

# Longitudinal Correlated Changes in Conscientiousness, Preventative Health-Related Behaviors, and Self-Perceived Physical Health

Yusuke Takahashi,<sup>1</sup> Grant W. Edmonds,<sup>2</sup>  
Joshua J. Jackson,<sup>3</sup> and Brent W. Roberts<sup>4</sup>

<sup>1</sup>Kyoto University

<sup>2</sup>Oregon Research Institute

<sup>3</sup>Washington University at St. Louis

<sup>4</sup>University of Illinois at Urbana-Champaign

## Abstract

**Objective:** Previous research has found that conscientiousness has positive associations with preventative health-related behaviors and self-perceived health, but little is known about the links between changes in these variables over time. In the present study, we examined how levels and changes in conscientiousness were linked to levels and changes in both preventative health-related behaviors and self-perceived physical health.

**Method:** Personality and health questionnaires were administered to participants in two waves, with an interval of approximately three years. Participants ranged in age from 19 to 94. To elucidate the tripartite relations between conscientiousness, preventative health-related behaviors, and self-perceived physical health, we used latent change models to estimate levels and changes of these latent constructs over time.

**Results:** Changes in conscientiousness were significantly and positively correlated with changes in preventative health behaviors and changes in self-perceived physical health. Changes in preventative health behaviors partially mediated the relation between changes in conscientiousness and changes in self-perceived physical health.

**Conclusions:** This longitudinal study extends previous research on conscientiousness and health by exploring the relations between latent variables over a 3-year period. It provides evidence that increases in conscientiousness and preventative health-related behaviors are associated with improvements in self-perceived health over the same time period.

**Keywords:** conscientiousness, health behaviors, physical health, latent change

Personality traits are involved in all aspects of the physical health process (Adler & Matthews, 1994). For example, several Big Five domains, such as Conscientiousness and Neuroticism, are consistently associated with physical health (Chapman, Roberts, & Duberstein, 2011; Roberts, Walton, & Bogg, 2005). Personality traits also predict whether patients adhere to medical regimens, which in turn plays a significant role in subsequent physical health and longevity (Hill & Roberts, 2011; Insel, Reminger, & Hsiao, 2006). Moreover, as a testament to the fact that personality traits predict multiple health factors, most personality traits are associated with mortality at levels similar to or higher than socioeconomic status (Deary, Batty, Pattie, & Gale, 2008; Kern & Friedman, 2008; Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007).

recently more attention has been focused on conscientiousness because of its well-replicated association with mortality (Hill, Turiano, Hurd, Mroczek, & Roberts, 2011; Kern & Friedman, 2008). Conscientiousness is defined as the propensity to be self-controlled, task- and goal-directed, planful, rule-following, and responsible to others (Jackson et al., 2009). Given its link to mortality, one would expect conscientiousness to be related to physical health and factors that contribute to better physical health. Indeed, conscientiousness is related to a variety of the health-related behaviors that are known to undermine or promote physical health, such as tobacco, alcohol, and drug consumption, risky sexual activity, risky driving, healthy

## What Is the Relationship Between Conscientiousness and Health?

Although a wide range of personality traits are now considered important for health-related behaviors and physical health,

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Correspondence concerning this article should be addressed to Yusuke Takahashi, Center for the Promotion of Excellence in Higher Education, Kyoto University, Rakuyu Kaikan Annex, Yoshida Knoe-cho, Sakyo-ku, Kyoto, 6068315, Japan. Email: takahashi.yusuke.3n@kyoto-u.ac.jp

eating, and physical activity level (Bogg & Roberts, 2004). Also, higher levels of conscientiousness are associated with lower rates of diabetes, high blood pressure, skin problems, strokes, ulcers, and tuberculosis (Goodwin & Friedman, 2006). In addition, higher levels of conscientiousness are associated with a healthier blood lipid profile (Sutin et al., 2010), and healthier body composition (Terracciano et al., 2009). Similarly, higher levels of conscientiousness predict lower levels of physician-rated illness burden (Chapman, Roberts, Lyness, & Duberstein, in press; Chapman, Lyness, & Duberstein, 2007). In addition, among patients with chronic medical illness, higher conscientiousness is associated with longer survival (Christensen et al., 2002). Finally, childhood ratings of conscientiousness predict midlife physical health ratings assessed a few decades later, even when controlling for social environmental factors such as education (Hampson, Goldberg, Vogt, & Dubanoski, 2007).

In most cases when personality traits are integrated into research on physical health processes, they are construed implicitly and simply as causes of physical health. Specifically, most theoretical models of physical health presume that personality traits are static predictors. Although this perspective has produced valuable cross-sectional and prospective results, the assumption that personality traits are static and unchanging ignores the empirical evidence that personality traits change throughout the life course (Roberts & Mroczek, 2008; Roberts, Walton, & Viechtbauer, 2006). Much of the developmental research on conscientiousness has focused on longitudinal patterns of continuity and change in conscientiousness across the life course. Conscientiousness shows moderately consistent rank-order stability over long periods of time and simultaneously shows systematic mean level increases. These occur largely in young adulthood but also in midlife and old age (e.g., Jackson et al., 2009; Roberts & DelVecchio, 2000; Roberts, Walton, et al., 2006). It should be noted, however, that these increases are followed by decreases in old-old age (Lucas & Donnellan, 2011; Wortman, Lucas & Donnellan, in press). Additionally, in an effort to explain these normative patterns of continuity and change in conscientiousness, a number of researchers have examined the correlates of individual differences in changes in conscientiousness as well as the manner in which those individual differences relate to life experiences (Roberts, Bogg, Walton, & Caspi, 2006; Roberts, Caspi, & Moffitt, 2003).

### Changes in Conscientiousness and Changes in Health

Given the prospective and cross-sectional links between conscientiousness, health-related behaviors, and physical health, an obvious question would be whether changes in conscientiousness are associated with both changes in health-related behaviors and physical health. Indeed, there have been several studies that have linked changes in conscientiousness to health-related phenomena. For instance, maintaining higher levels of drug use through young adulthood predicted changes in conscientious-

ness in midlife (Roberts & Bogg, 2004). Similarly, changes in rank-order in self-control across adolescence predicted better health outcomes in young adulthood (Moffitt et al., 2011). Moreover, change in conscientiousness is related to mortality risk above and beyond childhood conscientiousness, with increasing conscientiousness being predictive of lower mortality risk, and decreasing conscientiousness predicting greater mortality risk (Martin, Friedman, & Schwartz, 2007). On the other hand, a second study found that changes in conscientiousness were not significantly associated with changes in physical health (Small, Hertzog, Hultsch, & Dixon, 2003). However, this study had two possible limitations. First, the researchers used an early version of the NEO-PI (not NEO-PI-R), which had a limited assessment of conscientiousness. Second, the sample consisted of individuals exclusively over the age of 55. Without including participants from a wider age range, it is unclear whether the results extend to people younger than 55.

Additionally, most prior studies have examined the links between either conscientiousness and health-related behaviors, or conscientiousness and self-perceived physical health, but not all three simultaneously. Lodi-Smith et al. (2010) examined conscientiousness, health-related behaviors, and self-perceived physical health in two studies and found health-related behaviors partially mediated the links between conscientiousness and self-perceived physical health. However, because these studies were cross-sectional, they did not address changes in conscientiousness, health-related behaviors, and self-perceived physical health. Thus, little is known about how these three variables transact over time.

Taken together, these findings invite seldom-considered research questions: Are changes in conscientiousness related to changes in health-related behaviors and in turn changes in self-perceived physical health? These questions are important for several reasons. First, if personality traits do change in adulthood, then these changes may have implications for health-related behaviors, self-perceived physical health, and longevity above and beyond original standing on personality measures. Second, if changes in conscientiousness are associated with changes in health-related behaviors and self-perceived physical health, this association would imply that intervening to change personality traits might in turn improve health (e.g., Jackson, Hill, Payne, Roberts & Stine-Morrow, 2012; Tang et al., 2009). To provide a provisional test of this idea, we examine whether changes in preventative health-related behaviors mediate the relation between changes in conscientiousness and changes in self-perceived physical health.

Based on the evidence provided by cross-sectional and developmental studies relating personality to health behaviors and physical health outcomes, we expect to find that initial *levels* of conscientiousness, health-related behaviors, and self-perceived physical health will be positively correlated. In addition to replicating previous results, we propose the novel hypothesis that changes in conscientiousness, health-related behaviors, and self-perceived physical health will be positively correlated *over time*. We test this idea in an age-stratified

longitudinal sample that has been tracked for three years. In the current study, we focus on preventative health-related behaviors because these types of health-related behaviors were most strongly related to both self-perceived physical health and conscientiousness in our previous cross-sectional research on these samples (Lodi-Smith et al., 2010). We use a broad assessment of conscientiousness as well as multidimensional assessments of preventative health-related behaviors and self-perceived physical health.

## METHOD

### Participants

We used two-wave longitudinal data from the Health and Aging Studies of Central Illinois (HASCI; Lodi-Smith et al., 2010). The HASCI studies started in 2001–2003 (Time 1), followed by reassessments in 2004–2007 (Time 2). A total of 898 individuals, comprising 520 female, 371 male, and 7 participants who did not report their gender participated in Time 1. Participants ranged in age from 19 to 94 years ( $M = 48.92$ ,  $SD = 17.51$ ) and were primarily Caucasian (over 72 %). The two waves of data were collected approximately three years apart. Of the original 898 participants, 477 individuals (282 female, 188 male and 7 participants who did not report their gender) completed the second wave survey. Since sample attrition (approximately 47% in this case) may be associated with Time 1 levels of personality, health-related behaviors, and self-perceived physical health, we conducted a  $t$ -test to test whether there was differential attrition. There were no significant differences between individuals who did and did not complete Time 2 in terms of gender ( $t(880) = -1.15$ ,  $p = .25$ ), socioeconomic status (SES,  $t(849) = 1.94$ ,  $p = .05$ ), conscientiousness ( $t(876) = .34$ ,  $p = .74$ ), preventative health-related behaviors ( $t(882) = -1.15$ ,  $p = .25$ ), or self-perceived physical health at Time 1 ( $t(876) = .22$ ,  $p = .83$ ). However, we found that there was an effect for age ( $t(876) = -5.59$ ,  $p = .00$ ), indicating that younger people were more likely to drop out of the sample.

### Measures

**Conscientiousness.** Participants completed a 9-facet scale of conscientiousness (106 items) from the International Personality Item Pool (IPIP)-AB5C (Goldberg, 1999). The nine AB5C conscientiousness facets are Conscientiousness (13 items; Cronbach's alpha ( $\alpha$ ) = .75 for Time 1, and .75 for Time 2), Efficiency (11 items;  $\alpha = .80$  and .83), Cautiousness (13 items;  $\alpha = .84$  and .80), Dutifulness (12 items;  $\alpha = .80$  and .81), Rationality (12 items;  $\alpha = .72$  and .81), Purposefulness (12 items;  $\alpha = .62$  and .73), Perfectionism (14 items;  $\alpha = .49$  and .61), Organization (9 items;  $\alpha = .77$  and .76), and Orderliness (10 items;  $\alpha = .72$  and .79). Participants rated the items on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

**Preventative health-related behaviors.** To assess preventative health-related behaviors, two measures were used. The

Health Behavior Checklist (HBC; Vickers, Conway, & Hervig, 1990) assessed the preventative health-related behaviors of wellness maintenance (10 items;  $\alpha = .76$  and .76) and accident control (6 items;  $\alpha = .64$  and .63). Participants responded to these items on a 5-point scale of 1 (*strongly disagree*) to 5 (*strongly agree*). Preventative health-related behaviors were also assessed using scale items drawn from the Behavioral Risk Factor Surveillance System (BRFSS; National Center for Chronic Disease Prevention and Health Promotion, 2000) and the Youth Risk Behavior Surveillance System (YRBSS; National Center for Chronic Disease Prevention and Health Promotion, 1999). Scales assessing three preventative health-related behaviors were administered to participants: physical activity (three items; a 7-point scale from *0 times* to *7 days a week*;  $\alpha = .61$  and .58), healthy eating (six items; a 7-point scale from *0 times* to *4 or more times per day*;  $\alpha = .71$  and .59), and safe driving (two items; a 5-point scale from *never* to *always*;  $\alpha = .86$  and .75). Participants rated the frequency or quantity of activities within each domain. Items were  $z$ -scored and averaged to form a composite score indicating greater frequency across these domains.

**Self-perceived physical health.** To assess self-perceived physical health status, a version of the Medical Outcomes Study 36-item short-form health survey (SF-36; Ware & Sherbourne, 1992) was used. We used an abbreviated 33-item version<sup>1</sup> of the SF-36 which includes seven subscales: general health perceptions (five items;  $\alpha = .70$  and .73), physical functioning (10 items;  $\alpha = .84$  and .85), role limitations due to physical problems (reversed construct; six items;  $\alpha = .79$  and .76), energy (four items;  $\alpha = .88$  and .79), pain (two items;  $\alpha = .85$  and .88), emotional well-being (five items;  $\alpha = .86$  and .85) and a single reversed item measure of social functioning (i.e., *my health problems interfered with normal social activities*). In order to focus on investigating physical health rather than mental health, the emotional well-being subscale was not used in this study. Each item was rated on a 7-point Likert scale reflecting frequency (1 = *never*, 7 = *more than once a day*) or agreement (1 = *strongly disagree*, 7 = *strongly agree*).

**Control variables.** Participants were asked to indicate their age, gender, highest grade completed, and income level. Their highest grade completed was assessed using a 9-point scale ranging from *some elementary school* (1) to *doctoral degree* (9), and their income level was assessed using a 6-point scale ranging from *less than and equal to 10 thousand dollars* (1) to *over 70 thousand dollars* (6). A composite SES score was calculated by averaging  $z$ -scored highest grade completed and income level.

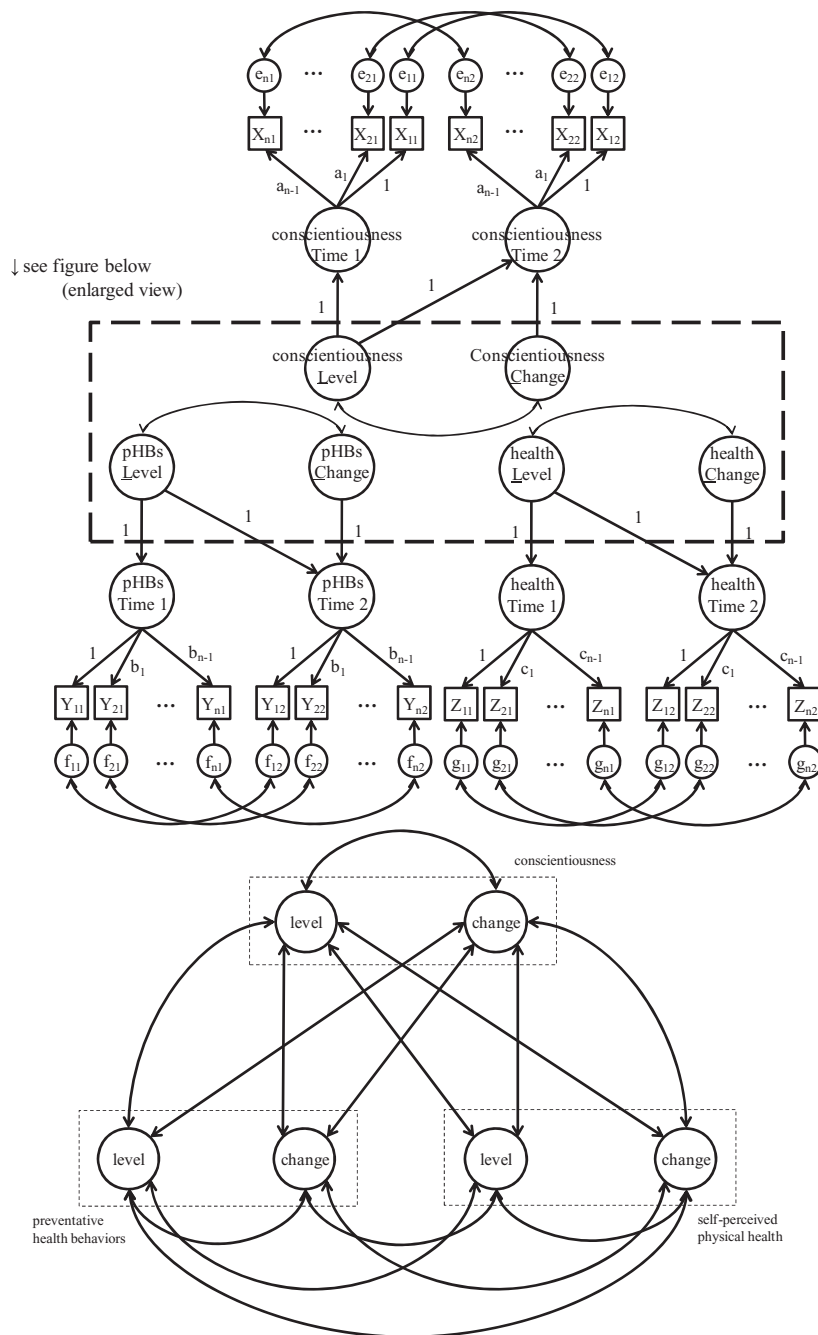
### Latent Change Models

To optimally assess changes in two wave studies, McArdle and Nesselrode (1994) introduced a latent change model, which involves a reparameterization of the structural equation of a

longitudinal factor model (Figure 1). In this model, the level of a latent construct and the change of this latent construct over time are estimated and all latent initial and change factors were allowed to covary (Hertzog & Nesselroade, 2003). To achieve metric measurement equivalence in the latent constructs underlying the latent change model, the unstandardized factor loadings of the indicators at Times 1 and 2 were constrained to be equal over time. The variance of the second latent variable

captures interindividual differences in latent variable change over time. If the variance of the second latent variable is significantly different from zero, there are interindividual differences in intraindividual development (Nesselroade, 1991).

When multiple variables are modeled simultaneously, latent change models can function as structural regression models in which initial level and change in one variable predict initial level and change in another variable (Allemand, Zimprich, &



**Figure 1** Multiple latent change model. Indicators of each latent variable are measured at two time points (Times 1 and 2). Regression coefficients shown in the figure were fixed at 1, defining the latent variable of  $V_{Level}$  as equal to  $V$  at Time 1 and  $V_{Change}$  as the difference between  $V$  at Time 1 and Time 2. Factor loadings for the indicators of  $V$  are constrained to be equal over time.

Hertzog, 2007; Hertzog, Dixon, Hultsch, & MacDonald, 2003; Small et al., 2003). In this study, we took this approach to examine longitudinal associations between initial levels and changes in conscientiousness, preventative health-related behaviors, and self-perceived physical health which are listed in Table 1, after controlling for demographic variables.

Based on previous work (e.g., Hampson et al., 2007; Lodi-Smith et al., 2010), we also tested whether changes in preventative health-related behaviors mediated the relation between changes in conscientiousness and changes in self-perceived physical health. For evidence of mediational links, one would expect all three variables to be correlated and to find a decrease in the magnitude of the direct effect of changes in conscientiousness on changes in self-perceived physical health in the presence of the mediator variable (changes in preventative health behaviors). In order to test the significance of the indirect effect, we used Sobel's *z*-test (Sobel, 1982).

All analyses were conducted using SPSS 18 and AMOS 18 (Arbuckle, 2009). The latent change models were fit to the data using full-information maximum likelihood (FIML) estimation, which corrects for statistical biases resulting from missing values in longitudinal data. When we employed multiple latent change models, the model fit was evaluated by the Comparative Fit Index (CFI) and the Root Mean Square Error of Approximation (RMSEA). A CFI above .90 is considered to

be adequate. For the RMSEA, values less than .08 indicate an acceptable model fit (Hu & Bentler, 1999).

## RESULTS

### Descriptive Statistics and Correlational Analysis

Table 1 shows descriptive statistics (means, standard deviations, and Cronbach's alphas) of all variables at Times 1 and 2. As shown in Table 2, we first calculated intercorrelations among conscientiousness, preventative health-related behaviors, self-perceived physical health, age, gender, and SES. At Time 1, conscientiousness was positively associated with preventative health-related behaviors, self-perceived physical health, and age. Self-perceived physical health at Time 1 was negatively correlated with age and positively associated with preventative health-related behaviors. At Time 2, conscientiousness was also positively associated with preventative health-related behaviors, and self-perceived physical health. Similarly, self-perceived physical health at Time 2 was negatively correlated with age and positively associated with preventative health-related behaviors. Some variables showed significant associations with gender, but in most cases these were small or insignificant correlations. Taken together, con-

**Table 1** Descriptive Statistics

Variables	N	M	SD	$\alpha$	N	M	SD	$\alpha$
Conscientiousness	884	3.69	.45	.95	467	3.69	.41	.95
Conscientiousness	884	3.89	.55	.75	467	3.88	.54	.75
Efficiency	884	3.69	.67	.80	467	3.67	.65	.83
Cautiousness	884	3.20	.59	.84	467	3.25	.57	.80
Dutifulness	884	4.12	.51	.80	467	4.15	.48	.81
Rationality	884	3.36	.46	.72	467	3.31	.44	.81
Purposefulness	884	3.67	.62	.62	467	3.67	.59	.73
Perfectionism	884	3.55	.67	.49	467	3.54	.63	.61
Organization	884	4.02	.54	.77	467	4.01	.51	.76
Orderliness	884	3.72	.64	.72	467	3.72	.62	.79
Preventative health-related behaviors <sup>a</sup>								
Wellness maintenance	890	3.53	.77	.76	466	3.55	.77	.76
Accidental control	890	3.63	.83	.64	466	3.65	.81	.63
Physical activity	890	2.20	1.24	.61	466	2.47	1.19	.58
Healthy eating	889	2.18	.77	.71	466	2.49	.64	.59
Safe driving	887	4.18	.99	.86	466	4.66	.71	.75
Self-perceived health	890	4.26	.64	.61	464	4.22	.65	.64
General health	890	4.93	1.46	.70	464	4.67	1.37	.73
Physical functioning	889	4.49	1.03	.84	461	4.31	1.09	.85
Role limitations	890	2.84	1.22	.79	464	2.89	1.32	.76
Energy	890	4.51	1.62	.88	464	4.38	1.68	.79
Pain	888	2.44	1.54	.85	461	2.56	1.69	.88
Social functioning	889	5.45	1.78	—	463	5.27	2.19	—
Emotional well-being <sup>b</sup>	890	5.29	1.47	.86	464	5.47	1.38	.85

<sup>a</sup>Because preventative health-related behaviors variables include 5- and 7-point scales (see also the Method section for more details), the mean, SD, and alpha of the total score were not calculated.

<sup>b</sup>This subscale was not included in the analysis in order to focus on examining physical health rather than mental health.

**Table 2** Intercorrelations and Partial Correlations Between All Variables in This Study

	C at Time 1	C at Time 2	Preventative HBs at Time 1	Preventative HBs at Time 2	Physical health at Time 1	Physical health at Time 2	Age	Gender
C at Time 1	—	.72* [.68-.76] (N = 427)	.33* [.25-.42] (N = 427)	.28* [.20-.37] (N = 427)	.25* [.16-.34] (N = 427)	.19* [.10-.28] (N = 427)		
C at Time 2	.72* [.67-.76] (N = 463)	—	.32* [.24-.40] (N = 427)	.35* [.26-.42] (N = 427)	.23* [.14-.32] (N = 427)	.24* [.15-.33] (N = 427)		
Preventative HBs at Time 1	.34* [.28-.40] (N = 878)	.32* [.24-.40] (N = 461)	—	.68* [.63-.73] (N = 427)	.18* [.11-.25] (N = 427)	.17* [.10-.24] (N = 427)		
Preventative HBs at Time 2	.30* [.21-.38] (N = 462)	.35* [.26-.42] (N = 465)	.69* [.63-.73] (N = 460)	—	.28* [.20-.36] (N = 427)	.29* [.21-.37] (N = 427)		
Physical health at Time 1	.22* [.16-.28] (N = 878)	.22* [.13-.30] (N = 464)	.18* [.11-.24] (N = 878)	.27* [.18-.35] (N = 463)	—	.75* [.71-.79] (N = 427)		
Physical health at Time 2	.15* [.06-.24] (N = 454)	.22* [.13-.31] (N = 456)	.16* [.07-.25] (N = 453)	.26* [.17-.34] (N = 456)	.78* [.74-.81] (N = 456)	—		
Age	.11* [.04-.17] (N = 879)	.08 [-.01-.17] (N = 465)	.11* [.04-.17] (N = 878)	.15* [.06-.24] (N = 464)	-.21* [-.27--.14] (N = 879)	-.25* [-.34--.17] (N = 455)	—	
Gender	.00 [-.07-.07] (N = 882)	-.05 [-.14-.04] (N = 466)	.09* [.02-.15] (N = 882)	.08 [-.01-.17] (N = 465)	-.15* [-.22--.09] (N = 882)	-.09 [-.18-.04] (N = 456)	.00 [-.06-.07] (N = 884)	—
SES	.06 [-.01-.12] (N = 851)	.07 [-.03-.16] (N = 446)	.11* [.05-.18] (N = 851)	.15* [.06-.24] (N = 446)	.19* [.12-.25] (N = 851)	.23* [.14-.32] (N = 437)	.01 [-.06-.07] (N = 853)	-.05 [-.11-.02] (N = 856)

Note. Zero-order correlation coefficients are presented below the diagonal. Partial correlation coefficients controlling for age, gender, and SES are presented above the diagonal. 95% confidence intervals are reported in brackets. C = conscientiousness; HBs = health-related behaviors; SES = socioeconomic status. \* $p < .05$ .

conscientiousness was positively associated with age, in line with past research (Jackson et al., 2009; Roberts, Walton, et al., 2006), and, unsurprisingly, self-perceived physical health was negatively associated with age.

Demographic variables, in particular age, can confound the relations between physical health and conscientiousness or preventative health-related behaviors. Thus, we next calculated the partial correlations between conscientiousness, preventative health-related behaviors, and self-perceived physical health after controlling for demographic variables: age, gender, and SES, (see Table 2). Conscientiousness was still positively and significantly correlated with preventative health-related behaviors and self-perceived physical health cross-sectionally. Similarly, preventative health-related behaviors had significant associations with self-perceived physical health cross-sectionally even after controlling for demographic variables.

Next, we evaluated prospective partial correlations between conscientiousness, preventative health-related behaviors, and self-perceived physical health (see Table 2). Conscientiousness and preventative health-related behaviors at Time 1 were positively correlated with self-perceived physical health at Time 2 even after controlling for age, gender, and SES. These results

indicate that conscientiousness and preventative health-related behaviors are meaningful predictors for future self-perceived physical health.

### Longitudinal Correlated Change Using Latent Change Models

After confirming a protective effect of conscientiousness and preventative health-related behaviors on self-perceived physical health, we next examined whether initial levels and changes in conscientiousness were correlated with initial levels and changes in preventative health-related behaviors and self-perceived physical health after controlling for age, gender, and SES. We constructed a model representing latent changes in each of these three variables. The overall model fit was acceptable (CFI = .90, RMSEA = .07). The latent level and change variances with standard errors are shown in Table 3. All latent level and change variances were statistically significant, which means that in these three variables interindividual differences in intraindividual change were found.

Table 4 shows latent correlations between initial level and change variables. In line with the correlations in Table 2, initial

latent levels of conscientiousness were positively correlated with latent levels in preventative health-related behaviors. Table 4 also reports latent correlations between initial level and change scores within each variable (e.g., levels of conscientiousness correlated with changes in conscientiousness). Each variable showed a negative association between initial levels and change. A negative correlation within the level and change variables of a single construct indicates that participants with higher scores at Time 1 tend to show less pronounced changes across time (e.g., Allemand et al., 2007).

Next, we examined correlations of change in two ways. First, we examined whether initial levels for each variable predicted change in the remaining two variables. For example, one can examine whether levels of conscientiousness, which represents conscientiousness at Time 1, predicts change in physical health over time. We found no statistically significant prospective relations between initial levels of each variable and subsequent changes in the other two outcome variables (see Table 4). In the case of conscientiousness this may have resulted from levels of conscientiousness at Time 1 being associated with less change in conscientiousness over time such that those who score higher on conscientiousness at Time 1 are likely to have less room to change while those who score lower on conscientiousness at Time 1 are likely to improve (see Figure 2). Second, we tested whether changes in all three variables were correlated over time. Most interestingly, we found that changes in conscientiousness were positively correlated with changes in preventative health-related behaviors ( $r = .20$ ,

$p < .05$ ) and changes in self-perceived physical health ( $r = .30$ ,  $p < .05$ ). We also found that changes in preventative health-related behaviors were positively correlated with changes in self-perceived physical health ( $r = .40$ ,  $p < .05$ )<sup>2</sup>.

### Do Changes in Health Behaviors Mediate Changes in Conscientiousness and Changes in Health?

We examined changes in preventative health-related behaviors as a mediator variable of the basic link between changes in conscientiousness and self-perceived physical health. The statistically significant relations among changes in all three variables satisfied the basic assumptions necessary to test mediation. Changes in conscientiousness were linked to changes in preventative health behaviors (.27,  $p < .05$ ); changes in preventative health-related behaviors were associated with changes in self-perceived physical health (.40,  $p < .05$ ); and the link between changes in conscientiousness and changes in self-perceived health was significant (.33,  $p < .05$ ). The basic link between changes in conscientiousness and self-perceived physical health was attenuated to .22 ( $p < .05$ ) by adding changes in preventative health-related behaviors into the model, suggesting partial mediation. Sobel’s  $z$ -test indicated that the indirect effect of the independent variable on the dependent variable via the mediator was significantly different from zero ( $z = 2.13$ ,  $p < .05$ ), formally demonstrating partial mediation.

In order to better show how changes in conscientiousness were related to changes in preventative health behaviors and changes in self-perceived health, we plotted the latent mean change patterns of conscientiousness from Time 1 to Time 2 by levels of self-perceived physical health and preventative health-related behaviors. For these plots, we used latent means (i.e., means of factor scores), since latent means are better indicators of true differences than observed scores (Hancock, 1997). We divided participants into three groups: increasing ( $SD > 0.50$ ), no changes ( $0.50 \leq SD \leq 0.50$ ), and decreasing

**Table 3** Latent Level and Change Variances and Standard Errors

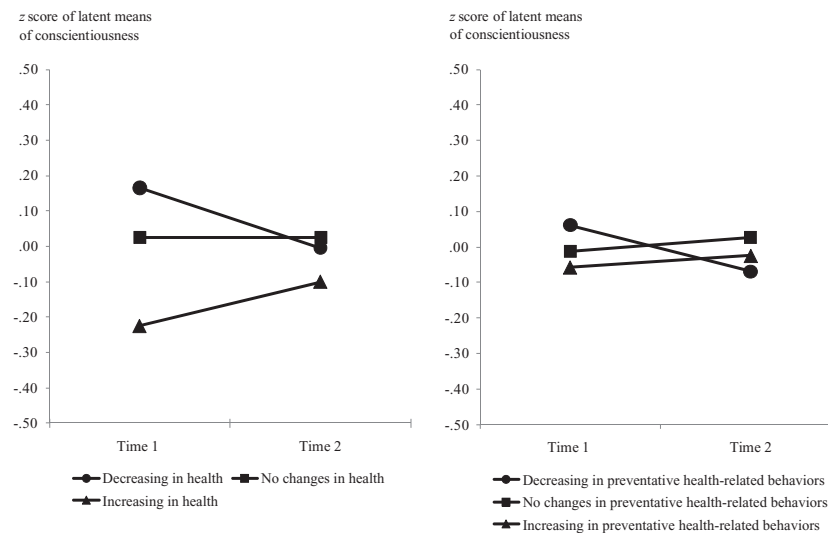
	Level		Change	
	Variance	S.E.	Variance	S.E.
Conscientiousness	.66	.04	.33	.03
Preventative health-related behaviors	.27	.04	.08	.02
Self-perceived health	.93	.09	.12	.05

Note. All variances are significant at the  $p < .05$  level.

**Table 4** Estimated Correlations Between Latent Level and Change Factors

		Levels			Changes	
		Conscientiousness	Preventative HBs	Physical health	Conscientiousness	Preventative HBs
Levels	Preventative HBs	.49*	—			
		[.38-.59]				
	Physical health	.34*	.33*	—		
		[.26-.42]	[.22-.44]			
Changes	Conscientiousness	-.40*	-.04	-.02	—	
		[-.51--.30]	[-.16-.08]	[-.12-.08]		
	Preventative HBs	-.08	-.17	.08	.20*	—
		[-.24-.08]	[-.42-.09]	[-.19-.26]	[.02-.37]	
	Physical health	-.11	-.04	-.15*	.30*	.40*
		[-.24-.01]	[-.21-.12]	[-.29-.01]	[.16-.43]	[.16-.63]

Note. 95% confidence intervals are reported in brackets. HBs = health-related behaviors. \* $p < .05$ .



**Figure 2** Changes in z-scores of latent means of conscientiousness.

( $SD > -0.50$ ) on both self-perceived health and preventative health behaviors. We used standardized latent mean scores of conscientiousness, so that the changes could be readily translated into an effect size metric (Cohen's  $d$ ). Figure 2 shows that for the self-perceived health and preventative health-related behaviors decreasing groups, conscientiousness decreased by about one-sixth of a standard deviation ( $d = -0.19, -0.14$ , respectively) from Time 1 to Time 2. For the no change groups, conscientiousness did not change across time points ( $d = 0.00, 0.04$ , respectively). Finally, for the self-perceived health increasing group, conscientiousness increased by about one-seventh of a standard deviation ( $d = 0.13$ ), whereas for the preventative health-related behaviors increasing group, conscientiousness stayed at almost the same level ( $d = 0.04$ ). Taken as a whole, the difference between the decreasing group and the increasing group on rates of change in conscientiousness was over a third of a standard deviation. These findings show that changes in conscientiousness were associated with changes in self-perceived physical health such that people who increase in conscientiousness tended to become healthier with time and that people who decrease in conscientiousness tended to become less healthy with time.

## DISCUSSION

In the current study, we used longitudinal data to test the associations between initial levels and changes in the personality trait of conscientiousness and initial levels and changes in preventative health-related behaviors and self-perceived physical health. The results of this study replicated cross-sectional studies, and additionally showed that the relation between conscientiousness and health factors is dynamic, such that changes in conscientiousness were associated with changes in health. In line with prior research (e.g., Bogg & Roberts, 2004;

Hampson et al., 2007; Lodi-Smith et al., 2010; Roberts et al., 2005), conscientiousness, preventative health-related behaviors, and self-perceived physical health were significantly and positively associated at both waves. Moreover, conscientiousness and preventative health-related behaviors predicted self-perceived physical health prospectively over time, showing that the typical cross-sectional association is not attributable to mood or situational confounds.

Additionally, since previous research has not systematically examined the relations among changes in conscientiousness, health-related behaviors, and self-perceived physical health simultaneously, relatively little is known about the tripartite relationships among dynamic forms of these three variables. Using latent change models, we found that increases in conscientiousness were associated with increases in self-perceived physical health. Even though physical health status typically becomes worse as people get older, changes in health variables were positively linked with changes in conscientiousness. Our findings imply that individuals increasing in conscientiousness tend to experience better health compared to their peers over time.

The current research is unique because we examined the relationships between changes in conscientiousness and changes in both preventative health-related behaviors and self-perceived health over time, which had not been systematically tested in prior research. Examining changes in conscientiousness addresses important theoretical and conceptual questions. First, research is only just beginning to investigate potential explanations of individual differences in personality trait change in adulthood. Given the consistent relation to health-related behaviors and self-perceived physical health, we hypothesized that changes in health-related behaviors and self-perceived physical health would both be related to changes in conscientiousness. This hypothesis was based on previous



research showing that decreases in alcohol and tobacco consumption were associated with decreases in impulsivity and constraint (e.g., Welch & Poulton, 2009). Consistent with this past research, we also found a link between changes in health factors and changes in the Big Five domain of Conscientiousness. Combined with research showing that life experiences in the domains of interpersonal relationships (Lehnart, Neyer, & Eccles, 2010; Roberts & Bogg, 2004) and work experiences (Hudson, Roberts, & Lodi-Smith, 2012) are associated with increases in conscientiousness, our results highlight the fact that personality trait change generalizes across life domains. One implication of these findings is that individual differences in personality trait change can hold a positive influence for most major domains of functioning, including work, relationships, and health.

Bolstering the potential importance of a more dynamic model of personality and health, changes in preventative health-related behaviors partially mediated the links between changes in conscientiousness and self-perceived physical health. Prior research has found that health behaviors partially mediated the link between conscientiousness and health, but these studies only tested a static model in which conscientiousness, health behaviors, and health were not changing (e.g., Hampson et al., 2007; Lodi-Smith et al., 2010). We found a similar partial mediation pattern for changes in all three variables. This finding indicates that the palliative effect of conscientiousness on health extends beyond a static and predictive relationship to the dynamic relation between changes in conscientiousness, changes in health behaviors, and changes in health.

The mediation findings have several interesting life course implications. First, given the fact that it is normative for people to increase on conscientiousness as they age (e.g., Jackson et al., 2009), it may be the case that most populations experience better health than would be expected otherwise because they are growing more conscientious with age. Second, these findings point to how one might facilitate changes in both health-related behaviors and self-perceived physical health simultaneously—by changing conscientiousness. This type of top-down possibility indicates that personality changes contribute to health improvement. It implies that if one can change conscientiousness directly, the result may be better health outcomes. This idea that changing personality traits would be an optimal way to change multiple health-related outcomes becomes more of a reality, given the recent research showing that personality traits can be changed through direct intervention, such as through the use of pharmacological agents (Tang et al., 2009) or through cognitive and behavioral interventions (Jackson et al., 2012).

Limitations to the present study must be considered. One obvious limitation is that the latent change models we used in the present study were restricted to only two measurement occasions. This means that the latent change models implicitly assume linear changes between the two time points, and that this model cannot test nonlinear changes. In a longitudinal data

set of three or more waves, latent growth curve modeling could be applied. Clearly the availability of multiple waves of longitudinal data provides substantially more information about the form and structure of the change process in personality traits and physical health. A second limitation is that the longitudinal data in the present study were collected only 3 years apart. Longer time intervals allow for larger changes to accrue, and may generate more insight into the predictive relationship from conscientiousness and preventative health-related behaviors to self-perceived physical health (e.g., Hampson et al., 2007; Martin et al., 2007). Moreover, as noted above, latent change models implicitly assume linear changes between the two measurement points, which means that they may not be an apt description of change over longer time intervals (Hertzog & Nesselrode, 2003). A third limitation is that physical health was self-reported. Personality traits may be linked to psychophysiological mechanisms underlying good health (Moffitt et al., 2011; Sutin et al., 2010). Actual physiological measures would be useful to further validate the critical mechanisms of the personality-health link. Fourth, we did not examine facet-level effects. As Jackson et al. (2009) revealed, not all facets of conscientiousness change similarly, suggesting that more detailed research assessing change at the facet level is needed. Fifth and finally, in this study we only dealt with one of many factors underlying the potential causal link of conscientiousness and perceived health: preventative health-related behaviors. Besides these, there are various other elements that may relate to change in personality and health, such as relationship experiences, work accomplishments, as well as other biological factors, such as puberty or menopause.

Despite these limitations, the present study is among the first to show that changes in conscientiousness are linked to changes in both health-related behaviors and self-perceived physical health. This two-wave longitudinal study extended previous research on conscientiousness and self-perceived physical health by exploring relations between latent variables of continuity and change over a 3-year period, and it provides evidence consistent with the notion that by increasing in conscientiousness, people may become healthier with time. Smith (2006) suggested that studies of links between personality and physical health may be an essential component of a comprehensive understanding of health process and disease mechanism. This study shows that changes in one of the most important health-related traits, conscientiousness, may be one of the mechanisms tied to changes in health with age.

## Notes

1. One item each from the general health subscale, the role limitation subscale, and the social functioning subscale were inadvertently left off the survey because of a collating error.
2. We also tested whether gender, age, and SES moderated the links between these relationships. To test age as a moderator of these effects, we created three age groups: younger-aged (age: 19–34,  $N = 217$ ), middle-aged (age: 35–54,  $N = 355$ ), and older-aged (age:

55–94,  $N = 314$ ). Because 12 participants did not provide their age, they were excluded from these multigroup analyses. Likewise, with regard to SES, we created three SES groups: lower ( $z$ -scored SES <  $-.30$ ,  $N = 272$ ), middle ( $-.30 \leq z$ -scored SES  $\leq .30$ ,  $N = 329$ ), and higher ( $z$ -scored SES >  $.30$ ,  $N = 259$ ). Because 40 participants did not provide their income and/or education, they were excluded from these analyses. For each moderating test, we calculated a critical ratio for differences statistic, where  $z$ -values with an absolute value greater than 2.58 indicate significance at the 0.01 level. Out of 105 comparisons (i.e., 15 for gender, 45 for age category, and 45 for SES category) only three comparisons showed evidence of potential moderation. Gender did not moderate any of the correlations between levels and changes in the variables of interest. The age moderation analyses revealed that the older-aged group had a negative correlation between changes in conscientiousness and changes in preventative health behaviors, which is the opposite direction to middle-aged groups ( $z = -2.65$ ,  $p < .01$ ). Additionally, the moderation analyses for SES revealed that the lower SES group had stronger correlations between level of conscientiousness and level of preventative health-related behaviors ( $z = 2.84$ ,  $p < .01$ ), and changes in conscientiousness ( $z = -2.62$ ,  $p < .01$ ). Because there was a high probability of finding these three effects by chance alone, we have refrained from emphasizing these findings.

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