention checks were included, future research could incorporate more objective measures (e.g. medical records, further personality testing) in order to measure more accurately. This research may have also been limited by the mental health scores being lower than average. It is also possible the present research was limited by its samples. The New Zealand sample reported better eating and physical activity habits however greater alcohol and drug use than the United States sample. It's possible the difference in these scores influenced the overall results of the research and may be responsible for the differences between the two samples.

This research did also have its strengths. Many of the relationships between neuroticism and health outcomes were in line with previous research. While few mediation effects were found, they do indicate a relationship between neuroticism and body vigilance, albeit the relationship was negative. The moderation effects for the New Zealand sample

indicated that high levels of conscientiousness can attenuate the negative effect of neuroticism slightly, while the United States findings indicate that high levels of neuroticism can compensate for low or average levels of conscientiousness.

Implications and Future Directions

While the findings of the present research are limited, they provide support to past research and suggest pathways for future research. Weston and Jackson's (2018) key findings was that neuroticism was related to better health behaviours through sensation awareness belief, was not replicated in the present research. The present findings do support the idea that vigilance and neuroticism are related. However, they indicated neuroticism is related to higher sensation awareness belief, which in turn, resulted in poorer health outcomes. There is currently limited research about the relationship between vigilance and personality factors with Weston and Jackson (2018) being, to my knowledge, the first to examine sensation awareness belief and change awareness belief. While the present research did not replicate their most important findings, they did find that those higher in neuroticism reported higher sensation awareness belief, which in turn related to lower self-rated health. This was also found in the present research with sensation awareness belief mediating the relationship between neuroticism and physical health in the New Zealand sample and mental health in the United States sample.

The moderation findings from the New Zealand sample provide support that high neuroticism is related to mental distress. This moderation effect found that high levels of conscientiousness can attenuate the negative effect of neuroticism slightly. However, they do not provide support to healthy neuroticism. However, the moderation findings from the United States sample are exciting. They suggest that high levels of neuroticism can compensate for low or average levels of conscientiousness. This even points to the idea that

high levels of neuroticism can benefit your health and even indicates support for healthy neuroticism.

There are many aspects future research should focus on. Firstly, one of the main avenues to focus on may be the causal pathways between vigilance and neuroticism in order to further understand their relationship. Many neuroticism studies in the past, have used a longitudinal design (Mroczek et al., 2009; Najjab et al., 2020; Shipley et al., 2007) and measured personality traits at different time points (Magee et al., 2013). Future neuroticism and body vigilance research may benefit from this as Weston and Jackson (2018) is the first study to examine this relationship. Future body vigilance work could also incorporate conscientiousness and other personality measures to assess their influence on vigilance and health. Longitudinal studies would allow for more objective measures (to aid in the limitation of self-report issues) and to examine how both personality and body vigilance may change in the course of one's life.

Neuroticism has been found to peak in late adolescence and decline slightly during adulthood which is something longitudinal research could also consider (Lahey, 2009). It has also been suggested that socio-economic factors, such as social class and education, may lead to health risk behaviours that in turn result in worse health, something future research should consider (Shipley et al., 2007). These socio-economic factors have also been previously related to conscientiousness (Bogg & Roberts, 2004). The impact of neuroticism on wellbeing has also been found largely indirect via psychological and physical health issues, something longitudinal research may also be able to consider (Gale et al., 2013). Most importantly, a longitudinal study would allow for the causal pathways to be explored which may be key in understanding the relationship between neuroticism and vigilance. Friedman (2019) presented the idea that neuroticism can lead people down two paths. The first is a pessimistic and anxious path that causes people to turn to unhealthy or risky behaviours and

the second path is one in which neuroticism results in vigilance and body awareness which in turn results in better health. This theory may influence or help explain the causal pathways that lead to healthy neuroticism and should be considered in future work.

Future studies may benefit by assessing the prevalence of any mental illness, physical illness or distress. Many studies include a measure of chronic conditions, both mental and physical (Liu & Lin, 2019; Najjab et al., 2020; Weston & Jackson, 2018). A longitudinal study would allow not only for this to be measured, but also its course and relationship with personality factors and body vigilance. Neuroticism has also been linked to higher mortality (Shiple et al., 2007) something a longitudinal study could also measure. Future research could also include samples with varying and similar health outcome scores and demographic information in order to examine differences.

While this research did not find overwhelming support for healthy neuroticism, the theory should not be discarded. This is only the second study, to my knowledge, that examines Weston and Jackson's (2018) body vigilance measures and conscientiousness. Healthy neuroticism has been increasingly discussed in literature since Friedman (2000) first presented it and should continue to be explored including both body vigilance and conscientiousness. While many studies still find negative effects of neuroticism on health outcomes, future research should continue to examine the links between both neuroticism and body vigilance and neuroticism and conscientiousness.

Conclusions

Overall, the findings from the present research partially supported my hypotheses. This research only produced minimal mediation and moderation effects. The aim of these studies was to replicate the findings found in Study 1 and 2. While it is disappointing that the present research did not replicate results across Study 1 and 2, it is interesting to note the findings similarities to other research. This research also aimed to explore the idea of

healthy neuroticism. While it is disappointing that this research only found one moderation effect that indicates high neuroticism and high conscientiousness may interact in a protective manner, it is still worth exploring and expanding on in future research. It is clear that more research is needed to further examine the impacts of vigilance and conscientiousness on healthy neuroticism.

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Appendix A

INFORMATION SHEET 1 – For United States Participants on MTurk

Personality and health behaviour Information Sheet

Thank you for your interest in this study. I am a Master's student from the School of Psychology, Speech and Hearing, University of Canterbury in New Zealand and we are looking for participants to complete an anonymous survey on personality and health behaviour.

What does participation involve?

Participation involves completing an online survey that will take around 20 minutes to complete. In this survey we will ask you questions about your personality and your health behaviours (such as eating behaviour and food intake, exercise, smoking)

Is there a reward for participation?

Each participant will receive US \$2.00 following completion of the questionnaire. The questionnaire must be completed in full and all participant codes must be entered correctly into the survey and into Mechanical Turk in order to receive payment.

Who can participate?

Anyone who is over 18 and fluent in English can complete the study. If you do not fulfil these criteria, please exit the survey now.

What happens to the information I provide?

The results of the study may be published, but you may be assured of the complete confidentiality of the data gathered in this study. We will not ask for any identifying information in the questionnaire. Data will be stored in a secure office in the Department of Psychology at the University of Canterbury. Only the researchers will have access to the data. The data will be stored securely for 5 years following the completion of the project and will then be destroyed.

Participation is voluntary and you have the right to withdraw without penalty. If you start the questionnaire and decide that you do not want to continue, please exit the questionnaire. Your incomplete questionnaire will then be withdrawn from the data base. However, once you have electronically submitted the questionnaire your data can no longer be removed.

Are there any risks involved?

The questionnaire has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human

Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch, New Zealand (human-ethics@canterbury.ac.nz). Participation is voluntary and all data will be anonymous.

It is not anticipated that participation in this study will pose any risk. If at any point you do not wish to continue your participation in the study, simply exit the survey and your responses will not be recorded. If you experience any concern about health issues, experience any emotional distress or you would like advice on how to change a health behaviour (such as eating healthier or quitting smoking), please contact your Family Physician for advice. Unfortunately we are unable to reimburse you for any related costs.

There are also several online resources that you may like to use:

USDA Center for Nutrition Policy and Promotion: <https://www.choosemyplate.gov/myplate-tip-sheets>

The American Heart Association: <https://www.heart.org/en/healthy-living>

Tools and Tips to Quit smoking: <https://smokefree.gov/>

Who are the researchers?

This research is carried out by Meg Elston as part of a Master's Thesis. She can be contacted at meg.elston@pg.canterbury.ac.nz. She is under the supervision of Associate Professor Roeline Kuijer who works at the Department of Psychology at the University of Canterbury. She can be contacted at roeline.kuijer@canterbury.ac.nz. They will be pleased to discuss any questions or concerns you might have about participation in the project.

Consent

I have read and understood the description of the above-named study. On this basis I agree to participate, and I consent to publication of the results of this study with the understanding that confidentiality will be preserved. I understand that my participation is entirely anonymous and that I may withdraw from the study at any point before I submit my responses.

I agree to participate (please go to the next page to start the questionnaire)

I have decided NOT to participate (please exit the questionnaire by closing this window)

INFORMATION SHEET 2 – For Social Media Participants

Personality and health behaviour Information Sheet

Thank you for your interest in this study. I am a Master's student from the School of Psychology, Speech and Hearing, University of Canterbury and we are looking for participants to complete an anonymous survey on personality and health behaviour.

What does participation involve?

Participation involves completing an online survey that will take around 20 minutes to complete. In this survey we will ask you questions about your personality your health behaviours (such as eating behaviour and food intake, exercise, smoking)

Is there a reward for participation?

Each participant who is entered via social media has the option entered into the draw to receive one of 4x \$50 gift vouchers. The prize draw is optional.

Who can participate?

Anyone recruited via social media, who is over 18 and fluent in English can complete the study. If you do not fulfil these criteria, please exit the survey now.

What happens to the information I provide?

The results of the study may be published, but you may be assured of the complete confidentiality of the data gathered in this study. We will not ask for any identifying information in the questionnaire. Data will be stored in a secure office in the Department of Psychology at the University of Canterbury. Only the researchers will have access to the data. The data will be stored securely for 5 years following the completion of the project and will then be destroyed.

Participation is voluntary and you have the right to withdraw without penalty. If you start the questionnaire and decide that you do not want to continue, please exit the questionnaire. Your incomplete questionnaire will then be withdrawn from the data base. However, once you have electronically submitted the questionnaire your data can no longer be removed.

Are there any risks involved?

The questionnaire has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch, New Zealand (human-ethics@canterbury.ac.nz). Participation is voluntary and all data will be anonymous.

It is not anticipated that participation in this study will pose any risk. If at any point you do not wish to continue your participation in the study, simply exit the survey and your responses will not be recorded. If you experience any concern about health issues, experience

any emotional distress or you would like advice on how to change a health behaviour (such as eating healthier or quitting smoking), please contact your General Practitioner for advice.

There are also several resources that you may like to use:

Healthline: 0800 611 116

Lifeline: 0800 543 354, <https://www.lifeline.org.nz/>

Youthline: 0800 376 633, <https://www.youthline.co.nz/>

Who are the researchers?

This research is carried out by Meg Elston as part of a Master's Thesis. She can be contacted at meg.elston@pg.canterbury.ac.nz. She is under the supervision of Associate Professor Roeline Kuijer who works at the Department of Psychology at the University of Canterbury. She can be contacted at roeline.kuijer@canterbury.ac.nz. They will be pleased to discuss any questions or concerns you might have about participation in the project.

Consent

I have read and understood the description of the above-named study. On this basis I agree to participate, and I consent to publication of the results of this study with the understanding that confidentiality will be preserved. I understand that my participation is entirely anonymous and that I may withdraw from the study at any point before I submit my responses.

I agree to participate (please go to the next page to start the questionnaire)

I have decided NOT to participate (please exit the questionnaire by closing this window)

INFORMATION SHEET 3 – For University of Canterbury Psychology Students**Personality and health behaviour Information Sheet**

Thank you for your interest in this study. I am a Master's student from the School of Psychology, Speech and Hearing, University of Canterbury and we are looking for participants to complete an confidential survey on personality and health behaviour.

What does participation involve?

Participation involves completing an online survey that will take around 20 minutes to complete. In this survey we will ask you questions about your personality and your health behaviours (such as eating behaviour and food intake, exercise, smoking)

Is there a reward for participation?

Each participant who is entered via the PSYC106 participant pool will receive 1 course credit for PSYC106 following completion of the questionnaire.

Who can participate?

Anyone, who is over 18 and fluent in English can complete the study. If you do not fulfil these criteria, please exit the survey now.

What happens to the information I provide?

The results of the study may be published, but you may be assured of the complete confidentiality of the data gathered in this study. The identity of each participant is confidential to the researcher, and all data will be anonymised prior to publication. We will not ask for any identifying information in the questionnaire. Data will be stored in a secure office in the Department of Psychology at the University of Canterbury. Only the researchers will have access to the data. The data will be stored securely for 5 years following the completion of the project and will then be destroyed.

Participation is voluntary and you have the right to withdraw without penalty. If you start the questionnaire and decide that you do not want to continue, please exit the questionnaire. Your incomplete questionnaire will then be withdrawn from the data base. If you later do you want to have your data included, please contact Meg Elston (meg.elston@pg.canterbury.ac.nz) up until November 1st to have your data removed.

Are there any risks involved?

The questionnaire has been reviewed and approved by the University of Canterbury Human Ethics Committee, and participants should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch, New Zealand (human-ethics@canterbury.ac.nz). Participation is voluntary and all data will be confidential.

It is not anticipated that participation in this study will pose any risk. If at any point you do

not wish to continue your participation in the study, simply exit the survey and your responses will not be recorded. If you experience any concern about health issues, experience any emotional distress or you would like advice on how to change a health behaviour (such as eating healthier or quitting smoking), please contact your General Practitioner for advice.

There are also several resources that you may like to use:

Healthline: 0800 611 116

Lifeline: 0800 543 354, <https://www.lifeline.org.nz/>

Youthline: 0800 376 633, <https://www.youthline.co.nz/>

Who are the researchers?

This research is carried out by Meg Elston as part of a Master's Thesis. She can be contacted at meg.elston@pg.canterbury.ac.nz. She is under the supervision of Associate Professor Roeline Kuijer who works at the Department of Psychology at the University of Canterbury. She can be contacted at roeline.kuijer@canterbury.ac.nz. They will be pleased to discuss any questions or concerns you might have about participation in the project.

Consent

I have read and understood the description of the above-named study. On this basis I agree to participate, and I consent to publication of the results of this study with the understanding that confidentiality will be preserved. I understand that my participation is entirely anonymous and that I may withdraw from the study at any point before I submit my responses.

I agree to participate (please go to the next page to start the questionnaire)

I have decided NOT to participate (please exit the questionnaire by closing this window)

Appendix B

HUMAN ETHICS COMMITTEE

Secretary, Rebecca Robinson
Telephone: +64 03 369 4588, Extn 94588
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2019/71 22 July 2019

Meg Elston

Psychology, Speech and Hearing UNIVERSITY OF CANTERBURY

Dear Meg

The Human Ethics Committee advises that your research proposal “What Makes Healthy Neuroticism? Neuroticism, Vigilance and Conscientiousness” has been considered and approved.

Please note that this approval is subject to the incorporation of the amendments you have provided in your email of 12th July 2019.

Best wishes for your project. Yours sincerely

Dr Dean Sutherland

Chair

University of Canterbury Human Ethics Committee



Appendix C

GP Consultations (for New Zealand) Family Physician Consultation (for United States).

On average, how often do you visit your GP?

1. Less than once a year
2. Once a year
3. Twice a year
4. At least every couple of months

You've had a runny nose for 2 days now, how likely are you to go to the doctor?

1. Definitely go
2. Probably go
3. Probably won't go
4. Definitely won't go

You've had sharp pain for over a week now, how likely are you to go to the doctor?

1. Definitely go
2. Probably go
3. Probably won't go
4. Definitely won't go

Height and Weight

Please answer the following questions as accurately as possible. If you do not know and are unable to measure yourself, please answer with your best estimate.

What is your height? (in centimetres for New Zealand sample, inches for United States sample) _____

What is your weight? (in Kgs for PYSC106 and social media, pounds for MTurk) _____

Just so that we know: how accurate are your estimates of your self-reported weight and height?

1. Both pretty accurate
2. Height pretty accurate, but I guessed my weight
3. Definitely won't go
4. I guessed both

Health Risk Behaviours:

Eating Behaviour

The following questions ask about your eating pattern. In the PAST TWO WEEKS, on how many days did you

	every day	on 5 or 6 days/week	on 3 or 4 days/week	on 1 or 2 days/week	less than once a week
eat healthy amounts of food (not too much or too little)	O	O	O	O	O

- 1 day
- 2 days
- 3 days
- 4 days
- 5 days
- 6 days
- 7 days

3. This question is about the time you spent sitting on weekdays during the last 7 days. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television. During the last 7 days, how much time did you spend sitting on a week day?

- 1-2 hours
- 3-4 hours
- 5-6 hours
- 7-8 hours
- 9-10 hours
- 11-12 hours
- 13-14 hours
- 15+ hours

Smoking

1. Do you smoke?

- Yes
- No, I am an ex-smoker
- No, I never smoked

1a. How many cigarettes do you smoke on a typical day?

- Less than 1 per day
- 1 - 5 per day
- 6 - 10 per day
- 11 - 15 per day
- 16 - 20 per day
- 21 - 25 per day
- 26 - 30 per day
- 31+ a day

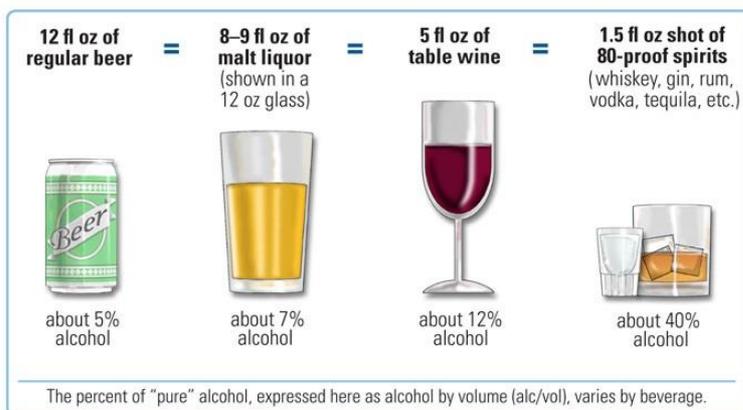
Alcohol Use

2. How often do you have a drink containing alcohol?

- Never, I don't drink alcohol
- Once a month or less
- Up to 4 times a month
- On 2-3 days a week
- On 4-5 days a week
- On 6-7 days a week

2a. How many standard drinks containing alcohol do you have on a typical day when you are drinking? (see picture below)

- 1 or 2
- 3 or 4
- 5 or 6
- 7 or 8
- 9 or 10
- 11 or more



2b. How often do you have six or more standard drinks on one occasion? (see picture above)

- Never
- Less than monthly
- Monthly
- Weekly
- Daily or almost daily

Drug Use

How many times in the past month have you used illicit drugs?

- Haven't used
- Once
- 2-3 times
- Several times

Appendix D*Vigilance Questionnaire***Sensation Awareness Belief**

These items are measured with a likert scale:

1 (never) 2 (sometimes) 3 (regularly) 4 (often) 5 (always)

How much do you wonder about why your body feels the way it does?

How much do you think about how your body feels?

How much do you try to figure out how your body works?

How much do you notice changes in how your body feels?

On average, how much time do you spend scanning your body for sensations?

These items are measured on a likert scale:

1 (strongly disagree) 2 (disagree) 3 (neither agree nor disagree) 4 (agree) 5 (strongly agree)

I am very sensitive to changes in my internal bodily sensations.

I am the kind of person who pays close attention to internal bodily sensations.

It is important for me to know how my body is feeling throughout the day.

I am sensitive to internal bodily tensions.

My mind and my body often want to do different things.

I can often feel my heart beating.

I notice differences in the way my body reacts to various foods.

I enjoy becoming aware of how my body feels.

I notice specific body responses to changes in the weather.

My bodily desires lead me to do things that I end up regretting.

I am quick to sense the hunger contractions of my stomach.

I suppress my bodily feelings and sensations.

Change Awareness Belief

I can accurately predict what time of day lack of sleep will catch up with me.

I am aware of a cycle in my activity level throughout the day.

I can predict how much sleep I will need at night in order to wake up refreshed.

I can distinguish between tiredness because of hunger and because of lack of sleep.

As soon as I wake up I know how much energy I'll have during the day.

When my exercise habits change, I can predict how that will affect my energy level.

I can always tell when I bump myself whether or not it will become a bruise.

I can tell when I go to bed how I will sleep that night.

I know in advance when I'm getting the flu.

I know I'm running a fever without taking my temperature.

There seems to be a best time for me to go to sleep at night.

I notice specific bodily reactions to being overhungry.

I am always aware of changes in my energy level when I eat certain foods.

I notice distinct body reactions when I am fatigued.

I always know when I've exerted myself to the point where I'll be sore the next day.

I am very aware of changes in my body temperature.

I know immediately when my mouth or throat gets dry.

I don't notice seasonal rhythms and cycles in the way my body functions.

Appendix E

Full Correlation Table for New Zealand Sample.

	Sex	Age	M.H.C	P.H.C	GP Consult	GPCS	B.M.I	Eating	Physic.	Alcohol	DrugUse	SleepR	Smoke	S.A	C.A	Consci.	Neur
Sex																	
Age	0.10																
M.H.C	-0.12	0.32**															
P.H.C	-0.07	-0.07	-0.19**														
GP Consultations	0.25**	0.01	-0.12*	-0.14**													
GP Care Seeking	0.10	0.02	0.12*	-0.06	0.30**												
BMI	-0.07	0.22**	-0.02	-0.11*	0.05	0.02											
Eating Behaviour	0.05	0.40**	0.36**	0.10	0.05	0.08	-0.02										
Physical Activity	-0.11*	-0.02	0.12*	0.27**	-0.09	-0.09	-0.10	0.34**									
Alcohol Use	-0.26**	-0.27**	0.01	-0.00	0.07	-0.09	-0.07	-0.14**	0.11*								
Drug Use	-0.11*	-0.20**	-0.18**	-0.01	0.13*	-0.06	-0.08	-0.14**	-0.03	0.35**							
Sleep	-0.08	0.02	0.31**	0.23**	-0.16**	0.08	-0.11*	0.22**	0.11	-0.05	-0.15**						
Smoking (current)	-0.00	0.01	0.05	0.14*	0.02	-0.01	-0.05	0.12*	0.05	-0.07	-0.16**	0.07					
Sensation Awareness B.	0.09	-0.04	-0.10	-0.14*	0.14**	0.00	0.08	0.01	0.14*	-0.02	0.09	-0.07	-0.00				
Change Awareness B.	0.13*	0.06	0.11*	0.03	0.05	-0.04	0.04	0.14**	0.07	-0.05	-0.02	0.09	0.01	0.43**			
Conscientiousness	0.23**	0.43**	0.28*	0.07	0.02	0.03	-0.02	0.45**	0.17**	-0.25**	-0.25**	0.06	0.11*	0.02	0.20**		
Neuroticism	0.08	-0.34**	-0.67**	0.00	0.19**	0.01	0.05	-0.37**	-0.21**	0.01	0.19**	-0.23**	-0.02	0.16*	-0.06	-0.30*	

Note: ** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed). Sex: 1 = male, 2 = female; Drug use: 1 = user, 2 = non-user; Smoking: 1 = smoker, 2 = non-smoker. M.H.C = Mental Health Component (SF-12), P.H.C = Physical Health Component (SF-12).

Appendix F

Full Correlation Table for United States Sample.

	Sex	Age	M.H.C	P.H.C.	GP Consult	GPCS.	B.M.I.	Eating	Physic.	Alcohol	DrugUse	SleepR	Smoke	S.A	C.A	Consci.	Neur
Sex																	
Age	0.19**																
M.H.C	-0.06	0.22**															
P.H.C	-0.04	-0.19**	-0.11														
GP Consultations	0.16	0.07	0.06	-0.36**													
GP Care Seeking	-0.02	0.00	0.13	-0.06	0.46**												
BMI	-0.03	0.08	-0.07	-0.12	0.06	-0.21**											
Eating Behaviour	0.09	0.10	0.31**	0.20**	0.04	0.17*	-0.23**										
Physical Activity	-0.08	-0.11	0.20**	0.31**	-0.11	0.03	-0.12	0.34**									
Alcohol Use	-0.17*	0.03	-0.25**	0.09	-0.02	-0.04	0.05	-0.03	-0.06								
Drug Use	0.00	-0.02	-0.09	0.00	0.04	0.01	0.01	-0.05	-0.07	0.27**							
Sleep	-0.07	-0.07	0.47**	0.06	0.04	0.23**	-0.13	0.30**	0.19**	-0.11	0.11						
Smoking (current)	0.05	-0.06	-0.02	-0.13	0.10	0.12	-0.01	0.03	-0.06	-0.20**	-0.18*	0.01					
Sensation Awareness B.	0.08	-0.11	-0.29**	-0.03	0.08	0.10	-0.09	0.00	0.08	0.10	-0.05	-0.28**	0.02				
Change Awareness B.	-0.05	-0.01	0.05	0.08	0.04	0.09	-0.11	0.15*	0.27**	0.03	-0.09	0.02	0.03	0.55**			
Conscientiousness	-0.02	0.30**	0.55**	0.07	0.08	0.10	-0.03	0.29**	0.18*	-0.12	-0.11	0.20**	-0.02	-0.05	0.27**		
Neuroticism	0.20**	-0.19**	-0.72**	0.12	-0.08	-0.06	-0.07	-0.12	-0.14	0.08	0.02	-0.36**	0.012	0.27**	-0.05	-0.54**	

Note: ** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed). Sex: 1 = male, 2 = female; Drug use: 1 = user, 2 = non-user; Smoking: 1 = smoker, 2 = non-smoker. M.H.C = Mental Health Component (SF-12), P.H.C = Physical Health Component (SF-12), GPCS = GP Care Seeking.