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Smoking mediates the effect of conscientiousness on mortality: The Veterans Affairs Normative Aging Study

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Abstract

This study examined the relationship between conscientiousness and mortality over 18 years and whether smoking behavior mediated this relationship. We utilized data from the Veterans Affairs Normative Aging Study on 1349 men who completed the Goldberg (1992) adjectival markers of the Big Five. Over the 18-year follow-up, 547 (41%) participants died. Through proportional hazards modeling in a structural equation modeling framework, we found that higher levels of conscientiousness significantly predicted longer life, and that this effect was mediated by current smoking status at baseline. Methodologically, we also demonstrate the effectiveness of using a structural equation modeling framework to evaluate mediation when using a censored outcome such as mortality.

Keywords

Personality; Conscientiousness; Mortality; Longevity; Smoking; Mediation

1. Introduction

Personality traits have emerged in recent years as important predictors of longevity. One of the most robust findings indicates that a higher level of trait conscientiousness predicts longer life expectancy (Friedman et al., 1993; Hampson & Friedman, 2008; Roberts,

Kuncel, Shiner, Caspi, & Goldberg, 2007). Conscientiousness involves the ability to be organized, responsible, disciplined, and planful (Roberts, Jackson, Fayard, Edmonds, & Meints, 2009, chap. 25). Although the potential health benefits associated with greater conscientiousness may appear straightforward, the precise reasons for this are not clearly established. One hypothesis states that conscientiousness is related to longevity because individuals high in this trait abstain from health damaging behaviors such as smoking (Smith, 2006). Given strong empirical evidence connecting low level of conscientiousness and smoking behavior (Bogg & Roberts, 2004), it is likely that this damaging health behavior is one conduit through which conscientiousness influences longevity. However, there is very little empirical evidence documenting that health behaviors, such as smoking, significantly mediate the conscientiousness–longevity association over an extended follow-up period.

The aim of the current study was to test whether smoking behavior explained the conscientiousness–longevity association. If so, it would provide evidence for a key theoretical position linking personality to health—the health behavior model (Smith, 2006). Additionally, we utilize an innovative statistical technique, extending structural equation modeling (*SEM*) for use with a censored outcome (Asparouhov, Masyn, & Muthén, 2006; Hill, Turiano, Hurd, Mroczek, & Roberts, 2011; Muthén & Masyn, 2005; Ploubidis & Grundy, 2009) to test our hypothesis that individuals scoring lower in conscientiousness would be more likely to smoke and thus have an increased risk of mortality.

The empirical evidence connecting conscientiousness with longevity has received much attention in recent years. Studies using diverse samples have, almost without exception, documented that high level of conscientiousness decreases mortality risk. This has been replicated in studies from different cultures (Iwasa et al., 2008; Taylor et al., 2009), in at-risk samples (i.e., participants with coronary disease; Christensen et al., 2002), and in healthy community samples (Terracciano, Löckenhoff, Zonderman, Ferrucci, & Costa, 2008). Moreover, the finding holds regardless of whether conscientiousness was assessed when participants were children (Friedman et al., 1993; Martin, Friedman, & Schwartz, 2007) or when they were adults (Hill et al., 2011; Wilson, Mendes de Leon, Bienas, Evans, & Bennett, 2004). Overall, the majority of studies finds that conscientiousness is positively associated with longevity, and meta-analyses of this topic provide further confirmation (Kern & Friedman, 2008; Roberts et al., 2007).

With the basic effect well-established, researchers are now turning to questions of mechanism. What mediating factors operate in the explanatory pathways leading from conscientiousness to the often quite distal endpoint of mortality? In other words, how does conscientiousness “get outside the skin” (Hampson, 2012) to affect behavior? The *health behavior model* provides the most theoretically elegant explanation for why conscientiousness predicts mortality (Friedman, 2000; Smith, 2006). The model holds that a general personality trait such as conscientiousness leads to specific conscientious behaviors, such as taking better care of one's health, which in turn lead to better health and ultimately greater longevity. A large part of taking care of one's health involves avoiding health-damaging behaviors, such as smoking. Meta-analyses of cross-sectional studies have shown that those lower in conscientiousness are far more likely to smoke tobacco (Bogg & Roberts, 2004; Malouff, Thorsteinsson, & Schutte, 2006), and longitudinal investigations have buttressed these results, documenting that low levels of conscientiousness in childhood predicted increased smoking in middle age and beyond (Friedman et al., 1995; Hampson, Goldberg, Vogt, & Dubanoski, 2006).

Even with the wealth of data documenting the associations among conscientiousness, smoking, and mortality, there is limited empirical evidence that smoking behavior does in

fact statistically mediate the conscientiousness–mortality relationship (Friedman et al., 1995; Hampson, 2008; Martin et al., 2007; Terracciano et al., 2008; Wilson et al., 2004). These prior studies are limited because smoking behavior is treated as a *control variable* and the variance associated with smoking is often ignored. We believe this strategy is flawed theoretically because smoking is actually a mediator on the causal pathway between conscientiousness and mortality. Both conscientiousness and smoking are important predictors of mortality, yet the former is likely more distal in the explanatory chain than the latter.

Moreover, due to limitations in commonly used statistical methods, most prior studies have not conducted significance tests for mediation of the personality–longevity association, including some of our own previous work (e.g., Mroczek, Spiro, & Turiano, 2009). Many prior investigations have treated smoking (as well as other health behavior variables) as a control variable (Friedman, Kern, & Reynolds, 2010; Kern et al., 2009; Martin et al., 2007; Shipley, Weiss, Der, Taylor, & Deary, 2007; Terracciano et al., 2008; Wilson et al., 2004), which can be misleading because many such indicators are “middle” variables, or mediators, on an explanatory pathway. However, this is not a statistical test of mediation because there was no test to determine whether the mediating variable indeed explained variance in the conscientiousness–mortality association. Covarying a variable instead of treating it as a mediator may mask the significant indirect effect health behaviors have between personality and mortality risk.

Taylor et al., (2009) used *SEM* to formally test mediation but the mortality outcome was dichotomous (dead or alive) and did not use the pertinent information of varying survival time, which can be critical when examining mortality over longer follow-up times. The main reason the health behavior pathway has never been formally evaluated is that *SEM* could not, until recently, be easily used with censored outcomes such as survival time (Hill et al., 2011; Muthén & Masyn, 2005; Ploubidis & Grundy, 2009). By using this technique of testing proportional hazards within an *SEM* framework, we attempted to provide a more complete test of the full conscientious–smoking–mortality pathway in a single parsimonious model which would provide empirical support for the health behavior model of personality.

2. Methods

2.1. Sample

Data included participants from the Department of Veterans Affairs Normative Aging Study (NAS), a longitudinal investigation of aging in healthy men. Founded at the Boston VA Outpatient Clinic in 1963 (Bosse' et al., 1984), the aims of the NAS were to follow a large cohort of men to understand the characteristics of healthy aging, identify the precursors of age-related diseases, and estimate the influence of these diseases on the aging process itself.

Between 1961 and 1970, approximately 6000 men were screened for the absence of serious physical or mental illnesses to obtain a closed panel of 2280 initially healthy men (born between 1884 and 1945). The NAS sample was generally representative of the greater Boston, Massachusetts area as of 1970, although only 2% of the sample is African American. A full description of the NAS sample and overview of the various examination cycles can be found elsewhere (Bosse' et al., 1984).

For purposes of the current study, participants were included if they completed the Goldberg (1992) personality measure in 1990–1991. Between the start of the NAS in 1970 and 1990–1991, 374 men (16%) had died, 204 men were only partially active in the study (9%), 155 had dropped out (7%), and 47 men were either too ill to continue participation or could not be contacted. More than half of the lost participants occurred between the first and second

examination cycles (1968–1973; Rose, Bosse, & Szretter, 1976). Thus, by the end of 1991, there were 1485 men active in the NAS who were eligible to complete the personality measure. Of these, 1349 men completed the Goldberg personality assessment and were included in the current study. We compared these men to those who did not have full data; the latter were less likely to be retired, but did not differ on income level, marital status, or self-rated health. In a related study, Spiro and colleagues (1994) concluded that the men who responded to the surveys used in the current study were generally representative of the original sample of NAS men.

2.2. Measures

2.2.1. Conscientiousness—Conscientiousness was assessed via the Goldberg (1992) adjectival markers of the Big Five. This measure contains 100 different adjectives (20 for each of the Big Five), and are administered in unipolar format (Goldberg found that this was more robust across samples than bipolar scales). Overall, Goldberg (1992) found the structure of these 100 adjectives provided a good alternative to using the NEO-PI and Hogan personality inventories.

Participants completed the questionnaire in late 1990 through mid-1991. The conscientiousness measure consists of 20 adjectives (e.g., inconsistent, haphazard, organized, careful), each rated on a 9-point Likert scale (*Extremely Inaccurate–Extremely Accurate*). Negative adjectives were reverse coded and the mean of all 20 adjectives represented level of conscientiousness. Cronbach's alpha for the conscientiousness scale was .86 in this sample.

2.2.2. Education—Education was included as a covariate since there are known social gradients in both personality and mortality risk (Chapman, Fiscella, Kawachi, & Duberstein, 2010). Education was assessed at study entry and ranged from completion of grade school up to an advanced graduate or professional degree. Education was utilized as a continuous variable; 1 (*grade school*) to 9 (*professional degree*).

2.2.3. Physical health—Current self-rated physical health was assessed during completion of the Social Survey II questionnaire mailed to participants in 1988 (2 years prior to assessment of personality). Participants rated their current state of physical health using a 5-point Likert scale response format: excellent, good, fair, poor, or very poor. Responses were coded so higher scores represented better physical health.

2.2.4. Smoking behavior—Smoking behavior was assessed via surveys conducted near the time of the personality assessments. Respondents indicated whether they: (1) were a never smoker, (2) an occasional smoker, (3) a regular smoker-on a daily basis, or (4) had quit smoking. Participants answered these questions for cigarette, cigar, and pipe use. Categories were created to indicate whether a participant in 1990–1991 was: (1) a current smoker of any tobacco product; (2) had quit smoking a tobacco product by 1990–1991; and (3) had never smoked any tobacco product by 1990–1991. Two dummy variables were created to contrast current smokers and former smokers with never smokers.

2.3. Mortality

Vital status is monitored by periodic mailings and when deaths are identified, death certificates are obtained. Survival time for decedents was the interval from the date the personality questionnaire was completed to the date of their death. Survivors (censored observations) had survival times that equaled the length of the follow-up (censored at 7/31/2008). Of the 1349 men who completed the Goldberg personality measure, 547 died

(41%) during the 18 year follow-up period. The mean survival time for decedents was 11.01 years ($SD = 4.55$; $range = .80$ – 18.50 years).

2.4. Data analysis

The first step of the analysis was to investigate whether conscientiousness differed between the survivors and decedents. The second step involved a standard Cox proportional hazards test (i.e., survival analysis) to determine whether conscientiousness predicted mortality risk net of age, education, and self-rated health. Lastly, we specifically tested whether current smoking or former smoking mediated the pathway from conscientiousness to mortality by employing an innovative method that utilizes proportional hazards modeling in an *SEM* framework. This approach is ideal because: (1) proportional hazards modeling takes into account continuous survival times, varying ages at entry into the study, and occurrence of a discrete outcome event (Cox, 1972); and (2) *SEM* allows us to assess both the direct and indirect effects of continuous survival time (Asparouhov et al., 2006). All analyses were conducted in Mplus® 6.0 software (Muthén & Muthén, 1998–2010) using a maximum likelihood robust estimator and Monte Carlo integration.

Since the commonly used causal steps approach (Baron & Kenny, 1986) for mediation testing is not appropriate in this case when utilizing a continuous survival outcome as the dependent variable because there is no direct estimate of the size of the indirect effect, or standard errors needed to construct confidence limits. Thus, to test each smoking variable as a mediator, we evaluated the significance of the *indirect effect* of conscientiousness through smoking status separately for former and current smokers. This decomposition technique through *SEM* allows us to “trace the influence of any path” in a hypothesized model (Bollen, 1987).

We hypothesized that higher levels of conscientiousness would be associated with a reduced odds of being a current or former smoker, and reduced hazards of dying over the 18-year follow-up period. Moreover, we hypothesized that both former and current smoking would mediate the relationship between conscientiousness and mortality risk. Specifically, we thought current smoking would be a stronger mediator of the conscientiousness–mortality association, compared to former smoking because of the cumulative damage associated with long-term smoking.

3. Results

3.1. Descriptive findings

Descriptive statistics for the entire sample stratified by survival can be found in Table 1. Notably, mean differences in conscientiousness were found based on survival. Those who died during the 18-year follow-up scored significantly lower on conscientiousness than those who survived ($t = 3.75$, $df = 1349$, $p < .001$). In terms of smoking status, current smokers scored marginally lower in conscientiousness ($t = 1.74$, $df = 399$, $p < .10$) than those that never smoked during their lives. There were no statistical differences in level of conscientiousness between former smokers and never smokers.

3.2. Survival analysis¹

The proportional hazards analyses confirmed that conscientiousness predicted mortality risk in an unadjusted model ($HR = 0.84$; $CI = 0.77$ – 0.91 ; $p < .001$). Adjusting for age, education, and self-rated health reduced the direct effect of conscientiousness but it was still significant ($HR = 0.91$; $CI = 0.84$ – 0.99 ; $p < 0.05$). For a standard deviation increase in

¹See Appendix A for proportional hazards models involving additional Big Five traits.

conscientiousness (about 1 point) there was a 9% decreased hazard of dying. Moreover, a standard deviation increase in age at baseline (approximately 8 years) was associated with an 11% increased hazard of dying ($HR = 1.11$; $CI = 1.10\text{--}1.12$; $p < 0.01$). Education was not a significant predictor of mortality risk². A unit change in self-rated health was associated with a 31% decreased hazard of dying ($HR = 0.69$; $CI = 0.64\text{--}0.87$; $p < 0.001$).

3.3. Test of mediation

Next, we conducted a simultaneous test of whether former or current smoking mediated the relationship between conscientiousness and mortality within a single *SEM* model. Table 2 presents estimates (hazard rates) of mortality risk based on the level of each predictor variable. It includes both the direct, indirect, and total effects for variables used in the current study. Fig. 1 displays the fully adjusted path model with the arrows representing the hypothesized direction of influence for ease of interpretation. All path estimates ($a1$, $a2$, $b1$, $b2$, c) are expressed in hazard rates or odds ratios, which are standardized effect sizes. We also included the 95% confidence limits for the true parameter estimates.

The *total* effect of conscientiousness on mortality (sum of paths [$a1 * b1$], [$a2 * b2$], and [c]) was significant, net of age, education, self-rated health, and smoking in the model. However, the *direct effect* of conscientiousness on mortality (path c) was not significant when smoking was included in the model. According to the mediated proportion (Ditlevsen, Christensen, Lynch, Damsgaard, & Keiding, 2005), comparison of the direct effect of conscientiousness on mortality before ($HR = .91$) and after ($HR = .92$) adjusting for smoking behavior revealed that smoking resulted in an 11% decrease in the effect of conscientiousness on mortality. Moreover, according to the significance of the indirect effects, conscientiousness specifically influenced mortality through current smoking (path $a1 * b1$) but not former smoking status (path $a2 * b2$). A standard deviation increase in conscientiousness was significantly associated with an 18% decreased odds of being a current smoker (path $a1$) and in turn, being a current smoker was associated with a 43% increased hazard of dying (path $b1$) over the 18-year follow-up period.

4. Discussion

The current study found that the relationship between conscientiousness and mortality risk was partially mediated by smoking behavior over an 18 year period. Specifically, conscientiousness affects mortality risk indirectly, through attenuating the likelihood of current smoking in this sample of older men. This is consistent with the well-established literature documenting a negative association between conscientiousness and smoking (Bogg & Roberts, 2004) as well as between conscientiousness and mortality risk (Kern & Friedman, 2008). The contribution of the current study rests in the fact that these pathways were estimated in a unified model that allows for a complete test of the health behavior model of personality. This approach is one of the most effective means of testing mediation when using a censored outcome such as mortality, and should be utilized in future investigations examining possible mechanisms underlying the personality–mortality association (Hill et al., 2011; Ploubidis & Grundy, 2009).

It is likely that the relationship between smoking and personality may be stronger in some cohorts such as the WWII generation who smoked at higher rates than others (Mroczek et al., 2009). In fact, tobacco products were routinely given to overseas soldiers during the WWII/Korea era as part of their rations and were sold at low prices on U.S. military bases, which increased the percentages of veterans who ever smoked, compared to non-veterans

²Sensitivity analyses indicated that adjustment for employment and marital status measured in 1990–1991 at baseline did not influence the conscientiousness–mortality association.

(Bedard & Deschênes, 2006). A large portion of the NAS men (more than three-quarters) reported smoking at some point in their lives, even if they had quit by the time of enrollment into the NAS study. With the increased prevalence of smoking, it is not surprising that current smokers in the study had a 43% increased hazard of dying compared to those who never smoked. In sum, our investigation is consistent with a prior study documenting that the WWII/Korea cohort of men suffered premature mortality perhaps attributable to military-induced smoking (Bedard & Deschênes, 2006).

Overall, the current study strengthens the idea that personality traits can be used to predict not only engagement in health behaviors, but also to identify individuals at an increased risk of poor health and ultimately mortality partly due to the behaviors they engage in. Based on our findings, part of the association between conscientiousness and mortality is explained via smoking behavior. An explanatory chain exists: individuals lower in conscientiousness are more likely to smoke, and their smoking behavior in turn raises mortality risk. Identifying individual differences in personality traits such as conscientiousness could reveal those at risk of initiating smoking and perhaps uncover those individuals who may be more or less likely to quit smoking based on their level of conscientiousness. The clinical relevance of this finding is important because it is well documented that those who smoke are not only at an increased risk of earlier mortality, but also a host of other negative health problems. Utilizing personality traits as a means to uncover chains of risk from dispositions, to behavior, and to disease/illness is an exciting possibility in the move toward personalized medicine. Future work in uncovering additional mechanisms connecting personality to health will fully illuminate why some people age successfully while others suffer disease burden and shortened longevity.

Even in light of the innovative statistical methods and long-term follow-up utilized in the current study, there are qualifications that must be discussed. First, the sample is select being restricted to men, many of whom were veterans of World War II or Korea. Although, veterans from this era are more or less representative of the adult male population because most eligible men served in the military (Bell, Rose, & Damon, 1972; Spiro et al., 1994).

Second, approximately 16% of the original sample of NAS men had already died before personality was assessed in 1990–1991. Thus, it is possible that a disproportionate number of smokers had already died due to smoking related diseases. This limitation likely results in an underestimation of the effects of conscientiousness and smoking on mortality risk. Another factor limiting the generalizability of the findings is that the original NAS sample selected in the 1960s included men in good health, but once men were enrolled, they were not excluded if they developed disease (which many of them did between 1970 and 1990). Although the sample was initially healthy, their rate of experiencing disease in subsequent years was similar to that of the general male population of that era. It is possible that the significant indirect effect found in this study could differ, whether stronger or weaker, for individuals who were already experiencing health declines and were thus not included in the original NAS sample. Clearly, more research on more diverse samples is needed to replicate the current study findings.

It is also important to note that other health behaviors such as alcohol and drug use should be included in future investigations since smoking behavior explained only roughly 11% of the variance in the conscientiousness–mortality association in the current study. Although a large portion of variance was left unexplained, this is to be expected since one health behavior is unlikely to account for all the variance in an inherently complex and multidetermined outcome such as mortality. Alcohol use, drug use, diet, and exercise behavior are just a few examples of other potential mediating variables (Bogg & Roberts, 2004). Moreover, investigating only health behaviors as a mechanism is a gross

oversimplification of the complex pathways linking personality and health. Rather, personality is likely related to a bundle of mechanisms involving multiple health behaviors, exposure to stress, and interrelated physiological influences on health (Friedman, 2000, 2008; Smith & Spiro, 2002).

It is also necessary to note that a more dynamic approach to considering change in personality could expand the current findings. A recent framework for personality development is the idea of interindividual differences in personality change throughout adulthood (Mroczek & Spiro, 2007; Roberts & Mroczek, 2008; Roberts, Walton, & Viechtbauer, 2006; Small, Hertzog, Hultsch, & Dixon, 2003). Personality is a set of malleable traits and if these traits change, then it is likely risk factors and health outcomes can also change (Turiano et al., 2012). Mroczek and Spiro (2007) show that individuals decreasing on neuroticism actually lower their risk of mortality. This provides direct evidence that both personality change and health outcomes are not static factors and change over the life course. Moreover, it is also possible that smoking can affect changes in conscientiousness over time (Mroczek & Spiro, 2007; Roberts & Bogg, 2004; Welch & Poulton, 2009). Clearly, more research is needed to understand how the dynamic relationship between personality and health behaviors changes over the life course.

The implications of the current study would also be strengthened with more detailed measures of smoking behavior (e.g., how many cigarettes per day; length of cessation), especially since a large portion of the sample had quit smoking (64%). It is also problematic that the mediator variable was measured prior to conscientiousness for individuals who had quit smoking prior to the baseline personality assessment in 1990–1991. This clearly limits the causal inferences that might be obtained if we had measures of conscientiousness prior to 1990–1991.

5. Conclusions

The current investigation utilized an innovative statistical technique to provide evidence that smoking mediated the influence of conscientiousness on mortality during an 18-year follow-up of older men. We provided a full test of the health behavior model of personality by documenting that current smoking behavior partially accounts for the conscientiousness–mortality association. Research into the underlying mechanisms linking personality to health is only at the beginning stages, but with more parsimonious estimation techniques and examination of multiple mediating variables, our understanding of why some personality traits predict health outcomes will be enhanced. Certain personality traits may hold the key to understanding how healthy and long someone will live.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations

SEM	Structural equation modeling
NAS	Normative Aging Study

Fig. 1.

Path analysis of smoking status mediating the association between conscientiousness and mortality risk. Parameters are expressed in hazard rates or odds ratios with 95% confidence intervals. The model was adjusted for age, education, and self-rated health. The indirect effect of conscientiousness on mortality risk through current smoking was ($HR = 0.91$, $CL = 0.82-0.96$). $^*p < .05$. $^tp < .10$.

Table 1

Descriptive statistics stratified by death status.

Variables	Deceased (<i>n</i> = 547) Mean (<i>SD</i>) or %	Alive (<i>n</i> = 802) Mean (<i>SD</i>) or %	Total sample (<i>n</i> = 1349) Mean (<i>SD</i>) or %	Range
Age	69.03 (7.42)	62.12 (6.65)	64.90 (7.75)	45–89
Education	5.28 (1.80)	5.37 (1.75)	5.34 (1.77)	1–9
Self-rated health	3.94 (0.72)	4.20 (0.67)	4.09 (0.70)	1–5
Conscientiousness	6.62 (0.99)	6.84 (0.96)	6.75 (0.98)	2–9
Never smoker	27%	25%	26%	0–1
Former smoker	60%	67%	64%	0–1
Current smoker	13%	8%	10%	0–1

Table 2

Mediating effect of smoking on the conscientiousness–mortality association: Direct and indirect effects.

		Endogenous variables		
		Mortality risk	Former smoker	Current smoker
Predictor		Hazard Rate [95% CI]	Odds ratio [95% CI]	Odds ratio [95% CI]
Conscientiousness	Direct	0.92 [0.85–1.01] ^t	0.99 [0.88–1.13]	0.82 [0.67–0.94] [*]
	Indirect ^a	0.99 [0.98–1.01]		
	Indirect ^b	0.91 [0.82–0.96] [*]		
	Total effect ^c	0.84 [0.74–0.96] ^{**}		
Former smoker	Direct	1.05 [0.86–1.28]		
Current smoker	Direct	1.43 [1.04–1.98] ^{**}		
Age at baseline	Direct	1.11 [1.10–1.12] ^{***}	0.99 [0.97–1.02]	0.96 [0.93–0.99] ^{**}
Education	Direct	0.98 [0.93–1.03]	0.99 [0.93–1.07]	0.86 [0.76–0.98] [*]
Physical health	Direct	0.69 [0.61–0.78] ^{***}	0.87 [0.80–0.95] ^{***}	0.79 [0.69–0.91] ^{***}

Note: $N = 1349$. Akaike's Information Criterion = 12471.03; Bayesian Information Criterion = 12552.92.

^a Effect of conscientiousness on mortality through former smoking.

^b Effect of conscientiousness on mortality through current smoking.

^c Sum of indirect effects and direct effect

^t $p < .10$

^{*} $p < .05$.

^{**} $p < .01$.

^{***} $p < .001$.