

# Neuroticism Predicts Negative Reinforcement Tobacco Smoking Motives

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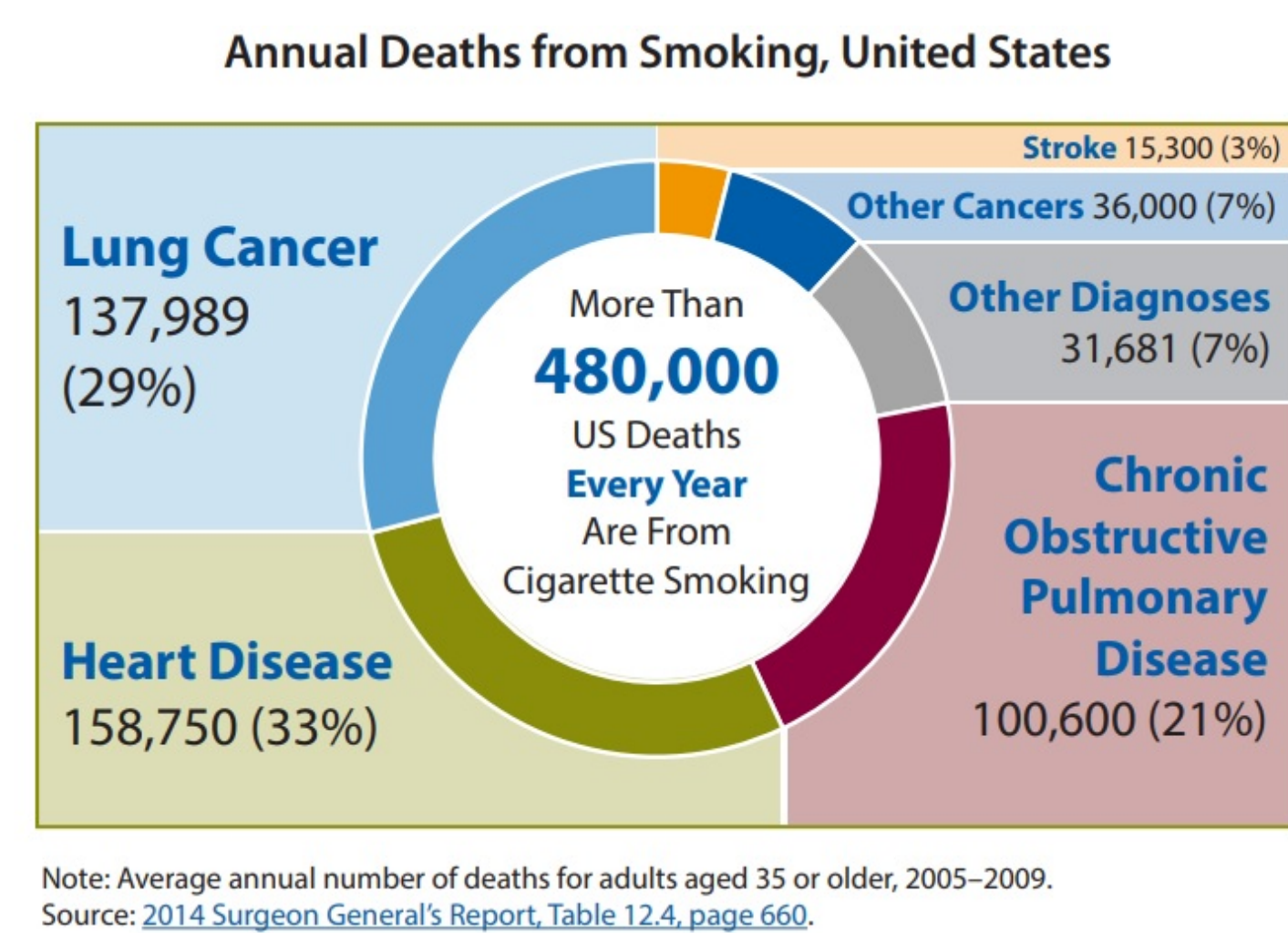
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## Introduction

- Nearly 70% of adult tobacco smokers want to quit, and annually, over 50% of these individuals attempt to quit. However, most attempts to abstain from smoking tobacco are unsuccessful<sup>1,2</sup>.
- While tobacco use is the leading preventable cause of mortality in the United States, the habit of tobacco use stems from the **addictive nicotine content** in cigarettes.
- Previous research has linked the personality traits of the five-factor model (extraversion, **neuroticism**, agreeableness, conscientiousness and openness to experience) with current smoking habits in adults. Current smoking in adults was positively associated with higher scores on both **neuroticism** and extraversion, as well as with lower scores in conscientiousness. **High neuroticism** reflects low emotional stability and high proneness to anxiety and stress<sup>3</sup>.
- Neuroticism**, in particular, has been heavily implicated in nicotine use motivation.
  - Specifically, **elevated neuroticism scores** were found to predict smoking relapse among ex-smokers and overall, was found to be negatively correlated with successful smoking-cessation.
  - High neuroticism** has also been shown to be positively associated with smoking initiation in some studies, but not others<sup>4-7</sup>.
  - Individuals with **dispositional negativity (neuroticism)** are more likely to engage in unhealthy behaviors; to suffer from sleep problems, chronic pain, and subjective health complaints; to become physically ill; and to die prematurely. They are also more likely to suffer from substance abuse.<sup>8</sup>
- Two motivational mechanisms for nicotine dependence include **positive reinforcement** and **negative reinforcement**. The positive reinforcement model states that smoking motives stem from a desire to experience the rewarding psychological and/or physical effects of nicotine (e.g., euphoria, arousal). The negative reinforcement model posits that people smoke to **ameliorate negative affect** (e.g., to reduce anxiety, irritability, stress)<sup>9</sup>.
- Past studies have largely focused on how variation in personality relates to smoking initiation, current smoking, or smoking cessation attempts. However, we have not found any studies that explored how variation in personality relates to what **motivates** an individual to maintain their present smoking habits.
- The aim of this study was to examine the relationship between neuroticism (as measured by the Big Five Inventory 2) and negative reinforcement smoking motives (as measured by the Wisconsin Inventory of Smoking Dependence Motives) in adult chronic, daily smokers. Based on previous research, we hypothesized that **higher neuroticism scores would predict higher negative reinforcement smoking motive scores**.

Source: 2020 Smoking Cessation by the Numbers: A Report of the Surgeon General (HHS.gov)



## Methods

### Participant recruitment and selection

Daily chronic smokers were recruited from the local D.C., Maryland, Virginia area via online posts on craigslist, Facebook/Instagram, and local university listservs. Physical flyers were posted in local public spaces. The recruited participants (n = 86; 29 females) were between the ages of 18-40 years old (Myears = 30.13 ± 5.60), and had smoked at least 7 cigarettes a day for at least six months. Expired carbon monoxide (CO) levels, measured with a Micro+ Smokerlyzer device, were collected to validate smoking habits. These participants were recruited as part of a larger neuroimaging study studying the neural correlates of negative affect in acute nicotine withdrawal.

## Exclusion Criteria

- Self-reported current diagnosis of psychiatric disorder,
- Self-reported severe/unstable medical conditions. Self-reported lifetime psychotic/bipolar disorder,
- Current psychological or pharmacological treatment for any psychiatric disorder or symptom(s), as indexed by self-report.
- Chronic/severe substance or alcohol abuse/dependence within the past 2 years and actively sought to quit smoking in the past 2 months

## Screening, Questionnaires, and Statistical Analysis

- Participants underwent a primary screening and secondary screening via online survey and telephone.
- Participants came into the University of Maryland Biology-Psychology building for a lab assessment which included questionnaire completion and CO assessment (Micro+Smokerlyzer).
- Big Five Inventory 2 and Wisconsin Inventory of Smoking Dependence Motive scores were coded and imported into R.
  - BFI-2 Domain Scale of Negative emotionality** (items: 4R, 9R, 14, 19, 24R, 29R, 34, 39, 44R, 49R, 54, 59) were reversed scored as indicated and summed
    - Range of possible scores: 12 (low) to 49 (high)
    - Mscore = 29.83 ± 9.87
  - WISDM Negative Reinforcement subscale** (items: 7,18,25,32,58,65) were averaged
    - Range of possible scores: 1.5 (low) to 7 (high)
    - Mscore = 4.94 ± 1.43
- Assumptions of the simple linear regression model were checked and a simple linear regression was run using the lm() function in R. Further exploratory models were run to check for possible interactions.

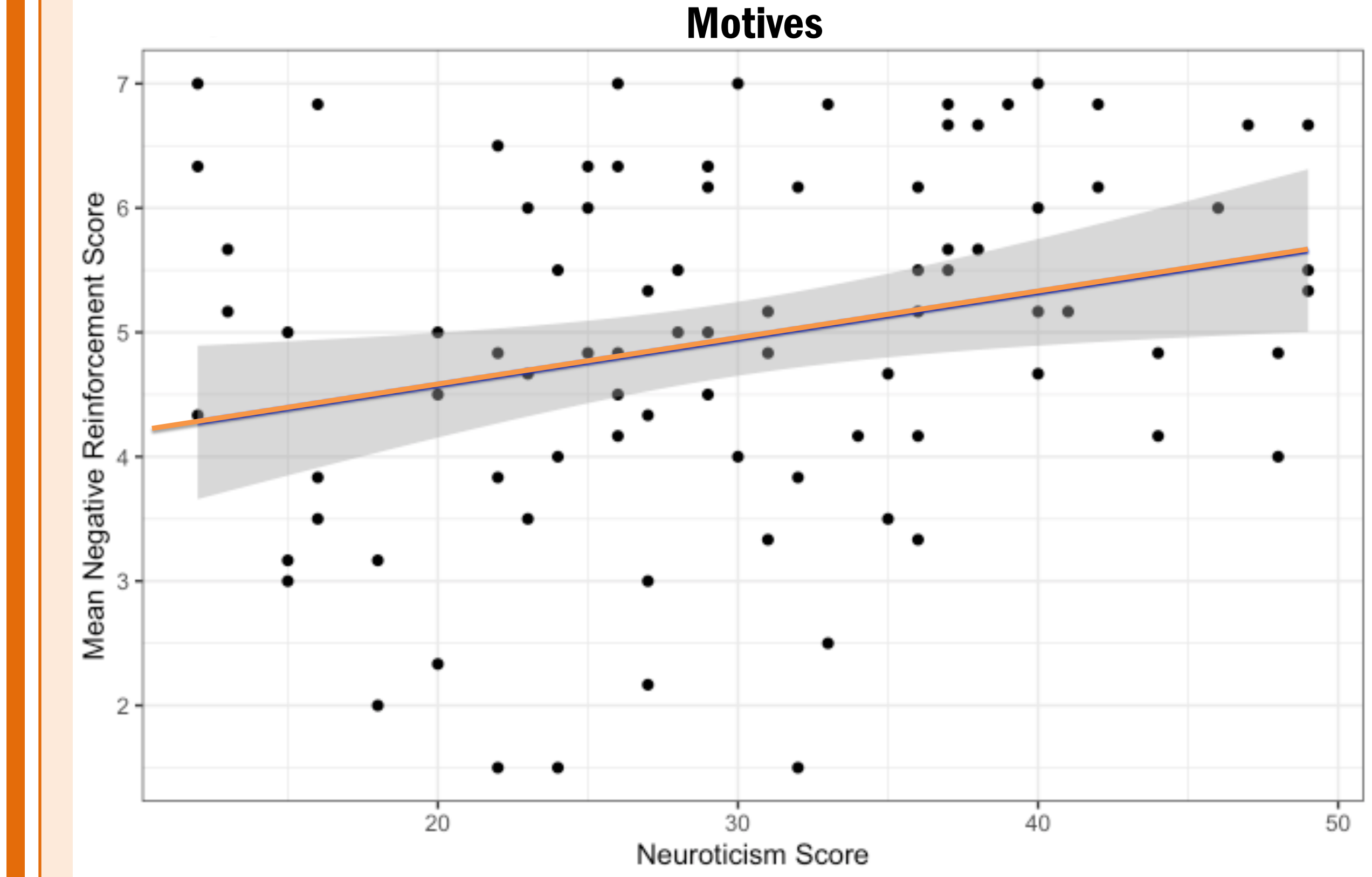


## Assumptions of Simple Linear Regression

- Linearity:** The relationship between neuroticism and mean negative reinforcement score did not appear to be particularly linear. This assumption is likely violated in our model, but for the purposes of this analysis it was assumed that the relationship between the variables is linear due to the slight positive slope of the line.
- Homogeneity of residuals:** The residuals appear to be scattered and unsystematic, suggesting that homogeneity of residuals is not violated.
- Normality of the residuals of negative reinforcement motives regressed on neuroticism score:** the residuals do appear to be relatively normally distributed, suggesting that this assumption is not violated.
- Data at the interval level:** The data appears to be continuous suggesting that this assumption is not violated.
- Data points are independent:** There is no reason to believe that one subject's data influenced another subject's data. This assumption is not violated.

## Results

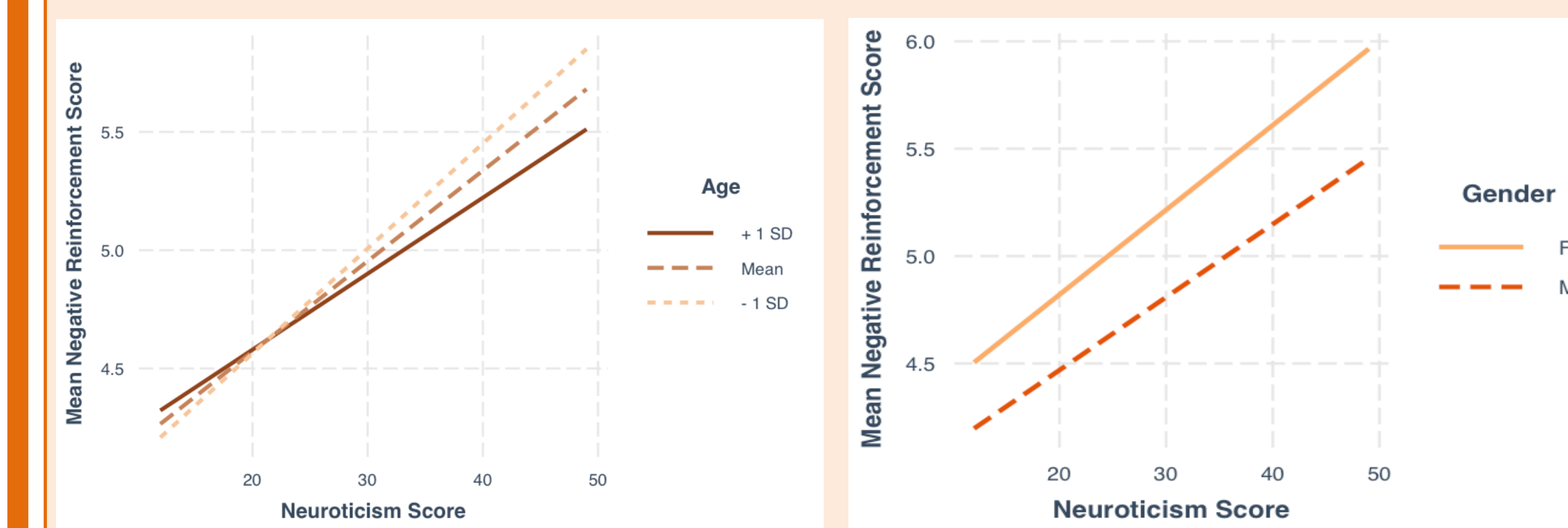
### A. Relationship between Neuroticism & Negative Reinforcement Motives



### 1. Increase in neuroticism score is associated with an increase in negative reinforcement smoking motive (Figure A.)

- Slope of the simple linear regression line was statistically significant,  $b = 0.037$ ,  $t(84) = 2.45$ ,  $p = 0.017$
- The model itself was also statistically significant, with neuroticism accounting for 6% of the variance in negative reinforcement smoking motives score,  $R^2 = 0.06$ ,  $F(1,84) = 5.99$ ,  $p = 0.016$ .

### B. No Interaction: Neuroticism x Age C. No Interaction: Neuroticism x Gender



### 2. No significant interactions found with age or gender

- There was no statistically significant interaction between neuroticism score and age when predicting negative reinforcement smoking motives score,  $F(1,82) = 0.15$ ,  $p = 0.697$  (Figure B.). However, a main effect of neuroticism remained significant,  $F(1,82) = 5.99$ ,  $p = 0.017$ .
- There was also no significant interaction found between neuroticism score and gender,  $F(1,82) = 0.03$ ,  $p = 0.873$  (Figure C.), but again, a main effect of neuroticism remained significant,  $F(1,82) = 5.35$ ,  $p = 0.023$ .

## Discussion

- Although the linear regression indicated a significant relationship between negative reinforcement score and neuroticism, there must be **other factors** to account for the other 94% of the variance in negative reinforcement smoking motives. Exploratory analysis in the present study revealed that gender and age do not interact with neuroticism scores to predict negative reinforcement scores. Possible alternatives variables that might help explain more variance include family history and genetics, smoking duration, and life experiences.
- The findings in this research are **limited to tobacco smokers only**. The results of the present study cannot be generalized to populations of individuals who vape or Juul because this specific study included only tobacco smokers.
- Smoking cessation will inevitably introduce withdrawal symptoms and these symptoms may be experienced more strongly by individuals with higher neuroticism. This can make smoking cessation more difficult for those that score higher in neuroticism.
- The significant positive association between neuroticism scores and specific smoking motives (such as negative reinforcement) can help explain the increased likelihood of those with dispositional negativity to engage in unhealthy behaviors and suffer from physiological and psychiatric health issues. It can also help explain how neurotic personalities facilitate unhealthy behaviors, such as tobacco smoking (i.e. **neuroticism** → **proneness to stress** → **motivation to relieve stress** → **unhealthy behaviors such as smoking**)
- Profiling a person's personality traits could help **identify those at risk** for developing severe nicotine use/dependency at earlier stages.
- A deeper understanding of the association between personality traits and smoking motives is fundamental in **improving tobacco cessation intervention programs** for chronic tobacco users.

## References

- HHS Office of the Secretary, Office. (2020, January 23). Smoking Cessation by the Numbers: A Report of the Surgeon General. Retrieved from <https://www.hhs.gov/surgeongeneral/reports-and-publications/tobacco/2020-cessation-sgr-infographic-by-the-numbers/index.html>
- Messer K, Trinidad DR, Al-Delaimy WK, Pierce JP. Smoking cessation rates in the United States: a comparison of young adult and older smokers. *Am J Public Health* (2008) 98:317–22. doi:10.2105/AJPH.2007.11206
- Hakulinen, C., Hintsanen, M., Munaff, M. B., Virtanen, M., Kivimäki, M., Batty, D., & Jokela, M. (2015). Personality and Smoking: Individual-Participant Meta-Analysis of 9 Cohort Studies. *SSRN Electronic Journal*. doi: 10.2139/ssrn.2648165
- Hampson S. E., Goldberg L. R., Vogt T. M., Dubanoski J. P. Forty years on: teachers' assessments of children's personality traits predict self-reported health behaviors and outcomes at midlife. *Health Psychol* 2006; 25: 57–64.
- Munafò M. R., Black S. Personality and smoking status: a longitudinal analysis. *Nicotine Tob Res* 2007; 9: 397–404.
- Turiano N. A., Whiteman S. D., Hampson S. E., Roberts B. W., Mroczek D. K. Personality and substance use in midlife: conscientiousness as a moderator and the effects of trait change. *J Res Pers* 2012; 46: 295–305
- Welch D., Poulton R. Personality influences on change in smoking behavior. *Health Psychol* 2009; 28: 292–9.
- Shackman, A. J., Tromp, D. P. M., Stockbridge, M. D., Kaplan, C. M., Tillman, R. M., & Fox, A. S. (2016, December). Dispositional negativity: An integrative psychological and neurobiological perspective. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/27732016>
- George, O., & Koob, G. (2017). Overview of Nicotine Withdrawal and Negative Reinforcement (Preclinical). *Negative Affective States and Cognitive Impairments in Nicotine Dependence*, 1–20. doi: 10.1016/b978-0-12-802574-1.00001-6