

THE ASSOCIATION BETWEEN PERSONALITY TRAITS, COVID-19 PREVENTATIVE
BEHAVIOR, AND SARS-CoV-2 SEROCONVERSION IN A RANDOM SAMPLE OF
UNDERGRADUATE STUDENTS DURING THE COVID-19 PANDEMIC

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Background: Studies examining the association between personality traits and COVID-19 in undergraduate students are not in the current literature surrounding COVID-19. We aimed to assess the association between three personality traits: 1) urgency (impulsivity), 2) risk-taking, and 3) excitement-seeking and the use of COVID-19 prevention methods and incident SARS-CoV-2 infection. We used data from a study conducted at Indiana University that included undergraduate students enrolled in the Fall 2020 semester.

Methods: To estimate the association between personality traits and avoiding social events as a method of COVID-19 prevention, risk ratios were estimated using generalized estimating equations (for within subject repeated measures) for Poisson regression, with multiple imputation of missing data. Log-binomial regression was used to estimate risk ratios for the relationship between the personality scales and incident SARS-CoV-2 infection. Finally, principal component analyses were conducted for both outcomes to combine the three personality scales into one model that accounted for multicollinearity.

Results: We did not observe any meaningful differences in avoiding social events by urgency, excitement-seeking, and risk-taking. We also found that for every 1-unit increase in students' scores on both the excitement-seeking and risk-taking scale, there was a 0.25% (95% CI:

1.0003,1.0046) and 0.31% (95% CI: 1.0007,1.0056) significantly increased likelihood of seroconversion, respectively. From the results of the principal component regression, we did not observe any meaningful differences in avoiding social events or SARS-CoV-2 infection by urgency, excitement-seeking, or risk-taking.

Conclusion: Preliminary evidence does not point to a strong relationship between personality traits and COVID-19 protective behaviors in a college population. Further studies are recommended to explore the relationship of personality traits among different age groups in the context of COVID-19 prevention and SARS-CoV-2 infection. Additionally, personality traits should be studied in a different time period, specifically, when prevention methods are recommended, rather than required, to further explore this potential association between personality traits and use of COVID-19 prevention. Future research could also explore the relationship between personality traits and other highly infectious diseases.

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CHAPTER 1: SPECIFIC AIMS

According to the Centers for Disease Control and Prevention (CDC), 104,455,294 cases of SARS-CoV-2 and 1,129,573 deaths due to SARS-CoV-2 had been reported in the United States as of April 23, 2023.¹ These counts continue to rise on a daily basis, as observed on the CDC's COVID Data Tracker ¹. Individuals between the ages of 18-24 had the highest incident SARS-CoV-2 cases per 100,000 population throughout the course of the pandemic.² With many universities having continued in-person learning in 2020 after the nationwide shut-down concluded, it is likely that students living on college campuses were at increased risk, thus contributing to the high incidence rates seen among individuals in this age group.

The risk factors related to SARS-CoV-19 seroconversion in college students living on campus are likely to differ in many ways from other subsets of the population. While university operations were atypical during the course of the pandemic, students living on campus still experienced close living quarters, potentially large social gatherings, some in-person coursework, etc. that put them at increased risk for developing SARS-CoV-2 infection. Although university students are at high risk for COVID-19, some studies suggest that college students might be less likely to engage in proper COVID-19 prevention practices compared to the rest of the population. For example, in a study conducted in August 2020, 13% of undergraduate students indicated that they did not wear a mask in crowded places, and 16% of undergraduate students chose not to implement physical distancing when in a crowd.³ In comparison to the general United States population, a study found that only 4.7% of randomly surveyed individuals stated they did not typically wear a mask.⁴ In another study, 23.5% of undergraduate students reported that they were not engaging in the recommended mask use practices on campus.⁵ Finally, only 47.6% of students reported that they always carried out proper social distancing.⁶ Personality profiles of college

students might contribute to an overall lack of uptake of COVID-preventative behaviors and incident SARS-CoV-2 infection. Impulsivity, risk-taking, and excitement-seeking personalities of students could correlate to decreased preventative measures being taken against the virus. In a study that compared personality scales of college students and adults, adults had significantly lower affinity for sensation-seeking personality traits compared to college students.⁷ Furthermore, reckless behavior (determined by reported frequencies of various reckless activities during the past year on an expanded version of Arnett's 15-item questionnaire) was significantly higher in college students than in adults.^{7,8} There is an overall lack of research related to COVID-19 and personality profiles of college students. This is a significant gap in the research. Personality profiles of university students need to be examined in the context of COVID-19 prevention and SARS-CoV-2 incidence in order to better understand who in the student population is seroconverting for more targeted prevention, both in the context of COVID-19 and other highly contagious respiratory illnesses.

Data from a longitudinal study conducted from August 2020 to November 2020 on a random sample of undergraduate students at Indiana University was used to assess the association between personality profiles of students and use of COVID-19 prevention methods and incident SARS-CoV-2 infection.

Specifically, we aimed to:

- 1. Estimate the association between individual personality profile scales related to impulsivity, risk-taking, and excitement seeking and the uptake of COVID-19 preventative behavior, specifically avoiding social events and gatherings.**

Hypothesis: Individuals who have personalities that motivate them to act more impulsively, that make them more likely to take risks, and that drive them to seek excitement will be more likely to attend large social gatherings over the course of the study period.

2. Estimate the association between individual personality profile scales related to impulsivity, risk-taking, and excitement-seeking and incident SARS-CoV-2 infection.

Hypothesis: We hypothesize that individuals who have personalities that motivate them to act more impulsively, that make them more likely to take risks, and that drive them to seek excitement will be more likely to have developed SARS-CoV-2 antibodies at study completion.

CHAPTER 2: BACKGROUND

2.1 Overview of COVID-19 in College Students

Individuals between the ages of 18-24 had the highest incident SARS-Cov-2 cases per 100,000 population between June 2020 and December 2020.² Despite the pandemic, many universities opted to resume in-person learning in the second half of 2020. Thus, it is likely that students living on college campuses were at increased risk, thus contributing to the high incidence rates that were observed among individuals in this age group. According to a study conducted in 2020, among counties with large colleges and universities, those who used remote-instruction for coursework experienced a 17.9% decline in mean COVID-19 incidence during the 21 days before through 21 days after the start of classes (from 17.9 to 14.7 cases per 100,000), and those who used in-person instruction for coursework experienced a 56.2% increase in COVID-19 incidence, from 15.3 to 23.9 cases per 100,000⁹. This data indicated the large contribution made by university students to COVID-19 incidence.

Student's attitudes towards the pandemic had both short-term effects (in terms of behaviors and attitudes that might contribute to seroconversion) and potential long-term effects in terms of academic achievement and overall mental health. According to a study conducted on 1500 students in public universities, 13% of students had to delay graduation dates, 40% had lost a job, internship, or job offer, and 29% indicated they expected to earn less at age 35, as a result of the COVID-19 pandemic.¹⁰ Additionally, 11% of students withdrew from classes, 12% intended to change majors (12%), and approximately 50% of students reported a decrease in study hours and in their academic performance.¹⁰

2.2 Overview of COVID-19 Preventative Behaviors in College Students

According to a book published in December of 2020 that focused on protective behaviors in the college student population, there were many potential reasons found as to why college students might

not always engage in the recommended protective, preventative measures as suggested (or required) on college campuses.¹¹ Transmission on campus occurred in situations where people refused or declined to wear masks (e.g. in dorms, at football games, parties, and sorority and fraternity gatherings).¹¹ Some of these types of situations and events were made public on social media with implications for diffusing social norms and guidance on COVID-19 precautionary measures.

College students worked to try to strike a balance between incentives for adopting protective behaviors and sanctions for noncompliance.¹¹ With the highly altered social scene that occurred on most college campuses, anxiety and depression were on the rise in students, and these conditions were found to prompt behaviors that were less desirable for preventing the spread of COVID-19.¹¹ “Shaming” of students who ignored COVID-19 prevention requirements occurred among college students themselves and toward college students on the part of communities where colleges and universities are located, which was hard for college-aged individuals to cope with.¹¹ This type of judgment also seemed to add to the lack of COVID-19 prevention adopted among college students in many cases.¹¹

Although university students are at high risk for SARS-Cov-2 infection, some studies suggest that college students might be less likely to engage in proper COVID-19 prevention practices compared to the rest of the population. For example, in a study conducted in August 2020, 13% of undergraduate students indicated that they did not wear a mask in crowded places, and 16% of undergraduate students chose not to implement physical distancing when in a crowd.³ In comparison to the general United States population, a study found that only 4.7% of randomly surveyed individuals stated they did not typically wear a mask.⁴ In another study, 23.5% of undergraduate students reported that they were not engaging in the recommended mask use practices on campus, and only 47.6% of students reported that they always carried out proper social distancing.^{5,6} Another study found that only 52% of female students and 44% of male students reported that they always wore masks or facial coverings in public.¹² Furthermore, only 70% of female students and 63% of male students reported that they always or often

observed proper social distancing of six feet or more in public.¹² For hand hygiene behaviors, a recent study on university students found that only about 42.0% of participants reported that they carried out proper handwashing/ sanitizing behaviors “Mostly” or “Always”⁶. Only 8.5% reported “Always”, and 44.0% of participants “Rarely/never” washed their hands before touching their face.⁶ Washing hands before touching the face followed by after touching animals, handling money/public equipment, and coughing/sneezing, were the activities least likely to be practiced.⁶ Finally, an additional study found that 31.4% of college students did not practice frequent handwashing in the recommended manner during the pandemic, which also showed that the proportion of young adults not following the handwashing guidelines was a matter of concern.¹³ A study that was conducted on a national sample of college students found that among students who experienced any COVID-19-related symptoms, only 46% stayed home while experiencing symptoms.¹⁴

While many studies discussed COVID-19 prevention in college students, there is an overall gap in the literature about Avoiding Social Gatherings/Events as a method of COVID-prevention, as shown in Table 2.1.

2.3 Overview of Psychological Profiles and Personality Scales

A recent study, conducted in 2017, explored adolescent cognitive development and risk-taking behavior. In this study, the authors outline that previous studies attributed risky behavior that is prevalent in adolescents to structural and functional imbalances between more fully developed limbic regions that subserve reward and emotion as opposed to those that enable cognitive control in this age group.¹⁵ This study challenged the previous interpretation of adolescent development by distinguishing risk-taking that peaks during adolescence (sensation seeking and impulsive action) from risk-taking that declines monotonically from childhood to adulthood (impulsive choice and other decisions under known risk).¹⁵ This article stated, “Thrill seeking is primarily motivated by exploration of the environment under

ambiguous risk contexts, while impulsive action, which is likely to be maladaptive, is more characteristic of a subset of youth with weak control over limbic motivation".¹⁵

On the other hand, risk taking that declines from childhood to adulthood occurs primarily under conditions of known risks and reflects increases in executive function as well as aversion to risk based on increases in gist-based reasoning.¹⁵ Thus, this study proposed the Life-span Wisdom Model, which highlights the importance of experience gained through exploration during adolescence, rather than simply attributing the risk-taking during adolescence simply to brain development.¹⁵

It is important to consider that personality profiles as discussed above might be directly linked to specific behaviors and attitudes towards behaviors in college students, like binge drinking, risky sexual activities, etc. In a study (2015) that observed impulsivity and sensation-seeking and the relationship with alcohol use, higher levels of sensation seeking were associated with significantly greater levels of weekly drinking.¹⁶ Higher scores for thrill-seeking tendencies predicted increased experiences of alcohol-related consequences.¹⁶ Additionally, those with higher scores of sensation-seeking personality types were less likely to engage in protective behaviors related to alcohol use, such as using a designated driver or avoiding drinking games that encourage binge drinking.¹⁷ **These data indicate that not only are these personality traits associated with risky behaviors, but they are also associated with decreased use of protective behaviors.**¹⁷

A study was conducted in 2000 that focused on personality traits of disinhibition, specifically excitement seeking and social deviance and their associations with alcohol use and risky sexual behavior in a sample of college students.¹⁸ This study found that both excitement seeking and social deviance proneness were significantly associated with increased alcohol use. Excitement-seeking was also significantly associated with risky sexual behaviors.¹⁸ While initial results indicated that alcohol use was significantly associated with risky sexual behavior, further analyses revealed that this relationship is due to their common association with dimensions of disinhibited personality, specifically excitement-seeking

and inability to tolerate boredom.¹⁸ The need for excitement (in those who are prone to excitement-seeking) seems to outweigh potential consequences of the subsequent behavior in this population.

An additional study found that those with a higher propensity for risk-taking (Disinhibition and Impulsivity scales) were more likely to have sexual experience and were more likely to misuse contraception/birth control methods or not use contraception/birth control methods at all.¹⁹ In another study that compared sensation seeking, aggression, and reckless behavior among adults, college students, and high school students, adults had significantly lower scores for sensation seeking ($M = 47.1$ (adults), 52.3 (high school), 53.9 college), all $p < .01$) and aggression ($M = 5.7$ (adults), 8.6 (high school), 8.0 (college), all $p < .01$) compared to the younger groups.⁷ Risky behavior was also higher for students (compared to adults) and for males (compared to females). Sensation seeking was positively correlated with reckless behavior ($r = .63$ (high school), $.59$ (college), $.52$ (adult), all $p < .01$).⁷

Another study used the Alternative Five Factor Model personality questionnaire to assess the propensity of binge drinking in college students.²⁰ The scores on Neuroticism-Anxiety and Impulsive Sensation-Seeking were higher in the binge-drinking group compared to the controls ($p < 0.001$ in both cases). The higher scores in the binge-drinking group in Neuroticism-Anxiety are due to higher scores in the women's group ($p = 0.014$), while those in Impulsive Sensation-Seeking are due to higher scores in the men's group ($p = 0.009$), both in the Impulsivity and in the Sensation-Seeking subscales ($p < 0.045$).²⁰ Other studies found associations between sensation-seeking personality types and increased hookah use, increased performance-enhancing substance use, marijuana use, and even texting while driving in college students.^{17,21,22}

2.4 The Potential Relationship Between Youth Perception of Risk and COVID-19 Seroconversion

Emerging adulthood is associated with increased autonomy and freedom, leading to new experiences such as substance use. The university environment can further facilitate this freedom and

can lead young people to explore new experiences.²³ This is especially true for students with higher propensity for impulsivity and excitement-seeking. High urgency scores have been associated with high levels of anxiety and low self-esteem, which has been associated with increased substance abuse²³. There is a relationship between substance use that is driven by peer pressure (conformity), and stress (coping), possibly related to the university environment (e.g., the burden to succeed in a high social environment).²³ The psychological profile associated with high impulsivity scores is characterized by low self-esteem, low academic attendance and poorer performance, high anxiety, etc., thus resulting in increased consumption motives (coping, enhancement, social).²³ There are many mechanisms or related personality traits that might predict other personality traits (i.e. impulsivity, excitement-seeking, and risk-taking).²³ These can be especially driven by college experiences and social experiences prior to college.

2.4.1 Youth and Young Adult Risk Perception and Decision Making Related to COVID-19

The American Psychological Association utilized an expert consultation process (initiated by outreach to 40 leading psychologist experts), who worked to create a report that addresses questions posed by the World Health Organization, pertaining to youth and young adults 15- to 30-years of age. It draws from research areas that include risk perception, decision-making, risk-taking, cognitive bias, social influences and norms, self-efficacy, environmental factors, and behavioral interventions related to health conditions.²⁴ Optimism bias in youth and young adults: adolescents take greater risks due to a felt sense of general invulnerability to danger, adolescents often exhibit greater “optimism bias” than adults. Research on students’ judgments of specific health-related risks highlights the idea of subjective invulnerability, further differentiated as danger invulnerability (e.g., “Special problems, like getting an illness or disease, are not likely to happen to me”) and psychological invulnerability (e.g., “The opinions of other people just don’t bother me”). Both were found to be more predictive of risk-taking behaviors.²⁴ It was found that in order to be effective, COVID-19 prevention programs should aim to

mobilize communities of young people and allow and encourage them to make meaningful contributions. In the design of such programs, it is critical to think of young people -- not in terms of the problems that they may cause through their behavior -- but rather in terms of their aspirations, need for experimentation and affiliation, sense of agency, and willingness, even eagerness, to be elements of positive social change.

2.5 Overview of Social Networks and Characteristics of Well-connected Students and Social Events/Gatherings

In a study that compared the social networks of drinkers and non-drinkers, non-drinkers had significantly lower indegree, which means they had fewer connections in their social networks. This suggests that they had lower network centrality (or popularity).²⁵ Social exclusion was reported more among non-drinkers, which suggests that network centrality or popularity was more highly associated with those who drink.²⁵ This might indicate that those with higher propensity for risk-taking and impulsivity are more likely to be heavier drinkers or substance users and might also be more socially connected (meaning they likely also attend more parties and gatherings, especially where drinking is occurring). Another study's results suggest that being popular and believing that heavy episodic drinking is normative among one's peers are associated with greater alcohol risk. Further, alcohol risks associated with nominating more peers may be enhanced or lessened depending on students' peer drinking norms.²⁶

One study looked at college students' social networks and how they influenced their likelihood to attend parties. This study focused on a large, public, midwestern university, which might be fairly comparable to IU. There were several important findings discussed in this paper.²⁷ Those who were most likely to attend larger gatherings were younger, white males with more spending money were more likely to attend larger parties, and participation in parties typically declined with each additional

year in school among both males and females.²⁷ Additionally, those who worked while in school, lived off campus, and had roommates were all more likely to attend larger parties. Furthermore, they also found that students involved in activities and organizations categorized as bonding were more likely to attend parties and that the effect was cumulative. Thus, the more bonding associations a student had, the more likely he or she was to attend an alcohol-present party.²⁷ While this study was conducted pre-pandemic and outside of the context of the societal changes that were introduced in the context of COVID-19, we might expect to see similar behaviors persist throughout the pandemic. Students who party and attend social events have high network centrality, thus making them important for transmission of respiratory diseases.

2.6 Significance of Current Research and Research Gaps

2.6.1 Current COVID-19 Research in College Students

In regards to COVID-19 research in college students, a majority of studies focused on social and mental well-being throughout the course of the pandemic, especially with a lack of social support and with most universities having put normal campus operations on hold. There are numerous studies about mental health and the psychological impact on college students during the pandemic.

In addition to studies related to mental health and COVID-19, the literature also contains several studies about general behavioral changes in students during the pandemic. These studies focused on the physical well-being of students during the pandemic. For example, there is research that outlines the lack of exercise in college students throughout the pandemic; students were often more sedentary and had less physical activity.

Additionally, there is a large portion of COVID-19 research in college students that focused specifically on certain populations within the university student body. Several studies focused solely on dental students, nursing students, pre-medical and medical students, student athletes, or other groups

of students. There are several studies related to risk-taking behaviors and higher prevalence of these types of behaviors in college students, specifically, smoking and vaping, drinking, excessive drinking, and having unsafe or risky sex. These studies focus on risky behaviors, rather than specifically on risk-taking or thrill-seeking personalities.^{16-18,21} Most articles about personality scales in college students are specifically related to sexual behavior and alcohol use.¹⁷⁻²⁰

2.6.2 Changes to Current COVID-19 Literature

Some longitudinal studies related to COVID-19 seroconversion in university students have been published more recently. One study, currently a preprint article, focused on SARS-CoV-2 seroprevalence in a university community.²⁸ This study observed the change in seroprevalence in both community members and returning students from the start of the Fall 2020 term to the end of the Fall 2020 term. While this study might not be generalizable to other populations, it found a high seroprevalence in the university population, but relatively low and stable rates of seroprevalence in this community, thus suggesting limited transmission between these differing groups.²⁸ It was also indicated that students had significantly higher rates of masking and gathering compared to community members. “[...] thus a next step is to identify factors that may explain this difference (e.g., differences in leisure time activity norms and/or perceptions of age-related risk; business closures; university policies and sanctions),” state the authors.²⁸ This study indicates next steps in researching the university population, and our study aims can work to begin to fill this gap in the literature.

2.6.3 Gaps in the Literature

There is an overall gap in the literature about Attending Social Gatherings/Events as a method of COVID-prevention. In table 2.1, we documented study articles that examined the uptake of COVID-19 prevention methods in college students. In this table, we documented study articles related to handwashing, avoiding touching eyes, nose, and mouth, staying home from work or school, mask-wearing, and social and physical distancing. We were unable to locate any articles that specifically

discussed avoiding social gatherings, social events, or parties. The majority of studies are about COVID-19 prevention in college students were focused on mask-wearing.

There is an overall gap in the literature about personality profiles in college students, especially as they might relate to uptake of COVID-19 prevention methods. As previously mentioned, there are few articles about personality profiles/scales in college students, and we were unable to locate any articles related to personality scales and incident COVID-19 cases in college students. Furthermore, personality traits, like risk-taking and thrill-seeking are often more prevalent in students who are more popular, and thus, more likely to attend social gatherings.

2.6.4 Benefits of this Research and Contributions to the Body of Research

Our research aims to address these gaps in the literature. To our knowledge, there have not been any previously published articles that explore the relationships between personality profiles of college students' and their likelihood to attend or avoid social gatherings. Additionally, there have not been any previously published articles that explore these personality scales and COVID-19 seroconversion in university students with longitudinal data. The knowledge gained from this study will better inform university faculty about relevant risk factors in certain subsets of the university student population for incident SARS-CoV-2. Additionally, this study could provide insight into the psychological aspects and personality traits of college students and how these might factor into the use of COVID-19 prevention strategies. This would allow for more-informed decision making on interventions that are more likely to be utilized to reduce rates of SARS-CoV-2 in college students. This would also allow for more targeted education about the importance of prevention methods to mitigate the spread of SARS-CoV-2. The knowledge gained from this research could extend beyond Indiana University and would likely be applicable to other large, public universities. Additionally, this research would provide knowledge and insight about prevention strategies and mitigation efforts for all respiratory illnesses that typically spread easily and rapidly among college students. The scope of the conclusions of this study

could extend well beyond COVID-19 and could be generalizable to similarly virulent infectious diseases, especially respiratory diseases.

2.6.5 Purpose

The purpose of this proposal is to investigate how personality profiles of college students are related to their uptake of COVID-19 prevention strategies, and to also investigate how these personality profiles of college students are related to SARS-CoV-2 incidence.

2.7 Tables and Figures

Table 2.1 Study articles that examine the uptake of COVID-19 preventative behaviors in college students

	COVID-19 Preventative Behaviors					
	Handwashing	Avoiding touching eyes, nose, mouth	Avoiding social events/ gatherings/ parties	Staying home from school/ work	Mask-wearing	Social/ Physical Distancing
Study Articles that address COVID-19 preventative behaviors among college students	Barrett, et al. ⁶ Sharma, et al. ¹³	Barrett, et al. ⁶		Cohen, et al. ¹⁴	Rader, et al. ⁴ Saefi, et al. ³ Cassimatis, et al. ¹²	Duong, et al. ⁵ Cassimatis, et al. ¹²

CHAPTER 3: METHODS

3.1 Study Design and Population

Both aims of this research included analyses of secondary data obtained from a cohort of 1076 randomly selected undergraduate students enrolled at Indiana University in 2020. IUB has a total undergraduate population of ~32,986. Many COVID-19 restrictions were in place during the data collection phase, including mask wearing, physical distancing, hybrid and remote classes, class spacing, contact tracing, mitigation testing, and quarantine and self-isolation mandates. The Office of the Vice Provost for Undergraduate Education generated the random list of undergraduates to be representative of the undergraduate student population. To be eligible, participants had to be 1) enrolled as an undergraduate student, 2) aged 18 years or older, and 3) residing in the same county where the university is located. Individuals not meeting the eligibility criteria were excluded from participating in the study.

Between September 8 and September 20, 2020, 7500 total invitations to participate in the study were sent by email to a randomly selected sample of IU undergraduate students. Of the 7500 invitations sent, 1192 (15.9%) completed the baseline survey, and 1076 (14.3%) received an antibody test. The baseline antibody testing was conducted in a central campus location outdoors on September 14, 16, 21, 23, and 30. Endline antibody testing was conducted in November 2020.

Study participants were asked to take a baseline online survey (less than 30 minutes), receive two free SARS-CoV-2 antibody tests (at baseline and at endline), and take four additional short online follow-up surveys every 2 weeks (less than 5 minutes each). In the baseline survey, participants scheduled their first laboratory visit involving a quick fingerstick blood test. All study participants received the results of their antibody tests. A full list of the baseline survey questions can be found in Appendix I. All data comes from the online self-reported surveys collected through REDCap (Research

Electronic Data Capture). Preliminary Results showed that of the 1076 who received an antibody test 47 (4.4%) were positive at baseline. A positive antibody test result indicates probable prior infection.

3.2 Assessment of Exposure, Outcome, and Covariates for Chapter 4 (Aim 1)

3.2.1 Assessment of Avoiding Social Gatherings as a COVID-19 Preventative Measure (Outcome)

Students were asked about their COVID-19 preventative behaviors in the survey at baseline, as well as in four additional follow-up surveys. The surveys ask students to recall how often they have avoided attending a social event they wanted to attend (in the last seven days). Selection options for this question were never, rarely, sometimes, very often, and always. 30.2% (323) of students responded that they always avoided a social event they wanted to attend. 26.8% (286) responded “very often”, 25.0% (267) responded “sometimes”, 10.0% (107) responded “rarely”, and 8.0% (86) responded “never” (at baseline). There was a wide distribution of student responses to this question.

3.2.2 Assessment of Personality Profile Scales (Exposure)

Three personality profiles were analyzed in this survey: Impulsivity, Excitement Seeking, and Risk Taking. These personality scales were used in multiple chapters, and therefore are described in detail below as well as within the methods section for each chapter.

3.2.2.1 Impulsivity

Impulsivity was measured with the Negative Urgency and Positive Urgency subscales of the Urgency Premeditation Planning Sensation Seeking Impulsive Behavior Scale (UPPS-P). The Urgency Premeditation Planning Sensation Seeking Impulsive Behavior scale was originally developed by Whiteside and Lynam (2001).^{29,30} Whiteside and Lynam (2001) created the scale by conducting a factor analysis of existing self-report scales measuring multiple different aspects of impulsive personality.^{29,30} This analysis resulted in four traits included in this original version of the scale: negative urgency, lack of

premeditation, lack of perseverance, and sensation seeking. *Negative urgency* is the tendency to act rashly under extreme negative emotions. *Lack of premeditation* is the tendency to act without thinking. *Lack of perseverance* is the inability to remain focused on a task. Finally, *sensation seeking* is the tendency to seek out novel and thrilling experiences.^{29,30}

In 2007, Cyders and colleagues noted that although impulsive action under extreme negative emotions was represented in the model, impulsive action under extreme positive emotions also exist and were not well conceptualized or measured in the literature.^{29,31,32} Therefore, the authors created a scale of positive urgency, which was later incorporated into the larger scale. *Positive urgency* is the tendency to act rashly under extreme positive emotions.^{29,31,32}

For the assessment of impulsivity in this survey, the items from both the negative urgency (12 items) and positive urgency (14 items) subscales were utilized. Students were asked to indicate their level of agreement with each of the statements related to negative and positive urgency, all 26 statements had a 4-point scale, ranging from 1 = “agree strongly” up to 4 = “disagree strongly”. The total scores were calculated by summing the numbers from the responses for each statement. Higher scores are associated with increased impulsivity.

3.2.2.2 Excitement Seeking

Excitement Seeking was measured with the 7-item Disinhibition subscale and the 10-item Boredom Susceptibility sub-scale of the Sensation Seeking Scale. Zuckerman (1964) created the Sensation Seeking scale (SSS) with the purpose of better understanding personality traits such as neuroticism, antisocial behavior, and psychopathy.^{33,34} There are 4 different aspects (subscales) of the SSS, which are Thrill and Adventure Seeking (TAS), Disinhibition (DIS), Experience Seeking (ES), and Boredom Susceptibility (BS). Zuckerman has proposed that these 'traits' come from a psycho-biological interaction.³³ The Disinhibition subscale (SSS_DIS) is a 7-item subscale, and the boredom susceptibility

subscale (SSS_BS) is a 10-item subscale, both of which come from the 40 item Sensation Seeking Scale (SSS).³³⁻³⁵

Students were asked to indicate their level of agreement with each of the statements related to excitement seeking tendencies. All 17 statements had a 4-point scale, ranging from 1 = “disagree strongly” up to 4 = “agree strongly”. The total scores were calculated by summing the numbers from the responses for each statement. Higher scores are associated with increased Excitement Seeking tendencies.

3.2.2.3 Risk Taking

Risk taking was Measured with the 10-item Thrill and Adventure Seeking subscale from the Sensation Seeking Scale. The Thrill and Adventure Seeking subscale (SSS_TAS) is a 10-item subscale that also comes from the 40-item Sensation Seeking Scale (SSS).³³⁻³⁵

Students were asked to indicate their level of agreement with each of the statements related to thrill and adventure seeking. All 10 statements had a 4-point scale, ranging from 1 = “disagree strongly” up to 4 = “agree strongly”. The total scores were calculated by summing the numbers from the responses for each statement. Higher scores are associated with increased risk-taking tendencies.

3.2.3 Assessment of Covariates

Potential covariates for these analyses were various demographic characteristics, alcohol and tobacco use, behavioral characteristics, and other interviewee information. These potential covariates include sex, age, race, occupation, place of residence, year in school, major school, relationship status, Greek membership, alcohol and tobacco use, general health, and test results group (Table A2.1). This study included a randomized control trial study arm, in which one group of students received their test results immediately, while the second group experienced a delay in receiving their test results (two weeks later). This was conducted to determine if student’s behavior was altered by being forced to wait to receive their test results (compared to those who received their results immediately). All additional

covariates came from the participant's survey responses and are self-reported. Confounding variables were identified via *a priori* decision-making by using directed acyclic graphs (DAGs) to assess variable sets for adjustment of suspected confounders (Figures 3.1 and 3.2). The analysis includes both an unadjusted model and an adjusted model. A description of all possible covariates, as well as how they were measured, and categorizations can be found in Appendix II (Table A2.1).

3.3 Assessment of Exposure, Outcome, and Covariates for Chapter 5 (Aim 2)

3.3.1 Assessment of Cases of Incident SARS-CoV-2 (Outcome)

We tested participants for SARS-CoV-2 antibodies at endline. Laboratory visits involved a quick fingerstick blood test to test for SARS-CoV-2 antibodies. Students were considered to have seroconverted over the study course if they had tested negative for SARS-CoV-2 antibodies at baseline and tested positive for SARS-CoV-2 antibodies at endline, which is indicative of incident COVID-19 cases over the course of the study period.

SARS-CoV-2 IgM/IgG rapid assay kits (Colloidal Gold method) were used to test participants for SARS-CoV-2 IgM and IgG antibodies. Compared to an CLIA Lab-based validation analysis, our BGI rapid kits show a 64% of sensitivity and a 100% specificity. The antibody test result was interpreted as positive if one or both of IgG and IgM antibody types were detected in the blood sample.³⁶

Of the 808 participants who tested negative at baseline and completed the endline antibody test, 42 (5%) seroconverted.

3.3.2 Assessment of Personality Profile Scales (Exposure)

Three personality profiles were analyzed in this survey: Impulsivity, Excitement Seeking, and Risk Taking. These personality scales were used in multiple chapters, and therefore are described in detail below as well as within the methods section for each chapter.

3.3.2.1 Impulsivity

Impulsivity was measured with the Negative Urgency and Positive Urgency subscales of the Urgency Premeditation Planning Sensation Seeking Impulsive Behavior Scale (UPPS-P). The Urgency Premeditation Planning Sensation Seeking Impulsive Behavior scale was originally developed by Whiteside and Lynam (2001).^{29,30} Whiteside and Lynam (2001) created the scale by conducting a factor analysis of existing self-report scales measuring multiple different aspects of impulsive personality.^{29,30} This analysis resulted in four traits included in this original version of the scale: negative urgency, lack of premeditation, lack of perseverance, and sensation seeking. *Negative urgency* is the tendency to act rashly under extreme negative emotions. *Lack of premeditation* is the tendency to act without thinking. *Lack of perseverance* is the inability to remain focused on a task. Finally, *sensation seeking* is the tendency to seek out novel and thrilling experiences.^{29,30}

In 2007, Cyders and colleagues noted that although impulsive action under extreme negative emotions was represented in the model, impulsive action under extreme positive emotions also exist and were not well conceptualized or measured in the literature.^{29,31,32} Therefore, the authors created a scale of positive urgency, which was later incorporated into the larger scale. *Positive urgency* is the tendency to act rashly under extreme positive emotions.^{29,31,32}

For the assessment of impulsivity in this survey, the items from both the negative urgency (12 items) and positive urgency (14 items) subscales were utilized. Students were asked to indicate their level of agreement with each of the statements related to negative and positive urgency, all 26 statements had a 4-point scale, ranging from 1 = “agree strongly” up to 4 = “disagree strongly”. Higher scores are associated with increased impulsivity.

3.3.2.2 Excitement Seeking

Excitement Seeking was measured with the 7-item Disinhibition subscale and the 10-item Boredom Susceptibility sub-scale of the Sensation Seeking Scale. Zuckerman (1964) created the

Sensation Seeking scale (SSS) with the purpose of better understanding personality traits such as neuroticism, antisocial behavior, and psychopathy.^{33,34} There are 4 different aspects (subscales) of the SSS, which are Thrill and Adventure Seeking (TAS), Disinhibition (DIS), Experience Seeking (ES), and Boredom Susceptibility (BS). Zuckerman has proposed that these 'traits' come from a psycho-biological interaction.³³ The Disinhibition subscale (SSS_DIS) is a 7-item subscale, and the boredom susceptibility subscale (SSS_BS) is a 10-item subscale, both of which come from the 40 item Sensation Seeking Scale (SSS).³³⁻³⁵

Students were asked to indicate their level of agreement with each of the statements related to excitement seeking tendencies. All 17 statements had a 4-point scale, ranging from 1 = “disagree strongly” up to 4 = “agree strongly”. Higher scores are associated with increased Excitement Seeking tendencies.

3.3.2.3 Risk Taking

Risk taking was Measured with the 10-item Thrill and Adventure Seeking subscale from the Sensation Seeking Scale. The Thrill and Adventure Seeking subscale (SSS_TAS) is a 10-item subscale that also comes from the 40-item Sensation Seeking Scale (SSS).³³⁻³⁵

Students were asked to indicate their level of agreement with each of the statements related to thrill and adventure seeking. All 10 statements had a 4-point scale, ranging from 1 = “disagree strongly” up to 4 = “agree strongly”. Higher scores are associated with increased risk-taking tendencies.

3.3.3 Assessment of Covariates

Potential covariates for these analyses will be various demographic characteristics, alcohol and tobacco use, behavioral characteristics, and other interviewee information. These potential covariates included include sex, age, race, occupation, place of residence, year in school, major in school, relationship status, Greek membership, alcohol and tobacco use, and general health (Table A2.1). All covariates came from the participant’s survey responses and are self-reported. Confounding variables

were identified via *a priori* decision-making by using directed acyclic graphs (DAGs) to assess variable sets for adjustment of suspected confounders (Figures 3.1 and 3.2). The analysis includes both an unadjusted model and an adjusted model. A description of all possible covariates, as well as how they were measured, and categorizations can be found in Appendix II.

3.4 Statistical Analysis

There were many statistical methods that were used in multiple chapters, and therefore are described in detail below, as well as within the methods section for each chapter.

3.4.1 Analysis for Chapter 4 (Aim 1)

Aim 1: Estimate the association between individual personality profile scales related to impulsivity, risk-taking, and excitement seeking and the uptake of COVID-19 preventative behavior, specifically avoiding social events.

Hypothesis: Individuals who have personalities that motivate them to act more impulsively, that make them more likely to take risks, and that drive them to seek excitement will be more likely to attend large social gatherings over the course of the study period.

Descriptive statistics were obtained via frequency calculations. Additionally, counts and percentages for each independent variable of interest (personality profile scales) and potential covariates were obtained via cross-tabulation. The counts and percentages for each level of the outcome (never, rarely, sometimes, very often, always) are presented. For the bivariate analysis, depending on variable type and distribution, relationships between pairs of variables in this data set were assessed using T-tests, Mann-Whitney U tests, Wilcoxon rank-sum tests, or chi-square tests in SAS 9.4 software (SAS Institute, Cary, NC).

Multiple imputation techniques were used to address the missing data in this cohort. Multiple imputation uses the distribution of the observed data to estimate missing values. In this analysis, we used fully conditional specification (FCS) multiple imputation, which imputes missing data on a variable-by-variable basis for the variables of interest for this aim.³⁷ We used ten imputations for this analysis, which were later pooled. We used DAGs to examine the relationships between the covariates and the exposure variables and the outcome variable. DAGs are tools that are used to visualize causal pathways.³⁸ In their simplest form, DAGs are used to determine if one covariate is a confounder of the exposure/outcome causal association.³⁸

We modeled the relationship between each individual personality profile scale (taken at baseline) and the four-level categorical variable “avoiding social gatherings” as a COVID-19 preventative measure (taken at baseline and each follow-up) (Appendix II) using GEE framework for Poisson regression to account for within-subject repeated measures. Because the outcome of interest, avoiding social gatherings, was a 4-level categorical variable, ordinal regression could have been used in this context. However, we used Poisson regression in order to obtain relative risks, rather than the odds ratios that would’ve resulted from ordinal regression models. Interpretation of risk is relatively more intuitive compared to odds when measuring an association between the exposure and outcome, thus relative risks were the preferred effect estimates for our results. We determined the correlation among each of the personality scales, and we also modeled the relationship between all three of the personality profile scales together in the same model and “avoiding social gatherings” using principal component analysis to account for multicollinearity among the three personality profile scales in the model by reducing the dimensionality of the data into principal components.⁴⁴ PCA factor analysis determined the number of factors (principal components) to be retained in a final principal component regression (PCR) model.⁴⁴⁻⁴⁷ These retained factors account for a majority of the variance in the reserved variables to reduce redundancy in the variables.^{44,45} Using the variable weights for each of the three

personality scales obtained in the PCA, both an unadjusted PCR model and a PCR model that adjusted for sex and year in school were built using the three personality scales and their perspective weights. Relative Risks and 95% confidence intervals were obtained. Confounding variables were identified via *a priori* decision-making by using DAGs to assess variable sets for confounders to be retained in the final model (Figure 3.1).

3.4.1 Analysis for Chapter 5 (Aim 2)

Aim 2: Estimate the association between individual personality profile scales related to impulsivity, risk-taking, and excitement-seeking and incident SARS-CoV-2 infection.

Hypothesis: We hypothesize that individuals who have personalities that motivate them to act more impulsively, that make them more likely to take risks, and that drive them to seek excitement will be more likely to have developed SARS-CoV-2 antibodies at study completion.

Descriptive statistics were obtained via frequency calculations. Additionally, counts and percentages for each independent variable of interest (personality profile scales) and potential covariates were obtained via cross-tabulation. For the outcome (SARS-CoV-2 seroconversion): of the 808 participants who tested negative at baseline and completed the endline antibody test, 42 (5%) seroconverted. For the bivariate analysis, depending on variable type and distribution, relationships between pairs of variables in this data set were assessed using T-tests, Mann-Whitney U tests, Wilcoxon rank-sum tests, or chi-square tests in SAS 9.4 software (SAS Institute, Cary, NC).

Multiple imputation techniques were used to address the missing data in this cohort. Multiple imputation uses the distribution of the observed data to estimate missing values. In this analysis, we used fully conditional specification (FCS) multiple imputation, which imputes missing data on a variable-by-variable basis for the variables of interest for this aim.³⁷ We used ten imputations for this analysis, which were later pooled. DAGs are tools that are used to visualize causal pathways.³⁸ In their simplest

form, DAGs are used to determine if one covariate is a confounder of the exposure/outcome causal association.³⁸ Confounding variables were identified via *a priori* decision-making by using DAGs to assess variable sets for confounders to be retained in the final model (Figure 3.2).

We modeled the relationship between each individual personality profile scale (taken at baseline) and SARS-CoV-2 seroconversion (determined by a negative antibody test at baseline and a positive antibody test at endline) (Appendix II) using log-binomial regression. We also modeled the relationship between all three of the personality profile scales together in the same model and SARS-CoV-2 seroconversion using principal component analysis to account for multicollinearity among the three personality profile scales in the model by reducing the dimensionality of the data into principal components.⁴⁴ These retained factors account for a majority of the variance in the reserved variables to reduce redundancy in the variables.^{44,45} Using the variable weights for each of the three personality scales obtained in the PCA, both an unadjusted PCR model and a PCR model that adjusted for sex and year in school were built using the three personality scales and their perspective weights. Relative Risks and 95% confidence intervals were obtained.

3.5 Tables and Figures

Figure 3.1 DAG of the Association between Personality Scales and Avoiding Social Events

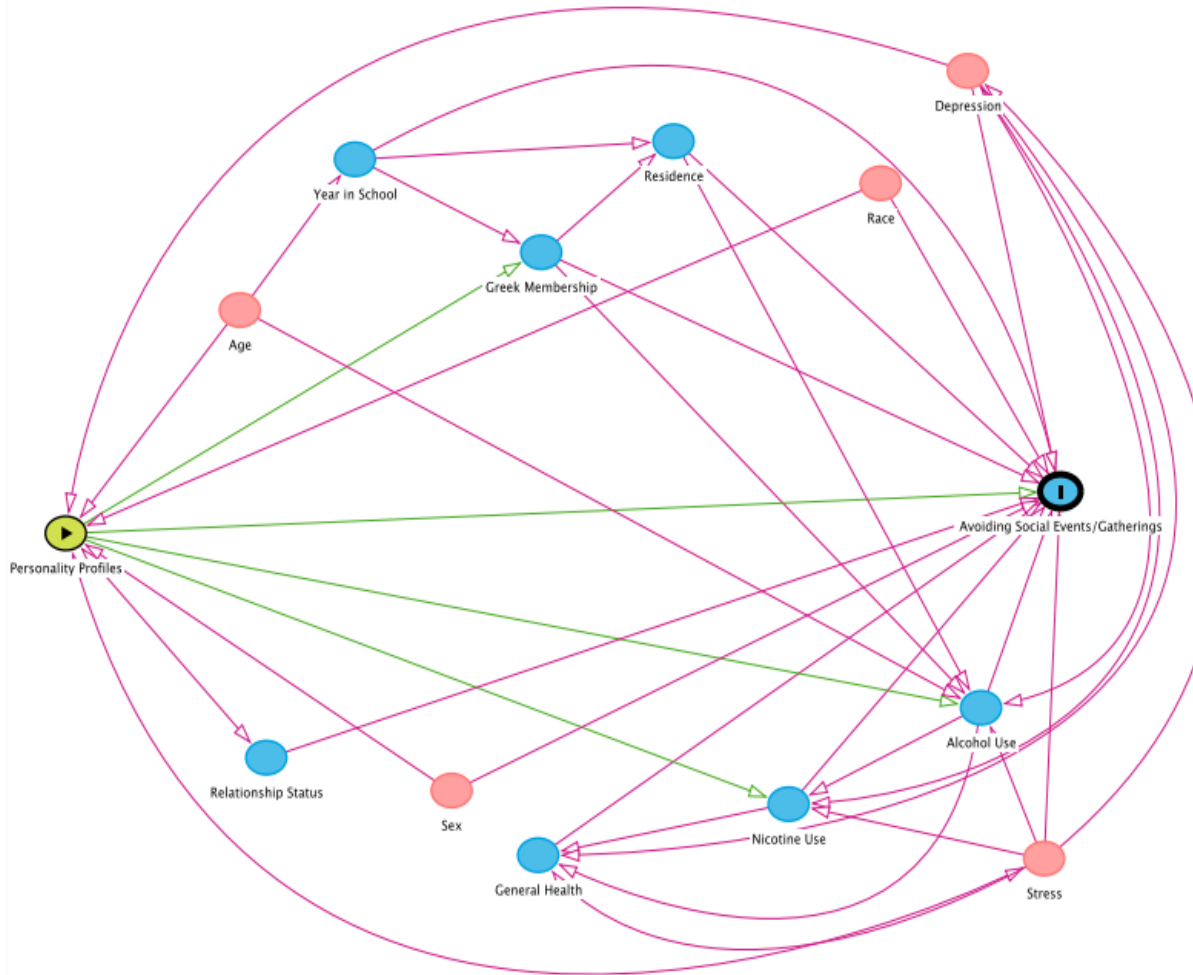
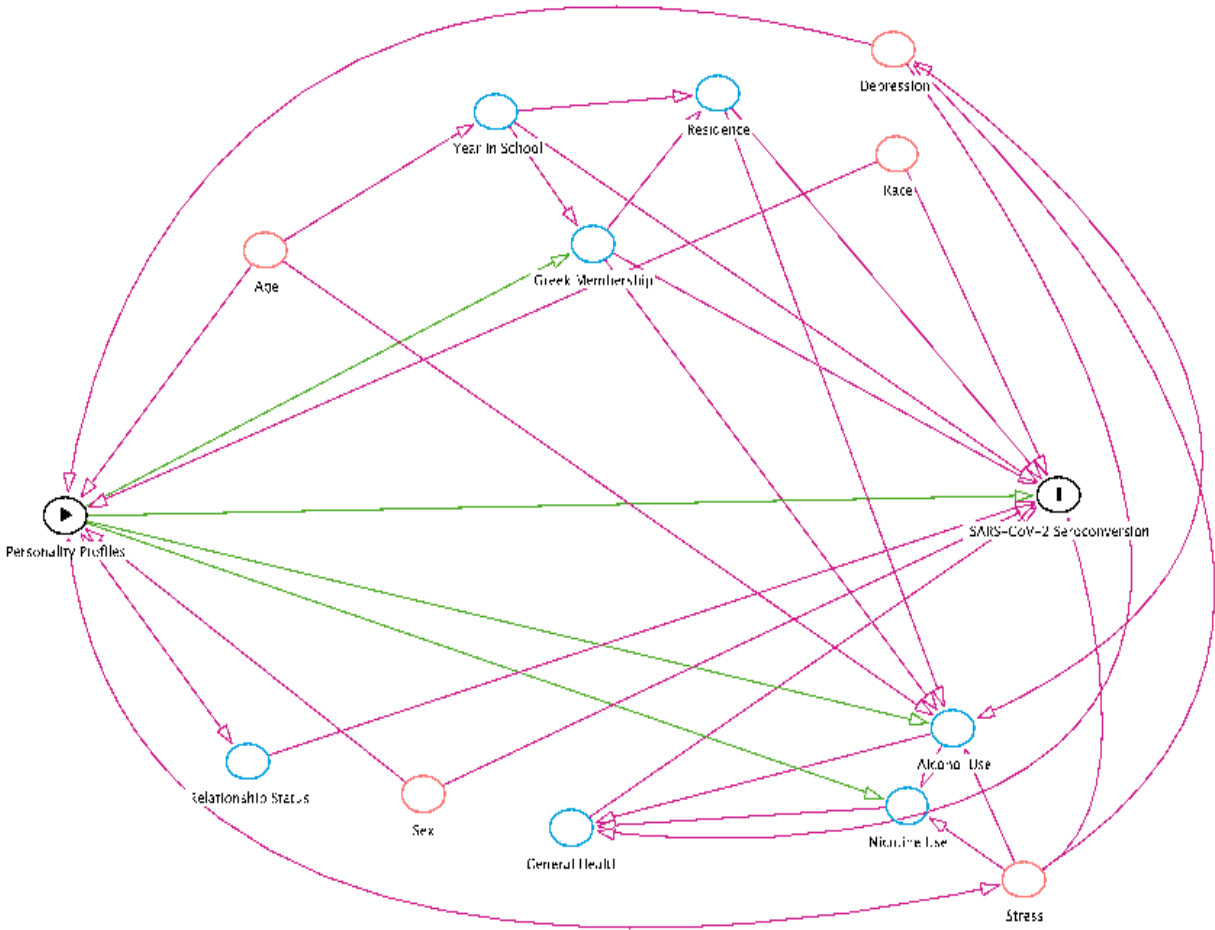


Figure 3.2 DAG of the Association between Personality Scales and SARS-CoV-2 Seroconversion



CHAPTER 4: THE ASSOCIATION BETWEEN PERSONALITY TRAITS AND COVID-19 PREVENTATIVE BEHAVIOR AMONG UNDERGRADUATE STUDENTS DURING THE COVID-19 PANDEMIC

4.1 Background and Rationale

During the acute phase of the COVID-19 pandemic, colleges and universities adopted a range of COVID-19 prevention measures to protect their students, faculty, and staff, and to minimize community transmission.¹⁻⁴ Many universities limited class sizes for in-person teaching, if in person-learning was conducted at all.^{3,4} Additional measures were also put into place, including required quarantine measures, especially among students living in dormitories, required masking on campus and in classrooms, limited gathering sizes and strict restrictions social events and gatherings, and required physical distancing.^{1-4,39-42}

The risk factors related to SARS-CoV-2 incidence in college students living on campus are likely to differ from other subsets of the population. While university operations were atypical during the course of the pandemic, students living on campus or in proximity to campus still experienced close living quarters, the potential for large social gatherings, and some in-person coursework. that put them at increased risk for SARS-CoV-2 infections.⁴³ Although university students are at high risk for SARS-CoV-2, several studies suggest that college students might be less likely to engage in proper COVID-19 prevention practices compared to the rest of the population. Studies found that undergraduate students were less likely to wear a mask in crowded spaces and when recommended compared to the general United States population.³⁻⁵ Furthermore, a higher percentage of undergraduate students did not engage in proper physical and social distancing compared to the rest of the population.^{3,6} Studies also found that university students did not always carry out proper handwashing and were less likely to stay home while experiencing symptoms of SARS-CoV-2.^{6,7} Research shows that SARS-CoV-2 is most easily and widely spread in large groups, thus distancing is even more important in the university setting,

where social events are a foundation of the student experience.^{3,6,7} Previous studies that addressed social distancing among college students focused on this risk factor in the context of student living quarters and dormitories, classroom settings, dining places, and other public spaces.^{3,6,7} We found no studies that focused more broadly on social events and gatherings, such as parties, where distancing is likely not possible or effective. Therefore, it is important to consider avoiding social events as an important measure of COVID-19 prevention, especially in students, whose participation in parties and other gatherings might be more probable.

Personality profiles, including impulsivity (urgency), risk-taking, and excitement-seeking, of college students might contribute to apprehension for avoiding social events and incident SARS-CoV-2 infection. Impulsivity, or urgency, is the tendency to act rashly under extreme emotion; risk-taking is the tendency to participate in life experiences that might be considered risky, such as desire to climb mountains or sky-dive; and excitement-seeking is the tendency to act in a way that is avoidant of boredom and focus on experiences.

In a study that compared personality scales of college students and adults, adults had significantly lower affinity for sensation-seeking personality traits compared to college students.⁸ Adolescent behavior is often more driven by impulsivity and sensation-seeking than in adults, whose behaviors are shaped by prior experiences from their adolescence and early adulthood.⁸ Because of this, personality scales have been previously studied in the context of many other behaviors among college students. In a study (2015) that observed impulsivity and sensation-seeking and the relationship with alcohol use, higher levels of sensation seeking were associated with significantly greater levels of weekly drinking.⁹ Additionally, students with higher scores of sensation-seeking personality types were less likely to engage in protective behaviors related to alcohol use, such as using a designated driver or avoiding drinking games that encourage binge drinking.¹⁰ Another study that focused on excitement seeking and social deviance proneness found that these personalities were significantly associated with

increased alcohol use and drug use.¹¹ This study found that excitement-seeking was also significantly associated with risky sexual behaviors.¹¹ This indicates that not only are these personality traits associated with risky behaviors, but they are also associated with decreased use of protective behaviors.^{10,11}

There is an overall lack of research related to COVID-19 and personality profiles of college students. This is a significant gap in the research, and personality profiles of university students need to be examined in the context of COVID-19 prevention. By identifying potential relationships between personality profiles of students and their propensity for certain behaviors related to disease prevention, more targeted prevention methods and education could be aimed at college students, who typically have higher tendency for these personality traits compared to the rest of the population.

4.1.1 Objectives

The primary objective of the current study was to evaluate the association between three personality scale measures and student participation in COVID-19 preventative behaviors, specifically avoiding social events and gatherings. Additionally, the secondary objective of the current study was to evaluate the association between three personality scale measures and each of the other five COVID-19 preventative behaviors collected in this study: hand washing, staying home from work/school, masking in public, physical distancing, and avoiding high-risk individuals. We hypothesized that individuals who have personalities that motivate them to act more impulsively, that make them more likely to take risks, and that drive them to seek excitement will be more likely to attend large social gatherings over the course of the study period. We hypothesize that these same individuals will also have lower uptake of related protective behaviors.

4.2 Methods

4.2.1 Study Design

We used data from a longitudinal cohort study collected from a random sample of undergraduate students at Indiana University was used to assess the association between personality profiles of students and uptake of COVID-19 preventative behavior. The study was conducted from September 2020 to November 2020.

4.2.2 Study Setting, Participants, and Procedures

This study was conducted on the Indiana University Bloomington (IUB) campus. In 2020, IUB had a total undergraduate population of about 32,986 students. Many COVID-19 restrictions were in place during the data collection phase, including mask wearing, recommended physical distancing, hybrid and remote classes, class spacing, contact tracing, mitigation testing, and quarantine and self-isolation mandates. A random sample of IUB undergraduate students ($n = 7,499$) were selected for participation in this study. Inclusion criteria were: 1) age 18 years or older, 2) IUB undergraduate students in fall 2020, and 3) residing in Monroe County, Indiana, at baseline.

Study invitation emails with information about the study and links to an eligibility screening online survey were sent to the 7,499 sampled students. Of these randomly selected students, 3,430 students did not meet one or more of the inclusion criteria and 2,672 did not respond. Of the total 1,397 students who consented to participate in the study, 130 did not complete any of the study procedures and 191 did not complete their baseline SARS-CoV-2 antibody testing, yielding 1,076 students with baseline study procedures. Eligible students were directed to an online eConsent form with more information about the study. Students who consented to participate could schedule a baseline antibody testing appointment and complete the online baseline survey. The baseline survey included questions about participant demographics, SARS-CoV-2 testing history, and personality traits, and participation in COVID-19 protective behaviors.

In-person SARS-CoV-2 baseline antibody tests were conducted between September 14 and 30 on the IUB campus. Four follow-up online surveys were administered every two weeks after the baseline antibody test visit. In each follow-up survey, participants self-reported their participation in COVID-19 protective behaviors. Participants were also tested for SARS-CoV-2 antibodies at endline (November 2020).

4.2.3 Variables

Primary exposure: The main exposures were three personality profile scales: Impulsivity, Excitement Seeking, and Risk Taking, measured at baseline. Impulsivity, or urgency, is the tendency to act rashly under extreme emotion; risk-taking is the tendency to participate in life experiences that might be considered risky, such as desire to climb mountains or sky-dive; and excitement-seeking is the tendency to act in a way that is avoidant of boredom and focus on experiences. The maximum possible scores for impulsivity (urgency), excitement-seeking, and risk-taking were 104, 68, and 40, respectively.

4.2.3.1 Impulsivity

Impulsivity was measured with the Negative Urgency and Positive Urgency subscales of the Urgency Premeditation Planning Sensation Seeking Impulsive Behavior Scale (UPPS-P). The Urgency Premeditation Planning Sensation Seeking Impulsive Behavior scale was originally developed by Whiteside and Lynam (2001).^{29,30} Whiteside and Lynam (2001) created the scale by conducting a factor analysis of existing self-report scales measuring multiple different aspects of impulsive personality.^{29,30} This analysis resulted in four traits included in this original version of the scale: *negative urgency* is the tendency to act rashly under extreme negative emotions; *lack of premeditation* is the tendency to act without thinking; *lack of perseverance* is the inability to remain focused on a task; and *sensation seeking* is the tendency to seek out novel and thrilling experiences.^{29,30} In 2007, Cyders and colleagues noted that although impulsive action

under extreme negative emotions was represented in the model, impulsive action under extreme positive emotions also exist and were not well conceptualized or measured in the literature.^{29,31,32} Therefore, the authors created a scale of *positive urgency*, which was later incorporated into the larger scale. Positive urgency is defined as the tendency to act rashly under extreme positive emotions.

For the assessment of impulsivity in this survey, the items from both the negative urgency (12 items) and positive urgency (14 items) subscales were utilized. Students were asked to indicate their level of agreement with each of the statements related to negative and positive urgency. All 26 statements had a 4-point scale, ranging from 1 = “agree strongly” up to 4 = “disagree strongly”. Higher scores are associated with increased impulsivity.

4.2.3.2 Excitement Seeking

Excitement seeking was measured with the 7-item Disinhibition subscale and the 10-item Boredom Susceptibility sub-scale of the Sensation Seeking Scale. Zuckerman (1964) created the Sensation Seeking scale (SSS) with the purpose of better understanding personality traits such as neuroticism, antisocial behavior, and psychopathy.^{33,34} There are 4 different aspects (subscales) of the SSS, which are Thrill and Adventure Seeking (TAS); Disinhibition (DIS); Experience Seeking (ES); and Boredom Susceptibility (BS).

The Disinhibition subscale (SSS_DIS) is a 7-item subscale, and the boredom susceptibility subscale (SSS_BS) is a 10-item subscale, were combined in this study to measure excitement-seeking, both of which come from the 40 item Sensation Seeking Scale (SSS).³³⁻³⁵ Students were asked to indicate their level of agreement with each of the statements related to excitement seeking tendencies. All 17 statements had a 4-point scale, ranging from 1 = “disagree strongly” up to 4 = “agree strongly”, though a few questions are reverse coded based on the construction of the statement. Higher scores are associated with increased Excitement Seeking tendencies.

4.2.3.3 Risk Taking

Risk Taking was measured with the 10-item Thrill and Adventure Seeking subscale from the Sensation Seeking Scale. The Thrill and Adventure Seeking subscale (SSS_TAS) is a 10-item subscale that also comes from the 40-item Sensation Seeking Scale (SSS) ³³⁻³⁵. Students were asked to indicate their level of agreement with each of the statements related to risk-taking. These items are related to life experiences that might be considered risky, such as desire to climb mountains or sky-dive, etc. All 10 statements had a 4-point scale, ranging from 1 = “disagree strongly” up to 4 = “agree strongly”. Higher scores are associated with increased risk-taking tendencies.

Primary Outcome: The main outcome in the current study was the avoidance of social gatherings and events as a COVID-19 preventative measure. Students were asked about their COVID-19 preventative behaviors in the survey at baseline, as well as in four additional follow-up surveys. The surveys ask students to recall how often they have avoided attending a social event they wanted to attend (in the last seven days). Selection options for this question included: never, rarely, sometimes, very often, and always. 30.2% (323) of students responded that they always avoided a social event they wanted to attend. This study combined the “always” and “very often” categories and the analyses were conducted on this four-level categorical outcome variable. This was done for consistency because the counts for these categories in several of the secondary outcome variables were low. Specifically, less than five participants marked “always” for handwashing, physical distancing, and avoiding contact with high-risk individuals (at baseline and follow-up). We collapsed these two categories, “often” and “always”, into one for all outcome variables (primary and secondary) in order to make up for the small counts in several of the outcome variables.

Secondary outcome: The secondary aim of this study was to evaluate the association between three personality scale measures and each of the other five COVID-19 prevention behaviors collected in

this study: hand washing, staying home from work/school, masking in public, physical distancing, and avoiding high-risk individuals. Students were asked about their COVID-19 prevention behaviors in the survey at baseline, as well as in four additional follow-up surveys. The surveys asked students to recall how often they engaged in each of the COVID-19 prevention methods in the last seven days. Response options for this question included: never, rarely, sometimes, very often, and always. This study combined the “always” and “very often” categories and the analyses were conducted on this four-level categorical outcome variable. Specifically, less than five participants marked “always” for handwashing, physical distancing, and avoiding contact with high-risk individuals (at baseline and follow-up). We collapsed these two categories, “often” and “always”, into one category for all outcome variables (primary and secondary) in order to make up for the small counts in some of the secondary outcome variables.

Covariates: Potential covariates for these analyses included various demographic characteristics, alcohol and tobacco use, behavioral characteristics, and other interviewee information. All covariate data were collected from the participant’s survey responses and were self-reported. Confounding variables were identified via *a priori* decision-making by using directed acyclic graphs (DAGs) to assess variable sets for adjustment of suspected confounders. An unadjusted model was built, as well as an additional model with a minimal adjustment set, including Sex (male or female), Year in School (first year undergraduate, second year undergraduate, third year undergraduate, or fourth year or greater undergraduate), and Test Results Group (group 1 received their results immediately, and group 2 had a delay in receiving their results- 2 weeks later).

4.2.4 Statistical Methods

Descriptive statistics were obtained via frequency calculations. Additionally, counts and percentages for each independent variable of interest (personality profile scales) and potential covariates were obtained via cross-tabulation.

The relationship between each individual personality profile scale (taken at baseline) and “avoiding social gatherings” as a COVID-19 preventative measure (taken at baseline and each follow-up) was modeled using a GEE framework for Poisson regression to account for within-subject repeated measures. The outcome of interest in this study, avoiding social gatherings, was a 4-level categorical variable, so ordinal regression could have been used in this context. However, because interpretation of relative risks is often more intuitive compared to the interpretation of odds ratios, relative risks were preferred for exploring the potential association between personality profile scales and avoiding social gatherings.⁴⁴ Thus, we used Poisson regression models in order to obtain these relative risks, rather than ordinal regression models that would’ve yielded odds ratios for the effect estimates. Each of the personality scales were modeled individually. We constructed unadjusted models and models adjusted for sex, year in school, and test results group. Next, an adjusted model and a model adjusted for sex, year in school, and test results group were built to explore the relationship between all three of the personality profile scales together in the same model and “avoiding social gatherings” using the same methodology as above, in order to determine a relationship among the three personality scales. Unadjusted and adjusted relative risks and 95% confidence intervals were obtained. The same methodology was then used to model the relationship between the three personality profile scales and each of the other five COVID-19 preventative behaviors collected in this survey: hand washing, staying home from work/school, masking in public, physical distancing, and avoiding high-risk individuals. Finally, a principal component analysis (PCA) was conducted to account for multicollinearity among the three personality profile scales in the model by reducing the dimensionality of the data into principal components.⁴² PCA factor analysis determined the number of factors (principal components) to be retained in a final principal component regression (PCR) model.⁴⁵⁻⁴⁸ These retained factors account for a majority of the variance in the reserved variables to reduce redundancy in the variables.^{45,46} Using the variable weights for each of the three personality scales obtained in the PCA, both an unadjusted PCR

model and a PCR model that adjusted for sex, year in school, and test results group were built using the three personality scales and their respective weights.^{47,48} Adjusted and unadjusted relative risks and 95% confidence intervals were obtained from these PCR models. All statistical analyses were conducted in SAS 9.4.

4.3 Results

Overall, 30.2% (323) of students responded that they always avoided a social event they wanted to attend. 26.8% (286) responded “very often”, 25.0% (267) responded “sometimes”, 10.0% (107) responded “rarely”, and 8.0% (86) responded “never” (at baseline). Table 4.1 summarizes the socio-demographic characteristics of the undergraduate student population, stratified by students who avoided social events and those who did not avoid social events at baseline. Among participants, the mean age was 20, 64.0% were female, 21.9% were first-year students, 22.9% were second-year students, 24.5% were third-year students, and 27.6% were fourth-year students. The mean total urgency score was 43.02 (SD: 11.5) (maximum possible score for urgency was 104), the mean total risk-taking was 23.24 (SD: 7.1) (maximum possible score for risk-taking was 40), and the mean excitement-seeking score was 56.20 (SD: 8.2) (maximum possible score for excitement-seeking was 68). Compared to female students, male students were less likely to avoid social events. Compared to other classes, first-year students were also less likely to avoid social events. Additionally, those with higher urgency scores were less likely to avoid social events, compared to those with lower urgency scores. Finally, students who were dating or hooking up indicated that they were less likely to avoid social events, while people in a relationship were more likely to avoid attending social events and gatherings. Figure 4.1 summarizes the percentage of students in each level of the avoiding social events variable by scores for each of the personality profile scales at both baseline and endline.

Table 4.2 summarizes the unadjusted and adjusted risk ratios from the GEE models for each personality scale and the association with avoiding social events. For every 1-unit increase in students' urgency scores, there was a 0.60% (CI: 0.9979,1.0141) increased likelihood of never avoiding social events (unadjusted). Conversely, for every 1-unit increase in students' scores on both the excitement-seeking scale and risk-taking scale, there was a 0.39% (CI: 0.9846,1.0076) and 1.07% (CI: 0.9768,1.0019) decreased likelihood of never avoiding social events, respectively (unadjusted). However, the magnitudes were small, with confidence limits overlapping the null. Results were similar when adjusting for sex, school year, and test results group, the minimally sufficient adjustment set. When all three personality scales were analyzed in the same model, results were similar. There were no significant differences in avoiding social events by personality scale scores.

Table 4.3 summarizes the unadjusted and adjusted risk ratios from the GEE models for each personality scale and the association with each of the remaining COVID-19 preventative measures that were collected in the study. We found similar results for each of these preventive measures compared to avoiding social events as the primary outcome of interest (Table 4.2).

The correlation matrix for the three personality variables is shown in table 4.4. From the principal component analysis, the two largest eigenvalues were 1.56 and 0.85 (typically factors with eigenvalues greater than 0.8 are retained), which together accounted for about 80.3% of the standardized variance.^{45,46} Thus, the two factors for the first two principal components were maintained in the principal component regression model. The results of this regression model are outlined in Table 4.5. For every 1-unit increase in students' urgency scores, there was a 0.49% (CI: 0.9968,1.0084) increased likelihood of never avoiding social events (unadjusted). For every 1-unit increase in students' scores on the excitement-seeking scale, there was a 0.03% (CI: 0.9861, 1.0074) increased likelihood of never avoiding social events (unadjusted). Finally, for every 1-unit increase in students' scores on the risk-taking scale, there was a 0.78% (CI: 0.9991, 1.0133) increased likelihood of never avoiding social

events, respectively. However, the magnitudes were small, with confidence limits overlapping the null. Results were similar when adjusting for sex, school year, and test results group.

4.4 Discussion

While many studies have examined the association between personality scales and certain behaviors in college students, such as excessive drinking, risky sexual behavior, drug use, and other risky behaviors, no studies to our knowledge have examined the potential correlation between personality scales and uptake of COVID-19 prevention in college students during the height of the pandemic.⁹⁻¹¹

We did not observe any meaningful differences in avoiding social events by urgency, excitement-seeking, or risk-taking in the univariate models, or in the multivariate models. Principal component regression was used in this analysis to address potential multicollinearity between the three personality scales in the multivariate model.^{47,48} When considering the combined effects of all three personality scales, again, none of the data points to a strong association between avoiding social events and personality profile scales. While there is a trend in the data that suggests increased likelihood of never avoiding social events with increased personality profile scores, there is not enough evidence to draw conclusions, since these estimates were very small in magnitude and had confidence intervals overlapping the null.

Again, previous studies found a significant association between personality profile scales and risky behaviors.⁹⁻¹¹ In the context of the COVID-19 pandemic, never avoiding social events could be considered a risky behavior, and we would expect to see that association between personality profile scales in college students and avoiding social events. The relatively small sample size might contribute to the lack of conclusions we can draw from this analysis. It is possible that stronger associations could be found with a larger sample of students. It is also important to note that at the time of this study, there

were strict policies in place at the university around avoiding these behaviors, which could prevent us from being able to observe the true association.

It is also possible that the distribution of personality profile scales in our sample of students is not representative of the distribution of personality scales in other studies conducted on college students. If so, this could be a result of differing characteristics among students that did not complete the survey to participate in the study versus students who did complete the survey for study participation. Compared to several articles related to personality profile scales in college students, our study had a similar, but a slightly higher distribution of risk-taking.⁴⁹⁻⁵³ In several studies, the distributions of the mean risk-taking scores in random samples of college students were less than the mean distribution in our study of our study (mean was equivalent to about 58% of the total possible risk-taking score in our study versus 48%, 50%, 52%, 43%, and 39% in other studies). Our study also had a similar distribution of impulsivity compared to other studies.^{49-51,53} In our study, the mean impulsivity score was equivalent to about 41% of the total possible score for impulsivity, compared to 50%, 37%, 45%, and 52% in other studies with random samples of college students.^{49-51,53} Lastly, our study had a higher distribution of excitement-seeking compared to other studies.⁵⁰⁻⁵³ In several studies conducted on random samples of college students, the mean excitement-seeking scores were equivalent to about 41%, 56%, 66%, and 67% of the total possible excitement-seeking scores, compared to our study, in which the mean excitement-seeking score was equivalent to about 83% of the total possible excitement-seeking score.⁵⁰⁻⁵³ The distribution of risk-taking and impulsivity (urgency) are relatively consistent with other studies with similar study samples, while the distribution of excitement-seeking is considerably higher in our study compared to others.⁴⁹⁻⁵³ Furthermore, the personality scales used in this study might not adequately measure the exposure variables of interest. Using the full scales for each personality profile in future studies might yield more significant results. Future research could explore these

avenues by conducting the same analyses on a larger sample size of students who complete full personality scale assessments to perhaps obtain more significant results.

4.4.1 Strengths and Limitations

Limitations

Due to the observational study design, there may be genetic or environmental factors that would lead to unmeasured confounding. Additionally, this study used shortened versions of each of the three personality scale assessments (rather than the full versions), and thus, the results from each personality profile scale are potentially less dependable than if the full versions of these assessments had been used. Future studies could use the full personality scale assessments. Because the data collected for the personality profiles and the COVID-19 preventative behaviors were self-reported, social desirability bias and recall bias could affect the data. However, because the surveys were completed remotely and online, the impact of this type of bias was expected to be minimal. More frequent follow-up surveys would add additional data points and might minimize recall bias by reducing the amount of time between follow-up surveys. This study might not be generalizable to all undergraduate students at Indiana University because many participants did not meet the study's inclusion criteria, specifically students were excluded if they already had COVID-19 prior to this study. However, study exclusion would only result in bias if the population that was excluded had a different relationship between the exposure and outcome variables. Finally, the response rate was only (27%). This can be considered greater than average when compared to other studies with random sampling on college campuses.⁵⁴ Future studies could incentivize participation to increase the response rate.

Strengths

This observational study design is the best option, given that the exposure, the three personality profile scales, are non-randomizable. Also, although the shortened versions of the personality profile scales were used in this study, these scales were validated. Additionally, Indiana University has similar demographics to other large universities, so these study results might be generalizable to other large universities in the United States.

4.5 Conclusion

While the magnitudes were small with confidence intervals overlapping the null, our findings suggest that students who have higher urgency, excitement-seeking scores, and risk-taking scores might be more likely to attend social events and gatherings when accounting for multicollinearity. Even though our study did not have statistically significant results for these protective behaviors, there might have been other behaviors (not collected in this study) that those with high urgency, risk-taking, and excitement-seeking scores could have engaged in that put them at higher risk for COVID-19. Further studies are recommended to explore the relationship of personality traits among different age groups in the context of COVID-19 prevention, as well as prevention of other highly contagious respiratory illnesses. Additionally, personality traits should be studied in a different time period, specifically, when prevention methods are recommended, rather than required, in order to further explore this potential association between personality traits and use of COVID-19 prevention.

4.6 Tables and Figures

Table 4.1. Demographic Characteristics and Personality Traits by Avoiding Social Events at Baseline

	Total Study Population (N= 1076)		Sometimes, Rarely, or Never Avoided Social Events (N=460)		Always or Very Often Avoided Social Events (N=609)	
Demographic Characteristics	% or Mean	(n)	% or Mean	(n)	% or Mean	(n)
Sex						
Male	35.50%	382	41.09%	189	31.36%	191
Female	64.03%	689	58.70%	270	67.98%	414
Missing	0.46%	5	0.22%	1	0.66%	4
Year in School						
First Year Undergraduate	21.93%	236	26.74%	123	18.23%	111
Second Year Undergraduate	22.86%	246	23.26%	107	22.66%	138
Third Year Undergraduate	24.54%	264	20.22%	93	27.75%	169
Fourth Year Undergraduate	27.60%	297	27.17%	125	28.24%	172
Fifth Year or More Undergraduate	2.60%	28	2.39%	11	2.46%	15
Missing	0.46%	5	0.22%	1	0.66%	4
Greek Membership						
Not a Member of Any Fraternity/Sorority	75.47%	812	75.22%	346	75.70%	461
Member of Any Fraternity/Sorority	23.88%	257	24.35%	112	23.48%	143
Missing	0.65%	7	0.43%	2	0.82%	5
Relationship Status						
Single & Not Dating/Hooking Up with Anyone	40.06%	431	39.57%	182	40.07%	244
Single & Dating/Hooking Up with One or More People	22.12%	238	25.87%	119	19.37%	118
In a Relationship/ Married	37.17%	400	34.13%	157	39.74%	242
Missing	0.65%	7	0.43%	2	0.82%	5
Alcohol Consumption and Smoking						
Days/Week Drinking Alcohol						
0 days	32.71%	352	24.35%	112	38.59%	235
1-2 days	42.01%	452	43.91%	202	40.72%	248
3-4 days	22.03%	237	28.04%	129	17.73%	108
5-7 days	2.60%	28	3.26%	15	2.13%	13
Missing	0.65%	7	0.43%	2	0.82%	5
Average number of Drinks Consumed/Night	3.03	1039	3.65	449	2.57	583
Days/Month of Smoking Cigarettes	2.55	173	2.3	90	2.79	82
Days/Month of Smoking E-cigarettes	10.04	400	10.6	197	10.02	200
Stress and Depression Scales						
Stress Score	18.23	1036	17.93	443	18.44	586
Missing	--	40	--	17	--	23
Total Depression Score	20.97	1033	20.54	439	21.28	587
Missing	--	43	--	21	--	22
Personality Profile Scales						
Total Urgency Score	43.02	994	44.09	423	42.15	564
Missing	--	82	--	37	--	45
Total Risk-Taking Score	23.24	1025	22.42	438	23.84	580
Missing	--	51	--	22	--	29
Total Excitement-Seeking Score	56.20	1022	54.73	436	57.33	579
Missing	--	54	--	24	--	30

Figure 4.1. Personality Scale Scores and Avoiding Social Events as a COVID-19 Preventative Measure at Baseline and Endline

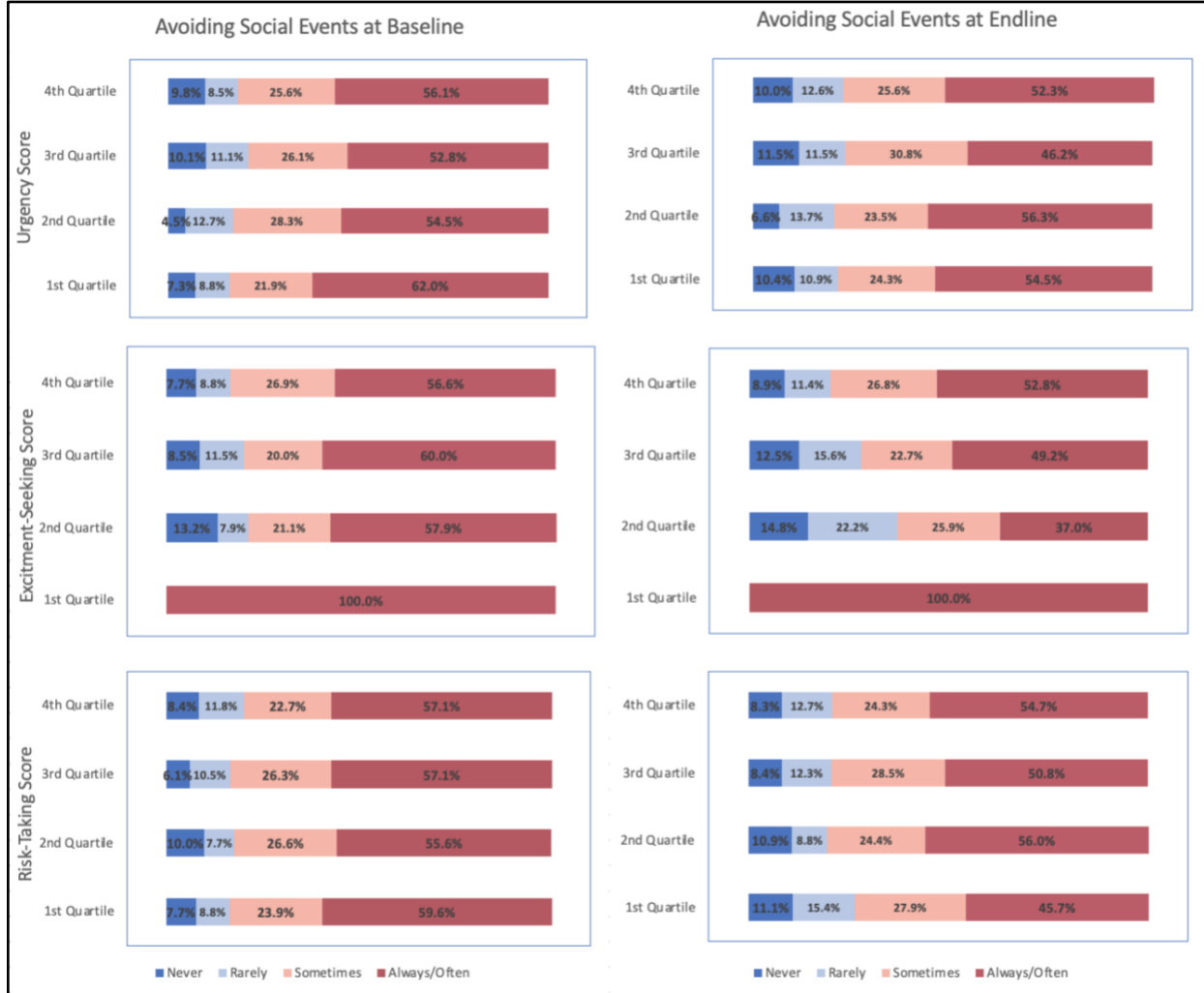


Table 4.2. Results of Analyses of Personality Scales and their Association with Avoiding Social Events as a COVID-19 Preventative Measure, Unadjusted and Adjusted Risk Ratios

	RR (95% CI)	aRR (95% CI)
Personality Scales (Modeled Separately)		
Urgency	1.0060 (0.9979,1.0141)	1.0066 (0.9990,1.0143)
Excitement Seeking	0.9961 (0.9846,1.0076)	0.9960 (0.9839,1.0077)
Risk Taking	0.9893 (0.9768,1.0019)	0.9877 (0.9744,1.0011)
Personality Scales (In the Same Model)		
Urgency	1.0056 (0.9971, 1.0141)	1.0062 (0.9981,1.0143)
Excitement Seeking	1.0016 (0.9887,1.0145)	1.0022 (0.9889,1.0154)
Risk Taking	0.9896 (0.9765, 1.0027)	0.9882 (0.9743,1.0021)

RR = crude risk ratio; aRR = adjusted risk ratio; CI = confidence interval

aRR was adjusted for sex, year in school, and test results group

* Statistically Significant at the 0.05 level

Table 4.3. Results of Analyses of Personality Scales and their Association with COVID-19 Protective Behaviors

	Hand Washing	Staying Home	Masking in Public	Physical Distancing	Avoiding Contact with At-Risk Individuals
Personality Scales (Modeled Separately)					
Urgency					
RR	0.9929	1.0034*	0.9966	0.9984	0.9980
aRR	0.9942	1.0032	0.9967	0.9983	0.9961
Excitement Seeking					
RR	1.0059*	0.9981	0.9912	0.9883	1.0061
aRR	1.0084	0.9980	0.9913	0.9882	1.0123
Risk Taking					
RR	1.0471*	1.0073*	0.9856*	0.9847*	0.9995
aRR	1.0252*	1.0079*	0.9864*	0.9861*	1.0019
Personality Scales (In the Same Model)					
Urgency					
RR	0.9952	1.0036	0.9946	0.9959	0.9997
aRR	0.9975	1.0032	0.9940	0.9953	0.9983
Excitement Seeking					
RR	1.0003	0.9966	0.9924	0.9899	1.0042
aRR	0.9903	0.9961	0.9920	0.9892	1.0057
Risk Taking					
RR	0.9999	1.0097*	0.9877	0.9880	0.9994
aRR	0.9985	1.0105*	0.9881	0.9891	0.9989

RR = crude risk ratio; aRR = adjusted risk ratio

aRR was adjusted for sex, year in school, and test results group

* Statistically Significant at the 0.05 level

Table 4.4. Correlation Matrix of Excitement Seeking, Risk Taking, and Urgency (Impulsivity)

	Excitement Seeking	Risk Taking	Urgency (Impulsivity)
Excitement Seeking	1.0000	0.3515	-0.3276
Risk Taking	0.3515	1.0000	-0.1543
Urgency (Impulsivity)	-0.3276	-0.1543	1.0000

Table 4.5. Results of Principal Component Analysis and Principal Component Regression in Analyses of Personality Scales and their Association with Avoiding Social Events as a COVID-19 Preventative Measure, Unadjusted and Adjusted Risk Ratios

	RR	<i>aRR</i>
Personality Scales		
Urgency	1.0049 (0.9968,1.0084)	1.0045 (0.9965, 1.0081)
Excitement Seeking	1.0003 (0.9861, 1.0074)	0.9998 (0.9862, 1.0070)
Risk Taking	1.0078 (0.9991, 1.0133)	1.0073 (0.9994, 1.0128)

RR = crude risk ratio; aRR = adjusted risk ratio; CI = confidence interval
aRR was adjusted for sex, year in school, and test results group

CHAPTER 5: THE ASSOCIATION BETWEEN PERSONALITY TRAITS AND SARS-COV-2 SEROCONVERSION AMONG UNDERGRADUATE STUDENTS DURING THE COVID-19 PANDEMIC

5.1 Background and Rationale

COVID-19 and its burden to college campuses has been well-documented in the literature. Many aspects of university life contribute to a unique set of risk-factors that affect college students. By May of 2021, more than 700,000 cases of SARS-CoV-2 infections had been reported from universities and colleges in the United States, most of which were among the students (rather than among faculty or staff).⁴³ Those who contract SARS-CoV-2 are subject to experience symptoms including cough, shortness of breath, fever, malaise, and fatigue.⁵⁵ While in some more severe cases, infected individuals also experience loss of smell, reduced ability to concentrate, and memory problems.⁵⁶⁻⁵⁹ These more serious symptoms are typically longer lasting and are more often reported in young adults.⁵⁵⁻⁵⁹ The student population, who might be considered high-risk for COVID-19 spread, can also impact the communities surrounding universities, thus imposing additional risk on others.⁵⁹ It is important to the body of research to identify risk factors for SARS-CoV-2 transmission among students in order to implement more targeted prevention methods. By doing so, application of prevention could be applicable to not only COVID-19 transmission, but also other highly contagious infections that can be easily transmitted among the student population of a university.

The risk factors related to SARS-CoV-19 seroconversion in college students living on campus are likely to differ in many ways from other subsets of the population.⁵⁹ The social norms among college students differ from those outside of the campus setting, and the developing minds of college students, especially in the campus setting, make their experiences unique compared to other subsets of the population.⁵⁸ With learning and development prominent in this age group, personalities among these

individuals are important to consider. Personality profiles are probably risk factors for SARS-CoV-2 infection and transmission, but this relationship has not been explored in the literature to date. Risk-taking, excitement-seeking, and impulsivity of students might increase their risk for infection, as well as alter their perceptions of risk of infection. These personality profiles might also impact students' aptitude for utilizing prevention methods as recommended for COVID-19 prevention, which can also increase risk for SARS-CoV-2 infection.

Previous studies suggest that college and university students are often less likely to engage in the recommended COVID-19 prevention practices compared to the rest of the population even though they are considered to be a high-risk group. While university students are at high risk for SARS-CoV-2, these students are less likely to engage in recommended COVID-19 prevention methods compared to the general population.⁵ In comparison to the general United States population, several studies found that undergraduate students were less likely to wear a mask in crowded spaces.³⁻⁵ Additionally, a higher percentage of undergraduate students did not engage in the recommended physical and social distancing measures than in the rest of the population.^{3,6} In other studies, university students did not always carry out proper hand washing or sanitizing.^{6,7} They were less likely to stay home while experiencing symptoms of SARS-CoV-2.^{6,7}

Emerging adulthood is associated with increased autonomy and freedom, leading to new experiences such as substance use. The university environment can further facilitate this freedom and can lead young people to explore new experiences.²³ This is especially true for students with higher propensity for impulsivity and excitement-seeking. High urgency scores have been associated with high levels of anxiety and low self-esteem, which has been associated with increased substance abuse.²³ There is a relationship between substance use that is driven by peer pressure (conformity), and stress (coping), possibly related to the university environment (e.g., the burden to succeed in a high social environment).²³ The psychological profile associated with high impulsivity scores is characterized by low

self-esteem, low academic attendance and poorer performance, high anxiety, etc., thus resulting in increased consumption motives (coping, enhancement, social).²³ There are many mechanisms or related personality traits that might predict other personality traits (i.e. impulsivity, excitement-seeking, and risk-taking).²³ These can be especially driven by college experiences and social experiences prior to college, and youth's/ young adults' perceptions of risk might be driving predictors for SARS-CoV-2 seroconversion.

There is an overall lack of research related to COVID-19 and personality profiles of college students. This is a significant gap in the research, and personality profiles of university students need to be examined in the context of COVID-19 incidence in order to better understand who in the student population is seroconverting for more targeted prevention, both in the context of COVID-19 and other highly contagious respiratory illnesses.

5.1.1 Objectives

The primary objective of the current study was to evaluate the association between three personality scale measures and SARS-CoV-2 seroconversion during the course of a school semester. Additionally, the secondary objective of the current study was to evaluate the association between three personality scale measures and self-reported SARS-CoV-2 seroconversion (via a positive RT-PCR SARS-CoV-2 test result within the study period). We hypothesized that individuals who have personalities that motivate them to act more impulsively, that make them more likely to take risks, and that drive them to seek excitement will be more likely to have seroconverted by the end of the study period.

5.2 Methods

5.2.1 Study design

Data from a longitudinal cohort study collected from August 2020 to November 2020 on a random sample of undergraduate students at Indiana University was used to assess the association between personality profiles of students and SARS-Cov-2 seroconversion. The study was conducted from September 2020 to November 2020.

5.2.2 Study setting, participants, and procedures

Indiana University Bloomington (IUB), which has a total undergraduate population of about 32,986 students, was the setting of this study. Restrictions, such as mask wearing, physical distancing, hybrid and remote classes, class spacing, contact tracing, mitigation testing, and quarantine and self-isolation mandates were in place during the data collection phase. 7,499 randomly selected IUB undergraduate students were emailed about study participation. These study invitation emails contained information about the study and links to an eligibility screening online survey. In order to participate in this study, students were required to be 1) age 18 years or older, 2) IUB undergraduate students in fall 2020, and 3) residing in Monroe County, Indiana, at the study's baseline.

3,430 of the original 7,499 students sampled did not meet one or more of the inclusion criteria, and 2,672 did not respond, which left 1,397 remaining students. Among the 1,397 students who consented to participate in the study, 130 did not complete any of the study procedures, and 191 students did not complete their baseline SARS-CoV-2 antibody testing. 49 of the remaining 1,076 students were excluded from the analysis because they tested positive for SARS-CoV-2 antibodies at baseline. Of the remaining 1027 participants who tested negative at baseline, a total of 808 completed their baseline antibody test. Students who were identified as eligible for this study completed an online eConsent form that contained more information about the study. After students consented to study participation, they were instructed to schedule a baseline antibody testing appointment and complete

the online baseline survey. This baseline survey collected information about student participants' demographics, SARS-CoV-2 testing history, personality traits, and participation in COVID-19 protective behaviors.

SARS-CoV-2 baseline antibody tests were conducted in-person between September 14 and 30 on the IUB campus. Additionally, follow-up online surveys were administered every two weeks after the baseline antibody test visit. There were a total of four follow-up surveys, with the first follow-up survey having been sent out on September 28, 2020. Participants were tested for SARS-CoV-2 antibodies at baseline in November 2020.

5.2.3 Variables

Primary exposure: The main exposures were the three personality profile scales: Impulsivity, Excitement Seeking, and Risk Taking, measured at baseline. Impulsivity, or urgency, is the tendency to act rashly under extreme emotion; risk-taking is the tendency to participate in life experiences that might be considered risky, such as desire to climb mountains or sky-dive; and excitement-seeking is the tendency to act in a way that is avoidant of boredom and focus on experiences. The maximum possible score for the impulsivity (urgency) scale was 104, the total possible score for the excitement-seeking scale was 68, and the maximum possible score for risk-taking was 40.

5.2.3.1 Impulsivity (Urgency)

Urgency was measured with the Negative Urgency and Positive Urgency subscales of the Urgency Premeditation Planning Sensation Seeking Impulsive Behavior Scale (UPPS-P). Originally developed by Whiteside and Lynam in 2001, the Urgency Premeditation Planning Sensation Seeking Impulsive Behavior scale provides a standardized measure of impulsivity.^{29,30} Whiteside and Lynam created the scale by conducting a factor analysis of already existing self-report scales measuring multiple different aspects of impulsive or reactionary personality.^{29,30} From this analysis, four traits were included in this original version of the scale: *negative urgency* is the

tendency to act rashly under extreme negative emotions; lack of premeditation is the tendency to act without thinking; *lack of perseverance* is the inability to remain focused on a task; and *sensation seeking* is the tendency to seek out novel and thrilling experiences.^{29,30} In 2007, Cyders and colleagues built upon the work of Whiteside and Lynam. They noted that although impulsive action under extreme negative emotions was represented in the model, impulsive action under extreme positive emotions also exists, which was not well conceptualized or measured in the literature.^{29,31,32} Thus, a scale of *positive urgency* was created and added into the larger impulsivity scale. Positive urgency is defined as the tendency to act rashly under extreme positive emotions.^{29,31,32}

Impulsivity was measured in this survey using items from both the negative urgency (12 items) and positive urgency (14 items) subscales. Students were asked to indicate their level of agreement with each of 26 statements that were related to negative and positive urgency. All statements had a 4-point scale, ranging from 1 = “agree strongly” up to 4 = “disagree strongly”. Higher scores are associated with increased impulsivity.

5.2.3.2 Excitement Seeking

Excitement Seeking was measured with two subscales of the Sensation Seeking Scale: the 7-item Disinhibition subscale and the 10-item Boredom Susceptibility sub-scale. The Sensation Seeking scale (SSS) was created by Zuckerman in 1964 with the purpose of better understanding personality traits including neuroticism, antisocial behavior, and psychopathy.³³⁻
³⁴ The four different aspects (subscales) of the SSS include Thrill and Adventure Seeking (TAS); Disinhibition (DIS); Experience Seeking (ES); and Boredom Susceptibility (BS).^{33,34}

The Disinhibition subscale (SSS_DIS) is a 7-item subscale, and the boredom susceptibility subscale (SSS_BS) is a 10-item subscale. Both of these sub-scales come from the 40 item 1978

Sensation Seeking Scale (SSS) and were combined to measure excitement-seeking in this study.³³⁻³⁵ Students were asked to indicate their level of agreement with each of the statements related to excitement seeking tendencies. All 17 statements had a 4-point scale, ranging from 1 = “disagree strongly” up to 4 = “agree strongly”, and higher scores are associated with increased Excitement Seeking tendencies.

5.2.3.3 Risk Taking

Risk Taking was measured with the 10-item Thrill and Adventure Seeking subscale from that also comes from the 1978 version of the 40-item Sensation Seeking Scale (SSS). The Thrill and Adventure Seeking subscale (SSS_TAS) is a 10-item subscale.³³⁻³⁵ Again, students indicated their level of agreement with each of the statements related to risk-taking, which are related to life experiences that might be considered risky, such as desire to climb mountains or sky-dive, etc. All 10 statements had a 4-point scale, ranging from 1 = “disagree strongly” up to 4 = “agree strongly”, and higher scores are associated with increased Risk Taking tendencies.

Primary outcome: The main outcome in the current study was SARS-CoV-2 seroconversion. Participants for SARS-CoV-2 antibodies at study endline. Laboratory visits involved a quick fingerstick blood test to test for SARS-CoV-2 antibodies. Students were considered to have seroconverted over the study course if they had tested negative for SARS-CoV-2 antibodies at baseline and tested positive for SARS-CoV-2 antibodies at endline, which was indicative of incident SARS-CoV-2 infections over the course of the study period.

SARS-CoV-2 IgM/IgG rapid assay kits (Colloidal Gold method) were used to test participants for SARS-CoV-2 IgM and IgG antibodies. Compared to an CLIA Lab-based validation analysis, our BGI rapid kits show a 64% of sensitivity and a 100% specificity.³⁶ The antibody test result was interpreted as positive if one or both of IgG and IgM antibody types were detected in the blood sample. Of the 808

participants who tested negative at baseline and completed the endline antibody test, 42 (5%) seroconverted.

Secondary outcome: The secondary outcome in this study was self-reported positive SARS-CoV-2 RT-PCR tests during the study period. Self-reported SARS-CoV-2 tests were collected in the baseline and endline surveys. If participants indicated that they had been tested for active SARS-CoV-2 infection since the baseline survey was collected, they were also asked to provide the result. Participants who had negative SARS-CoV-2 antibody tests baseline and self-reported testing for SARS-CoV-2 active infection since baseline, in the end-line survey, were included in this secondary analysis ($n = 518$). Students were considered to have new self-reported SARS-CoV-2 infection over the study course if they had a negative SARS-CoV-2 antibody test result at baseline and had self-reported a positive SARS-CoV-2 antibody test at endline, which was indicative of incident COVID-19 cases over the course of the study period that might not have been captured by our antibody tests.

Covariates: Potential covariates for these analyses included various demographic characteristics, alcohol and tobacco use, behavioral characteristics, and other interviewee information. All covariate data were collected from the participant's survey responses and were self-reported. Confounding variables were identified via *a priori* decision-making by using directed acyclic graphs (DAGs) to assess variable sets for adjustment of suspected confounders. An unadjusted model was built, as well as an additional model with a minimal adjustment set, including Sex (male or female), Year in School (first year undergraduate, second year undergraduate, third year undergraduate, or fourth year or greater undergraduate), and Test Results Group (group 1 received their results immediately, and group 2 had a delay in receiving their results- 2 weeks later).

5.2.4 Statistical Methods

Descriptive statistics were obtained via frequency calculations. Additionally, counts and percentages for each independent variable of interest (personality profile scales) and potential covariates were obtained via cross-tabulation.

The relationship between each individual personality profile scale (taken at baseline) and SARS-CoV-2 seroconversion (determined by a negative antibody test at baseline and a positive antibody test at endline) was modeled using log-binomial regression. Each of the personality scales were modeled individually. We constructed unadjusted models and models adjusted for sex, year in school, and test results group. Next, an unadjusted log-binomial regression model and another adjusted model (adjusting for sex, year in school, and test results group) were built to determine the relationship between all three of the personality profile scales together in the same model and SARS-CoV-2 seroconversion using the same methodology as above, in order to determine a relationship among the three personality scales. Adjusted and unadjusted relative risks and 95% confidence intervals were obtained. The same methodology was used to model the relationship between the three personality profile scales and self-reported SARS-CoV-2 infection during the study period (unadjusted and adjusted log-binomial regression models for each scale individually, as well as all three scales together in the same model). Finally, a principal component analysis (PCA) was conducted to account for multicollinearity among the three personality profile scales in the model by reducing the dimensionality of the data into principal components.⁴² PCA factor analysis determined the number of factors (principal components) to be retained in a final principal component regression (PCR) model.⁴⁵⁻⁴⁸ These retained factors account for a majority of the variance in the reserved variables to reduce redundancy in the variables.^{45,46} Using the variable weights for each of the three personality scales obtained in the PCA, both an unadjusted PCR model and a PCR model that adjusted for sex, year in school, and test results

group were built using the three personality scales and their perspective weights.^{47,48} Adjusted and unadjusted relative risks and 95% confidence intervals were obtained from these PCR models. All statistical analyses were conducted in SAS 9.4.

5.3 Results

Table 5.1 summarizes the socio-demographic characteristics of the undergraduate participants by the SARS-CoV-2 seroconversion. Among participants, the mean age was 20, 64% were female, 21.9% were first-year students, 22.9% were second-year students, 24.5% were third-year students, and 27.6% were fourth-year students. The mean total urgency score was 43.02 (SD: 11.5) (maximum possible score for urgency was 104), the mean total risk-taking was 23.24 (SD: 7.1) (maximum possible score for risk-taking was 40), and the mean excitement-seeking score was 56.20 (SD: 8.2) (maximum possible score for excitement-seeking was 68). Compared to females, males were more likely to seroconvert. Additionally, students who were dating or hooking up were more likely to seroconvert, while people in a relationship were less likely to seroconvert throughout the study period. Figure 5.1 shows the distribution of the total scores for each of the three personality scales among those who did and did not seroconvert over the course of the study period.

Table 5.2 summarizes the unadjusted and adjusted risk ratios from the log-binomial regression models for each personality scale and the association with SARS-CoV-2 seroconversion. For every 1-unit increase in students' urgency scores, there was a 0.15% (CI: 0.9969,1.0001) decreased likelihood of SARS-CoV-2 (unadjusted). Conversely, for every 1-unit increase in students' scores on both the excitement-seeking scale and risk-taking scale, there was a 0.25% (CI: 1.0003,1.0046) and 0.31% (CI: 1.0007,1.0056) increased likelihood of SARS-CoV-2 seroconversion, respectively, which were both statistically significant (unadjusted). Results were similar when adjusting for sex, year in school, and test results group. For every 1-unit increase in students' urgency scores, there was a 0.14% (CI:

0.9970,1.0003) decreased likelihood of SARS-CoV-2 seroconversion (adjusted, sex and year in school, and test results group). For every 1-unit increase in students' scores on both the excitement-seeking scale and risk-taking scale, there was a 0.24% (CI: 0.9997,1.0051) and 0.30% (CI: 1.0001,1.0059) increased likelihood of SARS-CoV-2 seroconversion, respectively (adjusted for sex, year in school, and test results group). When all three personality scales were analyzed in the same model, the results were similar. For every 1-unit increase in students' urgency scores, there was a 0.11% (CI: 0.9969,1.0009) decreased likelihood of SARS-CoV-2 (unadjusted). Conversely, for every 1-unit increase in students' scores on both the excitement-seeking scale and risk-taking scale, there was a 0.07% (CI: 0.9971,1.0043) and 0.22% (CI: 0.9985,1.0060) increased likelihood of SARS-CoV-2 seroconversion, respectively (unadjusted). There were no significant differences in avoiding social events by personality scale scores. Results were similar when adjusting for sex, school year, and test results group. For every 1-unit increase in students' urgency scores, there was a 0.10% (CI: 0.9970,1.0012) decreased likelihood of SARS-CoV-2 (adjusted for sex and year in school). For every 1-unit increase in students' scores on both the excitement-seeking scale and risk-taking scale, there was a 0.09% (CI: 0.9968,1.0049) and 0.21% (CI: 0.9978,1.0065) increased likelihood of SARS-CoV-2 seroconversion, respectively (adjusted for sex, year in school, and test results group).

Table 5.3 summarizes the unadjusted and adjusted risk ratios from the log-binomial regression models for each personality scale and the association with self-reported SARS-CoV-2 infection. For every 1-unit increase in students' urgency scores, there was a 0.03% (CI: 0.9983,1.0024) increased likelihood of self-reported SARS-CoV-2 (unadjusted). Additionally, for every 1-unit increase in students' scores on both the excitement-seeking scale and risk-taking scale, there was a 0.28% (CI: 0.9999,1.0056) and 0.32% (CI: 0.9987,1.0077) increased likelihood of SARS-CoV-2 seroconversion, respectively (unadjusted). Results were similar when adjusting for sex, year in school, and test results group. Although not statistically significant, they were also consistent with our findings from the primary outcome analysis.

Table 5.4 outlines the correlation matrix for the exposure variables, the three personality profile scales. From the principal component analysis, the two largest eigenvalues were 1.50 and 0.91 (typically factors with eigenvalues greater than 0.8 are retained), which together accounted for about 80.5% of the standardized variance.^{45,46} Thus, the two factors for the first two principal components were maintained in the principal component regression model. The results of this regression model are outlined in Table 5.5. For every 1-unit increase in students' urgency scores, there was a 0.12% (CI: 0.9987,1.0042) increased likelihood of SARS-CoV-2 seroconversion (unadjusted). Also, for every 1-unit increase in students' scores on both the excitement-seeking scale and risk-taking scale, there was a 0.04% (CI: 0.9971,1.0032) and 0.24% (CI: 0.9997,1.0051) increased likelihood of SARS-CoV-2 seroconversion, respectively (unadjusted). These results were not statistically significant at the 0.05 level, and they were similar when adjusting for sex, school year, and test results group (Table 5.5). These steps were repeated for the secondary outcome, self-reported COVID-19. Consistent with the results from the primary outcome analysis, for every 1-unit increase in students' urgency scores, there was a 0.03% (CI: 0.9982,1.0033) increased likelihood of self-reported SARS-CoV-2 seroconversion (unadjusted). Also, for every 1-unit increase in students' scores on both the excitement-seeking scale and risk-taking scale, there was a 0.19% (CI: 0.9967,1.0064) and 0.12% (CI: 0.9978,1.0042) increased likelihood of self-reported SARS-CoV-2 seroconversion, respectively (unadjusted). Results were similar when adjusting for sex, school year, and test results group and are reported in Table 5.6.

5.4 Discussion

While many studies have examined the association between personality scales and certain behaviors in college students, such as excessive drinking, risky sexual behavior, drug use, etc., no studies to our knowledge have examined the potential correlation between personality scales and SARS-CoV-2 seroconversion in college students during the height of the pandemic.

While the magnitude was very small and the confidence interval overlapped the null, when considering the effect of each individual personality profile scale, we found that students with higher urgency scores might be less likely to seroconvert, compared to those with lower scores. In contrast, students with higher excitement-seeking and risk-taking scores were significantly more likely to seroconvert, compared to those with lower scores. Results were similar for the effect of each of the personality profile scales and the secondary outcome of self-reported SARS-CoV-2 infection. When combining the three personality scales in the same model, we did not observe any meaningful differences in avoiding social events by urgency, excitement-seeking, or risk-taking.

Principal component regression was used in this analysis to address potential multicollinearity between the three personality scales.^{45,46} The data does not point to a strong association between SARS-CoV-2 seroconversion and the personality profile scales when considering the combined effects of all three scales together and accounting for multicollinearity. While there is a trend in the data that suggests increased likelihood of SARS-CoV-2 seroconversion with higher personality profile scores, these results indicate that there is not significant effect.

The social norms among college students differ from those outside of the campus setting, and the developing minds of college students, especially in the campus setting, make their experiences unique compared to other subsets of the population.⁵⁹ With learning and development prominent in this age group, personalities among these individuals are important to consider, and it is still probable that personality profiles act as risk factors for SARS-CoV-2 infection and transmission. Higher scores on the impulsivity, risk-taking, and excitement-seeking personality scales also likely alter students' perceptions of risk of infection. We would expect that this would affect students' use of recommended COVID-19 prevention methods, thus increasing their risk for SARS-CoV-2 infection and other similar highly contagious respiratory illnesses.

The relatively small sample size of this cohort and the very small sample size of those who seroconverted likely contributes to the lack of conclusions we can draw from this analysis. It is possible that stronger associations could be found with a larger sample of students. It is also possible that the distribution of personality profile scales in our sample of students is not representative of the distribution of personality scales in other studies conducted on college students. If this were the case, it could be a result of differing characteristics among students that did not complete the survey to participate in the study versus students who did complete the survey for study participation. Our study had a similar, but a slightly higher distribution of risk-taking compared to several study articles related to risk-taking personality in college students.⁴⁹⁻⁵³ In several studies, the distributions of the mean risk-taking scores in random samples of college students were less than the mean distribution in our study of our study. The mean was about 58% of the total possible risk-taking score in our study versus means of about 48%, 50%, 52%, 43%, and 39% of the total possible scores in other studies. Our study also had a similar distribution of impulsivity compared to other studies.^{49-51,53} In our study, the mean impulsivity score was equivalent to about 41% of the total possible score for impulsivity, compared to 50%, 37%, 45%, and 52% in other studies with random samples of college students.^{49-51,53} Finally, our study had a higher distribution of excitement-seeking compared to other studies.⁵⁰⁻⁵³ In several studies conducted on random samples of college students, the mean excitement-seeking scores were equivalent to about 41%, 56%, 66%, and 67% of the total possible excitement-seeking scores, compared to our study, in which the mean excitement-seeking score was equivalent to about 83% of the total possible excitement-seeking score.⁵⁰⁻⁵³ The distribution of risk-taking and impulsivity (urgency) are relatively consistent with other studies with similar study samples, while the distribution of excitement-seeking is considerably higher in our study compared to others.⁴⁹⁻⁵³ It would seem as though study participants in our study had higher than average excitement-seeking tendencies. Furthermore, the personality scales used in this study might not adequately measure the exposure variables of interest. Using the full scales for each

personality profile in future studies might yield more accurate estimates. Future research could explore these avenues by conducting the same analyses on a larger sample size of students who complete full personality scale assessments to perhaps obtain more significant results.

5.4.1 Strengths and Limitations

Limitations

We are limited in our ability to make causal inferences due to the observational study design. Second, shortened versions of the full personality scales were used for the purposes of this study, so results from each of the three shortened personality scales might be less dependable than if the full versions were used. Future studies could use the full personality scale assessments for potentially more dependable measures of personality profiles. Self-reported COVID-19 preventative behaviors could result in skewed data due to social desirability bias and recall bias. Surveys for this study were completed online in remote locations, so these types of bias are likely minimal. For future studies, more frequent follow-up surveys would add additional data points and could help reduce recall bias by lessening the amount of time between follow-up surveys. Additionally, this study used biological antibody testing to measure the seroconversion outcome. This might be a source of measurement error due to the potential misclassification of SARS-CoV-2 seroconversion based on test reliability. While antibody testing kits can capture undetected previous SARS-CoV-2 infections, the antibody testing kits in this study had a low sensitivity. Different test kits could be considered for future studies. Finally, the response rate was only (27%), but this is greater than average compared to other studies conducted on college campuses.⁵⁴ To address this overall low response rate, future studies could increase the number of students randomly sampled to increase sample size, and study participation could be further incentivized to encourage involvement.

Strengths

Given that the exposure variables, the three personality scales, are non-randomizable, the observational study design is the best choice. Additionally, this study might be generalizable to other large universities in the country because Indiana University has similar demographics to other large universities. Even though the antibody testing kits in this study had a low sensitivity, specificity was high, so it is probable that most students who did not have SARS-CoV-2 had a correct negative antibody test.

5.5 Conclusion

Our findings suggest that students with higher scores for excitement-seeking and risk-taking are more likely to seroconvert, thus suggesting that students with impulsive, risk-taking, and excitement-seeking personalities might be at increased risk for incident SARS-CoV-2 infection. When taking multicollinearity for account by using PCR, our findings also suggest that students who have higher urgency, excitement-seeking scores, and risk-taking scores might be at increased risk for SARS-CoV-2 seroconversion. However, these magnitudes were small, with confidence limits overlapping the null, so we can't draw meaningful conclusions from the results. Further studies are recommended to explore the relationship of personality traits among different age groups in the context of incident SARS-CoV-2 infection, as well as prevention of other highly contagious respiratory illnesses. Future research could also explore the relationship between personality traits and other highly infectious diseases.

5.6 Tables and Figures

Table 1. Demographic Characteristics and Personality Traits by SARS-CoV-2 Seroconversion

	Total Study Population (N= 808)		Did Not Seroconvert During Study Period (N=766)		Seroconverted During Study Period (N=42)		
	% or Mean	(n)	% or Mean	(n)	% or Mean	(n)	p-value
Demographic Characteristics							
Sex							
Male	34.03%	275	33.81%	259	38.10%	16	0.489
Female	65.97%	533	66.19%	507	61.90%	26	
Missing	0%	0	0%	0	0%	0	
Year in School							
First Year Undergraduate	20.91%	169	20.75%	159	23.81%	10	0.684
Second Year Undergraduate	23.27%	188	22.98%	176	28.57%	12	
Third Year Undergraduate	23.64%	191	24.02%	184	16.67%	7	
Fourth Year Undergraduate	29.83%	241	29.77%	228	30.95%	13	
Fifth Year or More Undergraduate	2.23%	18	2.35%	18	0%	0	
Missing	0.12%	1	0.13%	1	0%	0	
Greek Membership							
Not a Member of Any Fraternity/Sorority	77.23%	624	77.81%	596	66.67%	28	0.604
Member of Any Fraternity/Sorority	22.52%	182	21.93%	168	33.33%	14	
Missing	0.25%	2	0.26%	2	0%	0	
Relationship Status							
Single & Not Dating/Hooking Up with Anyone	41.96%	339	42.43%	325	33.33%	14	ref
Single & Dating/Hooking Up with One or More People	20.54%	166	19.97%	153	30.95%	13	0.091
In a Relationship/ Married	37.50%	303	37.60%	288	35.72%	15	0.118
Missing	0%	0	0%	0	0%	0	
Alcohol Consumption and Smoking							
Days/Week Drinking Alcohol							
0 days	32.67%	264	33.42%	256	19.05%	8	ref
1-2 days	43.07%	348	42.17%	323	59.52%	25	0.164
3-4 days	21.29%	172	21.41%	164	19.05%	8	0.217
5-7 days	2.85%	23	2.87%	22	2.38%	1	0.196
Missing	0.12%	1	0.13%	1	0%	0	
Average number of Drinks Consumed/Night	2.95	790	2.90	745	4.17	42	0.068
Days/Month of Smoking Cigarettes	2.11	121	2.10	114	1.83	6	0.018*
Days/Month of Smoking E-cigarettes	9.56	177	9.58	256	8.74	19	0.030*
Stress and Depression Scales							
Total Stress Score	18.13	789	18.16	749	17.68	40	0.806
Missing	--	19	--	17	--	2	
Total Depression Score	21.06	788	21.08	750	20.45	38	0.960
Missing	--	20	--	16	--	4	
Personality Profile Scales							
Total Urgency Score	42.88	763	42.63	726	46.78	37	0.057
Missing	--	45	--	40	--	5	
Total Excitement-Seeking Score	23.53	781	23.65	744	20.41	37	0.299
Missing	--	27	--	22	--	5	
Total Excitement-Seeking Score	56.51	782	56.68	742	53.60	40	0.475
Missing	--	26	--	24	--	2	

* Statistically Significant at the 0.05 level

Figure 5.1. Histogram of Personality Traits by SARS-CoV-2 Seroconversion

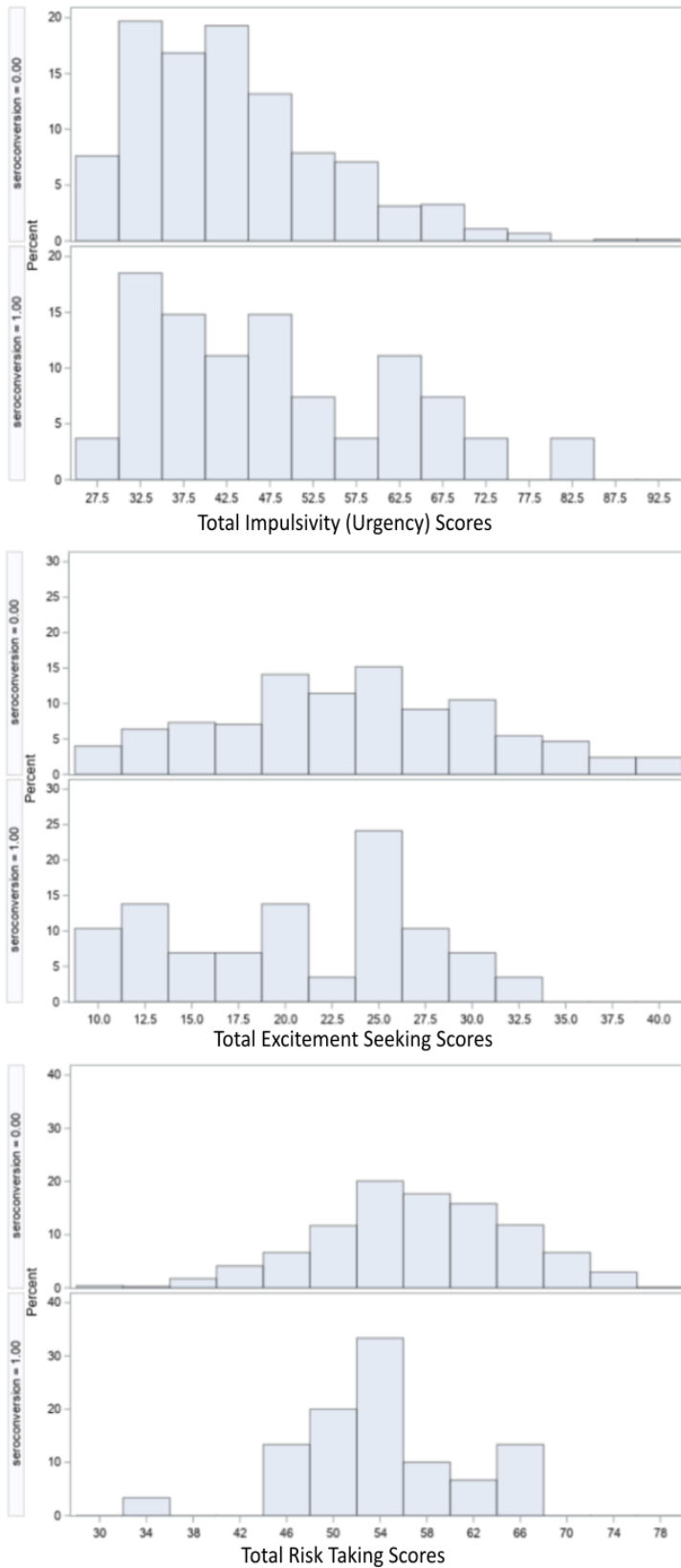


Table 5.2. Results of Analyses of Personality Scales and their Association with SARS-CoV-2 Seroconversion, Unadjusted and Adjusted Risk Ratios

	RR (95% CI)	aRR (95% CI)
Personality Scales (Modeled Separately)		
Urgency	0.9985 (0.9969,1.0001)	0.9986 (0.9970,1.0003)
Excitement Seeking	1.0025 (1.0003,1.0046)*	1.0024 (0.9997,1.0051)
Risk Taking	1.0031 (1.0007,1.0056)*	1.0030 (1.0001,1.0059)*
Personality Scales (In the Same Model)		
Urgency	0.9989 (0.9969,1.0009)	0.9990 (0.9970,1.0012)
Excitement Seeking	1.0007 (0.9971,1.0043)	1.0009 (0.9968,1.0049)
Risk Taking	1.0022 (0.9985,1.0060)	1.0021 (0.9978,1.0065)

RR = crude risk ratio; aRR = adjusted risk ratio; CI = confidence interval

aRR was adjusted for sex, year in school, and tests results group

* Statistically Significant at the 0.05 level

Table 5.3. Results of Analyses of Personality Scales and their Association with Self-Reported Positive COVID-19 Test, Unadjusted and Adjusted Risk Ratios

	RR (95% CI)	aRR (95% CI)
Personality Scales (Modeled Separately)		
Urgency	1.0003 (0.9983,1.0024)	1.0002 (0.9982,1.0022)
Excitement Seeking	1.0028 (0.9999,1.0056)	1.0026 (0.9980,1.0071)
Risk Taking	1.0032 (0.9987,1.0077)	1.0034 (1.0000,1.0067)
Personality Scales (In the Same Model)		
Urgency	1.0011 (0.9988,1.0034)	1.0012 (0.9988,1.0034)
Excitement Seeking	1.0029 (0.9996,1.0063)	1.0032 (0.9993,1.0072)
Risk Taking	1.0021 (0.9970,1.0071)	1.0019 (0.9978,1.0069)

RR = crude risk ratio; aRR = adjusted risk ratio; CI = confidence interval

aRR was adjusted for sex, year in school, and test results group

* Statistically Significant at the 0.05 level

Table 5.4. Correlation Matrix of Excitement Seeking, Risk Taking, and Urgency (Impulsivity)

	Excitement Seeking	Risk Taking	Urgency (Impulsivity)
Excitement Seeking	1.0000	0.3546	-0.2874
Risk Taking	0.3546	1.0000	-0.0922
Urgency (Impulsivity)	-0.2874	-0.0922	1.0000

Table 5.5. Results of Principal Component Analysis and Principal Component Regression in Analyses of Personality Scales and their Association with SARS-CoV-2 Seroconversion, Unadjusted and Adjusted Risk Ratios

	RR	aRR
Personality Scales		
Urgency	1.0012 (0.9987,1.0042)	1.0018 (0.9995,1.0036)
Excitement Seeking	1.0004 (0.9971,1.0032)	1.0007 (0.9983,1.0034)
Risk Taking	1.0024 (0.9997,1.0051)	1.0033 (0.9999,1.0049)

RR = crude risk ratio; aRR = adjusted risk ratio; CI = confidence interval
aRR was adjusted for sex, year in school, and test results group

Table 5.6. Results of Principal Component Analysis and Principal Component Regression in Analyses of Personality Scales and their Association with Self-Reported Positive COVID-19, Unadjusted and Adjusted Risk Ratios

	RR	aRR
Personality Scales		
Urgency	1.0003 (0.9982,1.0033)	1.0008 (0.9981,1.0030)
Excitement Seeking	1.0019 (0.9967,1.0064)	1.0022 (0.9970,1.0062)
Risk Taking	1.0012 (0.9978,1.0042)	1.0015 (0.9980, 1.0043)

RR = crude risk ratio; aRR = adjusted risk ratio; CI = confidence interval
aRR was adjusted for sex, year in school, and test results group

CHAPTER 6: DISCUSSION

6.1 Summary

Studies examining the association between personality traits and COVID-19 in undergraduate students are not in the current literature surrounding COVID-19. Further investigation into this area is necessary to explore potential relationships between infectious diseases, specifically SARS-CoV-2 and other highly contagious respiratory infections, and personality scales. We aimed to assess the association between three personality scales: urgency (impulsivity), risk-taking, and excitement-seeking and the use of COVID-19 prevention methods and incident SARS-CoV-2. To do this, we used data from a longitudinal cohort study conducted at Indiana University that included undergraduate students enrolled in the Fall 2020 semester.

We did not observe any meaningful differences in avoiding social events by urgency, excitement-seeking, or risk-taking in the univariate models, or in the multivariate models. We also found that students with higher urgency scores were less likely to seroconvert, compared to those with lower scores (not statistically significant). In contrast, students with higher excitement-seeking and risk-taking scores were significantly more likely to seroconvert, compared to those with lower scores, but this significance only remains for risk-taking after minimal adjustment. Because there was a statistically significant association between excitement-seeking and risk-taking and SARS-CoV-2 seroconversion but not between the same personality traits and avoiding social events, it is likely that there are other factors related to personality traits that contribute to SARS-CoV-2 seroconversion. There were some significant associations between excitement-seeking and risk-taking and other COVID-19 prevention methods, such as lack of handwashing and not staying home when experiencing symptoms. Thus, it is possible that personality traits are associated with certain behaviors, but not others. It is also possible that we did not observe significant associations between personality traits and behaviors, like masking

and avoiding social events, due to the strict policies set by the university that were in place at the time of this study, which prohibited large social gatherings and required masking on campus. Had such restrictions not been set at the time, we might have observed more robust associations between personality traits and avoiding social events. When considering the combined effects of all three personality scales in PCR, none of the data points to a strong association between avoiding social events and personality profile scales or between SARS-CoV-2 seroconversion and personality profile scales. While there are trends in the data that might suggest increased likelihood of never avoiding social events with increased personality profile scores, as well as increased risk of SARS-CoV-2 infection with increased personality profile scores, there is not enough evidence to draw meaningful conclusions due to the small effect sizes and confidence intervals that overlapped the null. Again, these small effect sizes could be a result of strict COVID-19 prevention policies set by the university during the course of the study period that would've likely reduced the number of incident SARS-CoV-2 cases overall.

It is possible that the distribution of personality profile scales in our sample of students is not consistent with the distribution of personality scales in other studies conducted on college students. If so, this could be a result of differing characteristics of students that did not complete the survey to participate in the study versus students who did complete the survey for study participation. Compared to several articles related to risk-taking in college students, our study had a similar, but slightly higher distribution of risk-taking.⁴⁹⁻⁵³ In one study, the mean risk-taking score in a random sample of college students was equivalent to about 48% of the total possible risk-taking score, compared to our study, in which the mean risk-taking score was about 58% of the total possible risk-taking score.⁴⁹ In additional studies conducted on random samples of college students, the mean risk-taking scores were equivalent to about 50%, 52%, 43%, and 39% of the total possible risk-taking scores.⁵⁰⁻⁵³ Our study also had a similar distribution of impulsivity compared to other studies.^{48-50,52} In one study, the mean impulsivity score in a random sample of college students was equivalent to about 50% of the total possible

impulsivity score, compared to our study, in which the mean impulsivity score was equivalent to about 41% of the total possible impulsivity score.⁵⁰ Additional studies on random samples of college students had mean impulsivity scores equivalent to about 37%, 45%, and 52%.^{50,51,53} Lastly, our study had a higher distribution of excitement-seeking compared to other studies.⁵⁰⁻⁵³ In two studies conducted on random samples of college students, the mean excitement-seeking scores were equivalent to about 41%, 56%, 66%, and 67% of the total possible excitement-seeking scores, compared to our study, in which the mean excitement-seeking score was equivalent to about 83% of the total possible excitement-seeking score.⁵⁰⁻⁵³ The distribution of risk-taking and impulsivity (urgency) are relatively consistent with other studies with similar study samples, while the distribution of excitement-seeking is considerably higher in our study compared to others.⁴⁹⁻⁵³

6.2 Limitations

Due to the observational study design, there may be genetic or environmental factors that would lead to unmeasured confounding. This study utilized shortened versions of each of the three personality scale assessments (rather than the full versions), and thus, the results from each personality profile scale are potentially less dependable than if the full versions of these assessments had been used. Future studies could use the full personality scale assessments. Because the data collected for the personality profiles and the COVID-19 preventative behaviors were self-reported, social desirability bias and recall bias could affect the data. However, because the surveys were completed remotely and online, the impact of this type of bias was expected to be minimal. More frequent follow-up surveys would add additional data points and might minimize recall bias by reducing the amount of time between follow-up surveys. Finally, the response rate was only (27%). This can be considered greater than average when compared to other studies with random sampling on college campuses.⁵⁶ Future studies could incentivize participation to increase the response rate.

Additionally, this study used biological antibody testing to measure the seroconversion outcome for aim 2. This might be a source of measurement error due to the potential misclassification of SARS-CoV-2 seroconversion based on test reliability. While antibody testing kits can capture undetected previous SARS-CoV-2 infections, the antibody testing kits in this study had a low sensitivity. Different test kits could be considered for future studies. Our study also has some missing data as a result of loss to follow-up. One possible explanation for this is that students who were sick over the course of the semester (between study baseline and endline) were potentially less likely to come back for their second antibody test, having already known about their seroconversion. Lastly, the sample size of this cohort, especially the sample size of those who seroconverted, is small, which might limit the precision of our findings in this study.

6.3 Strengths

Given that the exposure variables, the three personality scales, are non-randomizable, the observational study design is the best choice. Also, although the shortened versions of the personality profile scales were used in this study, these scales were validated. This study might be generalizable to other large universities in the country because Indiana University has similar demographics to other large universities. Even though the antibody testing kits in this study had a low sensitivity, specificity was high, so it is probable that most students who did not have SARS-CoV-2 had a correct negative antibody test.

6.4 Future Research Directions

While the COVID-19 pandemic has settled throughout the world, there continues to be risk for variant outbreaks and future pandemics that could arise due to highly contagious respiratory illnesses. There has been little research done on personality traits and use of prevention methods for these

illnesses. Future research should focus on replication of the previous studies in different populations to determine if there is truly an association between personality traits and each COVID-19 prevention method. Ideally, studies should use a nationally representative sample to estimate these effects so that fewer assumptions need to be made in order to generalize the results. Additionally, future studies could examine the association between personality traits and disease prevention methods in the context of other infectious diseases. These future studies should include better data collection on measurement of personality traits with full personality scales. Future studies should aim to collect personality scale data at multiple points throughout life, individual views and traits can evolve and shift with age.

Further studies are also recommended to explore the relationship of personality traits among different age groups in the context of COVID-19 prevention. Additionally, personality traits should be studied in a different time period, specifically, when prevention methods are recommended, rather than required, in order to further explore this potential association between personality traits and use of COVID-19 prevention.

6.5 Conclusion

Our findings suggest that students who have higher urgency, excitement-seeking scores, and risk-taking scores might be more likely to attend social events and gatherings when accounting for multicollinearity. However, these magnitudes were small, with confidence limits overlapping the null. While our study did not have statistically significant results for these protective behaviors, there might have been other behaviors (not collected in this study) that those with high urgency, risk-taking, and excitement-seeking scores could have engaged in that put them at higher risk for COVID-19.

Additionally, students with higher scores for excitement-seeking and risk-taking were significantly more likely to seroconvert, thus suggesting that students with impulsive, risk-taking, and excitement-seeking personalities might be at increased risk for incident SARS-CoV-2 infection. When

taking multicollinearity for account by using PCR, our findings also suggest that students who have higher urgency, excitement-seeking scores, and risk-taking scores might be at increased risk for SARS-CoV-2 seroconversion. These results also lacked statistical significance at the five percent level, but the trends in the data could still inform future prevention strategies. Again, preliminary evidence does not point to a strong relationship between personality traits and COVID-19 protective behaviors in a college population. It is likely that the strict policies related to mask-use and gathering sizes at the university had an effect on our results. Had there not been such policies in place, students might have been more likely to attend social events, in general. There also would likely have been more incident SARS-CoV-2 infections without required prevention methods across campus. Future research could explore the same associations in a similar population without such stringent requirements related to COVID-19 prevention. Additionally, future research could explore the relationship between personality traits and other highly infectious diseases.

Appendix I: Baseline Survey Questions

**Baseline Survey Instrument
IU SARS-CoV-2 Serosurvey
v1.0 August 17, 2020**

Star * shows required questions

META-DATA		
1	ID	
2	Date	
3	Time interview started	
4	Time interview ended	

Eligibility Criteria		
1	Are you 18 years or older? *	Yes No [End Survey]
2	Are you a current IU undergraduate student? *	Yes No [End Survey]
3	Are you current resident of Monroe county, Indiana? *	Yes No [End Survey]

Consent Form		
1	Participant's First Name *	[Text box]
2	Participant's Last Name *	[Text box]
3	Participant's E-Signature *	[e-sign Text box]
4	Date *	[Date validated (D-M-Y) Text box]

RESPONDENT CONTACT INFORMATION		
2	What is your cell phone number? *	[Validated phone number]
3	What is your local (Bloomington) address? *	[Text box]
4	What is your IU email? *	[Validated email address]

Schedule Meeting		
1	Please choose a date/time for your first antibody test.	[Drop-down menu with available times]

RESPONDENT DEMOGRAPHICS		
1	What is your date of birth?	MM/DD/YYYY
2	What sex were you assigned at birth, on your original birth certificate?	Male Female
3	Gender identity How do you describe yourself? (check one)	Male Female Transgender Do not identify as male, female, or transgender
4	Race/Ethnicity Which categories describe you (choose all that apply)	White Hispanic or Latinx or Spanish origin Black or African-American Asian America Indian or Alaska Native Middle Eastern or North African Native Hawaiian or Other Pacific Islander Some other race, ethnicity, or origin (specify: _____)
5	Where do you currently live?	On campus (in a dorm/residence hall) Off campus apartment Off campus house

		At home with parents or other family members Other, please describe:
6	How many people, including yourself, live at your current residence, or have stayed there in the past 2 weeks?	_____ people [validated number]
7	How many bedrooms does your current residence have?	_____ bedrooms [validated number]
8	What is your year in school?	First year undergraduate Second year undergraduate Third year undergraduate Fourth year undergraduate Fifth year or more undergraduate
9	In what school or college is your major or degree program?	College of Arts and Sciences Eskenazi School of Art, Architecture, and Design Kelley School of Business School of Education Hamilton Lugar School of Global and International Studies Hutton Honors College Luddy School of Informatics, Computing, and Engineering Maurer School of Law The Media School School of Medicine Jacobs School of Music School of Nursing School of Optometry O'Neill School of Public and Environmental Affairs School of Public Health School of Social Work
10	Which of the following best describes your current relationship status?	Single and not dating/hooking up with anyone Single and dating/hooking up with multiple people Single and dating/hooking up with one specific person In a relationship but not living together

		Living together but not married Married and living together Married but not living together
1 1	What is your membership status with IUs fraternities and sororities?	Member of an IFC fraternity Member of a PHA sorority Member of a MCGC fraternity Member of a NPHC sorority Member of another fraternity/sorority Not a member of any fraternity/sorority
1 2	In general, how would you describe your health?	Excellent Very good Good Fair Poor
1 3	Do you have any medical conditions that places you at high risk for severe COVID-19 disease? Please choose all that apply from the current CDC list:	Cancer Chronic kidney disease COPD Immunocompromised state BMI 30 or higher Serious heart condition Sickle cell disease Type 2 diabetes
1 4	Do you live with anyone with any medical conditions that places them at high risk for severe COVID-19 disease? Please choose all that apply from the current CDC list:	Cancer Chronic kidney disease COPD Immunocompromised state BMI 30 or higher Serious heart condition Sickle cell disease Type 2 diabetes
1 5	Do you have any of these additional medical conditions?	Asthma Recent pneumonia Recent RSV infection
1 6	Did you get a flu vaccine last year?	Yes No
1 7	On average, how many hours of sleep do you get a night?	[validated number, max=24, min=0]

SARS-CoV-2 RISK/PROTECTIVE BEHAVIORS: (Adapted from WHO instrument: https://www.euro.who.int/_data/assets/pdf_file/0007/436705/COVID-19-survey-tool-and-guidance.pdf)		ANSWERS
1	Think back over the past week: How many times did you spend at least 15 minutes with people other than those who live with you?	Often (6-7 days) Sometimes (3-5 days) Rarely (about 1-2 days) Never (no days)
2	Think back over the past week: How many times did you spend at least 15 minutes with people other than those who live with you without wearing facial coverings or masks?	Often (6-7 days) Sometimes (3-5 days) Rarely (about 1-2 days) Never (no days)
3	Do you have a job or internship that requires you to interact face-to-face (non-virtually) with others?	Yes No
4	If yes, about how many hours do you work in-person each week?	____ hours [validated number, max=168, min=0]
5	If yes, what is your job?	[Text box]
6	Does anyone you live with have a job or internship that requires them to interact face-to-face (non-virtually) with others?	Yes No
7	How many credit hours are you taking this semester?	# [validated number]
8	How many credit hours have in-person instruction?	# [validated number]
9	Are you taking any classes with in-person instruction from the Music school?	Yes No
10	Think back over the last 7 days: How often did you use indoor campus recreational sports facilities (e.g. SRSC, Bill Garrett fieldhouse)?	Often (6-7 days) Sometimes (3-5 days) Rarely (about 1-2 days) Never (no days)
11	Think back over the last 7 days: How often have you attended social events or parties?	Often (6-7 days) Sometimes (3-5 days) Rarely (about 1-2 days) Never (no days)

12	If > 'Never:' Think back to the most recent social event or party you attended. About how many people were there?	A lot (>25 people) A fair number (16-25 people) Some (6-15 people) Few (1-5 people)
13	During the last 7 days, which of the following measures have you taken to prevent infection from COVID-19? (each item below)	
	Frequently washed my hands with soap and water for at least 20 seconds	Always • Very Often • Sometimes • Rarely • Never
	Avoided touching my eyes, nose and mouth with unwashed hands	Always • Very Often • Sometimes • Rarely • Never
	Used disinfectants to clean hands when soap and water were not available	Always • Very Often • Sometimes • Rarely • Never
	Avoided a social event I wanted to attend	Always • Very Often • Sometimes • Rarely • Never
	Stayed at home from work/school	Always • Very Often • Sometimes • Rarely • Never
	Wore a mask in public	Always • Very Often • Sometimes • Rarely • Never
	Ensured physical distancing in public	Always • Very Often • Sometimes • Rarely • Never
	Avoided contact with high-risk individuals	Always • Very Often • Sometimes • Rarely • Never

SARS-CoV-2 TESTING HISTORY		ANSWERS
1	Have you ever been tested for SARS-CoV-2 before? <i>[Note: by this, we mean testing for active infections, usually done with a nasal swab or saliva test]</i>	Yes No
2	Have you ever tested positive for a SARS-CoV-2 infection?	Yes

		No
3	If yes, when?	[validated DD/MM/YY, min=29/12/2019]
4	If yes, how would you describe the symptoms of your infection?	Asymptomatic Mild Severe
5	[For everyone except yes to Q2]: Do you believe you may have previously been infected with SARS-CoV-2?	Yes No Don't know
6	If yes, why?	Had symptoms consistent with COVID Exposed to a confirmed case Other
7	Have you ever been tested for SARS-CoV-2 antibodies before? <i>[Note: by this, we mean testing for evidence of a previous infection, usually done with a blood test]</i>	Yes No
8	If yes, Have you ever tested positive for SARS-CoV-2 antibodies?	Yes No
9	If yes, when?	[validated DD/MM/YY, min=29/12/2019]
10	Do you know people in your immediate social environment who are or have been infected with COVID -19 (suspected or confirmed)?	Yes No
11	Have you known someone who has died of COVID-19?	Yes No
12	What do you consider to be your own probability of getting infected with COVID -19?	Extremely likely ... Extremely unlikely [slider ranging from 0 (extremely unlikely) to 100 (extremely likely)]

ALCOHOL HISTORY		
1	How many days a week do you usually drink alcohol?	0-7 [drop-down menu with values ranging from 0 day to 7 days]
2	On a typical night, how many alcoholic beverages do you consume?	# [validated number, min=0, max=100]
	On a typical night, how many people do you usually hang out with when you are drinking alcohol?	# [validated number, min=0, max=1000]
5	Alcohol expectancies	Measured with the Alcohol Expectancy Questionnaire⁸³
	<p>The following questions contain statements about the effects of alcohol. Answer each statement according to your own personal thoughts, feelings, and beliefs about alcohol. We're interested in what you think about alcohol, not what others might think. Whether or not you've had actual drinking experience, you should answer in terms of how you think alcohol affects the typical or average drinker. By alcohol, we mean beer, wine, whiskey, liquor, rum, scotch, vodka, gin, or various alcoholic mixed drinks.</p> <p>Answer according to how much you agree or disagree with each question.</p> <p>4. Alcohol generally has powerful positive effects on people (makes a person feel good or happy; future seems brighter).</p> <p>2. Alcohol can help or hurt how well a person gets along with others (makes people want to have fun together; makes people mean to others).</p>	<p>Disagree strongly Disagree somewhat Uncertain Agree somewhat Agree strongly</p>

<p>3. Alcohol helps people think better and helps coordination (people understand things better; can do things better).</p> <p>4. Alcohol improves sex (more enjoyable; feel more romantic or sexual; makes it easier to have sex).</p> <p>5. Alcohol hurts how people think and it hurts their coordination (run into things, act silly, have a hangover).</p> <p>6. Alcohol makes a person feel stronger and more powerful (easier to fight, speak in front of others, stand up to others).</p> <p>7. Alcohol helps a person relax, feel less tense, and can keep a person's mind off of mistakes at school or work.</p>	
<p>6 Problem alcohol use Because alcohol use can affect your health and can interfere with certain medications and treatments, it is important that we ask some questions about your use of alcohol. Your answers will remain confidential so please be honest. Mark that which best describes your answer to each question.</p>	<p>10-item World Health Organization AUDIT scale</p>
<p>1. How often do you have a drink containing alcohol?</p>	<p>Never Monthly or less 2-4 times a month 2-3 times a week 4 or more times a week</p>
<p>2. How many drinks containing alcohol do you have on a typical day when you are drinking?</p>	<p>1 or 2 3 or 4 5 or 6 7 to 9 10 or more</p>
<p>3. How often do you have six or more drinks on one occasion?</p>	<p>Never Less than monthly Monthly Weekly</p>

		Daily or almost daily
	4. How often during the last year have you found that you were not able to stop drinking once you had started?	Never Less than monthly Monthly Weekly Daily or almost daily
	5. How often during the last year have you failed to do what was normally expected of you because of drinking?	Never Less than monthly Monthly Weekly Daily or almost daily
	6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?	Never Less than monthly Monthly Weekly Daily or almost daily
	7. How often during the last year have you had a feeling of guilt or remorse after drinking?	Never Less than monthly Monthly Weekly Daily or almost daily
	8. How often during the last year have you been unable to remember what happened the night before because of your drinking?	Never Less than monthly Monthly Weekly Daily or almost daily
	9. Have you or someone else been injured because of your drinking?	No Yes, but not in the last year Yes, during the last year
	10. Has a relative, friend, doctor, or other health care worker been concerned about your drinking or suggested you cut down?	No Yes, but not in the last year Yes, during the last year

NICOTINE USE		ANSWERS
1	Have you ever used any of the following inhaled tobacco products before today? Check all that apply	Cigarettes E-cigarettes or vape Neither

2	[Display if 1=Cigarettes] During the last 30 days, on how many days did you use <u>cigarettes</u> ? Please enter a number from 1 to 30 day(s).	[validated integer min=1, max=30]
3	[Display if 1= E-cigarettes or vape] During the last 30 days, on how many days did you use <u>E-cigarettes</u> ? Please enter a number from 1 to 30 day(s).	[validated integer min=1, max=30]

PERSONALITY SCALES		SOURCE
1	Depression	20-item Center for Epidemiologic Studies Depression-Revised (CESD-R) Scale ⁸⁰
	<p>Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week.</p> <p>During the past week:</p> <ol style="list-style-type: none"> 1. I was bothered by things that usually don't bother me. 2. I did not feel like eating; my appetite was poor. 3. I felt that I could not shake off the blues even with help from my family or friends. 4. I felt that I was just as good as other people. 5. I had trouble keeping my mind on what I was doing. 6. I felt depressed. 7. I felt that everything I did was an effort. 8. I felt hopeful about the future. 9. I thought my life had been a failure. 10. I felt fearful. 11. My sleep was restless. 12. I was happy. 13. I talked less than usual. 14. I felt lonely. 15. People were unfriendly. 16. I enjoyed life. 17. I had crying spells. 18. I felt sad. 19. I felt that people dislike me. 20. I could not get "going". 	<ol style="list-style-type: none"> 1 = Rarely or None of the Time (Less than 1 Day) 2 = Some or a Little of the Time (1-2 Days) 3 = Occasionally or a Moderate Amount of Time (3-4 Days) 4 = Most or All of the Time (5-7 Days)
2	Impulsivity	Measured with the Negative Urgency and Positive Urgency sub-scales of the Urgency Premeditation Planning

	Sensation Seeking Impulsive Behavior Scale
<p>Below are a number of statements that describe ways in which people act and think. For each statement, please indicate how much you agree or disagree with the statement. Be sure to indicate your agreement or disagreement for every statement below. Agree Strongly Agree Some Disagree</p> <p><u>(Negative) Urgency</u></p> <p>2. I have trouble controlling my impulses.</p> <p>7. I have trouble resisting my cravings (for food, cigarettes, etc.).</p> <p>12. I often get involved in things I later wish I could get out of.</p> <p>17. When I feel bad, I will often do things I later regret in order to make myself feel better now.</p> <p>22. Sometimes when I feel bad, I can't seem to stop what I am doing even though it is making me feel worse.</p> <p>29. When I am upset I often act without thinking.</p> <p>34. When I feel rejected, I will often say things that I later regret.</p> <p>39. It is hard for me to resist acting on my feelings.</p> <p>44. I often make matters worse because I act without thinking when I am upset.</p> <p>50. In the heat of an argument, I will often say things that I later regret.</p> <p>53. I always keep my feelings under control.</p> <p>58. Sometimes I do impulsive things that I later regret.</p> <p><u>Positive Urgency</u></p> <p>5. When I am very happy, I can't seem to stop myself from doing things that can have bad consequences.</p> <p>10. When I am in great mood, I tend to get into situations that could cause me problems.</p> <p>15. When I am very happy, I tend to do things that may cause problems in my life.</p> <p>20. I tend to lose control when I am in a great mood.</p> <p>25. When I am really ecstatic, I tend to get out of control.</p> <p>30. Others would say I make bad choices when I am extremely happy about something.</p> <p>35. Others are shocked or worried about the things I do when I am feeling very excited.</p>	<p>1= Agree Strongly 2= Agree Somewhat 3= Disagree somewhat 4= Disagree Strongly</p>

	<p>40. When I get really happy about something, I tend to do things that can have bad consequences.</p> <p>45. When overjoyed, I feel like I can't stop myself from going overboard.</p> <p>49. When I am really excited, I tend not to think of the consequences of my actions.</p> <p>52. I tend to act without thinking when I am really excited.</p> <p>54. When I am really happy, I often find myself in situations that I normally wouldn't be comfortable with.</p> <p>57. When I am very happy, I feel like it is ok to give in to cravings or overindulge.</p> <p>59. I am surprised at the things I do while in a great mood.</p>	
3	Excitement seeking	Measured with the 7-item Disinhibition sub-scale and the 10-item Boredom Susceptibility sub-scale of the Sensation Seeking Scale
	<p>Directions: A number of statements are shown below that describe some ways in which people act and think. Please indicate for each statement how much you agree or disagree. If you have not experienced that circumstance, please try to describe how you would act or what you think about that situation. Be sure to indicate your agreement or disagreement for every statement.</p> <p>Boredom Susceptibility (10-item)</p> <ol style="list-style-type: none"> 1. (17) [BS/Imp] I prefer friends who are excitingly unpredictable. 2. (37) [BS/Imp] I get restless if I have to stay around home for any length of time. 3. (57) [BS/Imp] I enjoy spending time in the familiar surroundings of my home or apartment. 4. (77) [BS/Imp] I am polite and attentive to someone even if I do not find their conversation interesting. 5. (97) [BS/Imp] I have a reserved and cautious attitude toward life. 6. (117) [BS/Imp] My thinking is usually cautious and sensible. 7. (137) [BS/Imp] I don't like to start a project until I know exactly how to proceed. 	<ol style="list-style-type: none"> 1. Disagree Strongly 2. Disagree Somewhat 3. Agree Somewhat 4. Agree Strongly

	<p>8. (157) [BS/Imp] I tend to value and follow a rational and moderate approach to things.</p> <p>9. (177) [BS/Imp] I usually make up my mind through careful reasoning.</p> <p>10. (197) [BS/Imp] Before I get into a new situation I like to find out what to expect from it.</p> <p>Disinhibition (7-item)</p> <p>1. (12) [Dis] I'll try anything once.</p> <p>2. (32) [Dis] I like 'wild' uninhibited parties.</p> <p>3. (52) [Dis] I like to let myself go and do impulsive things just for fun.</p> <p>4. (72) [Dis] I go to parties to meet exciting and stimulating people.</p> <p>5. (92) [Dis] I do not try to restrain my urges to have exciting experiences.</p> <p>6. (112) [Dis] I prefer quiet parties where one can have good conversation.</p> <p>7. (132) [Dis] I am not interested in having new experiences just for the sake of experiencing new sensations.</p> <p>8. (152) [Dis] I enjoy quiet, melodic popular or classical music.</p> <p>9. (172) [Dis] One should not go too far in physical intimacy until one gets to know the other person.</p> <p>10. (192) [Dis] One of my goals in life is to experience intense and pleasurable sensations.</p>	
4	Risk taking	Measured with the 10-item Thrill and Adventure Seeking subscale from the Sensation Seeking Scale
	<p>Directions: A number of statements are shown below that describe some ways in which people act and think. Please indicate for each statement how much you agree or disagree. If you have not experienced that circumstance, please try to describe how you would act or what you think about that situation. Be sure to indicate your agreement or disagreement for every statement.</p> <p>Thrill and Adventure Seeking (10-item)</p> <p>1. I often wish I could be a mountain climber.</p> <p>2. I sometimes like to do things that are a little frightening.</p>	<p>1. Disagree Strongly</p> <p>2. Disagree Somewhat</p> <p>3. Agree Somewhat</p> <p>4. Agree Strongly</p>

	<ol style="list-style-type: none"> 3. I would like to take up the sport of water skiing. 4. I would like to try surfboard riding. 5. I would like to learn to fly an airplane. 6. I would like to go scuba diving. 7. I would like to try parachute jumping. 8. I like to dive off the high board. 9. I would like to sail a long distance in a small but seaworthy sailing craft. 10. I think I would enjoy the sensations of skiing very fast down a high mountain slope. 	
5	<p>Perceived Stress Scale: The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate how often you felt or thought a certain way:</p> <ol style="list-style-type: none"> 1. In the last month, how often have you been upset because of something that happened unexpectedly? 2. In the last month, how often have you felt that you were unable to control the important things in your life? 3. In the last month, how often have you felt nervous and “stressed”? 4. In the last month, how often have you felt confident about your ability to handle your personal problems? 5. In the last month, how often have you felt that things were going your way? 6. In the last month, how often have you found that you could not cope with all the things that you had to do? 7. In the last month, how often have you been able to control irritations in your life? 8. In the last month, how often have you felt that you were on top of things? 9. In the last month, how often have you been angered because of things that were outside of your control? 10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them? 	<p>0 = Never 1 = Almost Never 2 = Sometimes 3 = Fairly Often 4 = Very Often</p>

PAST BEHAVIOR (2):

· In the past month, how often did you maintain physical distance of at least 6 feet from crowds and strangers to reduce the spread of COVID-19?

Never	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	Almost Always
	1	2	3	4	5	6	7	

· In the past week, I have maintained physical distance of at least 6 feet from crowds and strangers to reduce the spread of COVID-19?

False	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	True
	1	2	3	4	5	6	7	

INTENTION (3):

· I plan to maintain physical distance of at least 6 feet from crowds and strangers to reduce the spread of COVID-19.

Unlikely	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	Likely
	1	2	3	4	5	6	7	

· I _____ intend to maintain physical distance of at least 6 feet from crowds and strangers to reduce the spread of COVID-19.

Definitely do not	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	Definitely
	1	2	3	4	5	6	7	

· How likely are you to maintain physical distance of at least 6 feet from crowds and strangers to reduce the spread of COVID-19?

Unlikely	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	Likely
	1	2	3	4	5	6	7	

ATTITUDE TOWARDS THE ACT (4):

- Instrumental
 - o Maintaining physical distance of at least 6 feet from crowds and strangers to reduce the spread of COVID-19 would be:

Harmful	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	Beneficial
	1	2	3	4	5	6	7	

- o Maintaining physical distance of at least 6 feet from crowds and strangers to reduce the spread of COVID-19 would be:

Foolish	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	Wise
	1	2	3	4	5	6	7	

- Experiential
 - o Maintaining physical distance of at least 6 feet from crowds and strangers to reduce the spread of COVID-19 would be:

Bad	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	Good
	1	2	3	4	5	6	7	

- o Maintaining physical distance of at least 6 feet from crowds and strangers to reduce the spread of COVID-19 would be:

Unpleasant	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	Pleasant
	1	2	3	4	5	6	7	

PERCEIVED NORM (4):

· Injunctive

o Most people who are important to me think that I should maintain physical distance of at least 6 feet from crowds and strangers to reduce the spread of COVID-19?

Disagree	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	Agree
	1	2	3	4	5	6	7	

o Most people whose opinions I value think that it is appropriate to maintain physical distance of at least 6 feet to reduce the spread of COVID-19?

Disagree	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	Agree
	1	2	3	4	5	6	7	

· Descriptive

o How many people similar to you will maintain physical distance of at least 6 feet apart from crowds and strangers to reduce the spread of COVID-19?

None	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	Almost all
	1	2	3	4	5	6	7	

o Most people like me will maintain physical distance of at least 6 feet apart from crowds and strangers to reduce the spread of COVID-19.

Disagree	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	Agree
	1	2	3	4	5	6	7	

PERCEIVED BEHAVIORAL CONTROL (4):

· Autonomy

o Maintaining physical distance of at least 6 feet from crowds and strangers to reduce the spread of COVID-19 is...

Not up to me	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	Up to me
	1	2	3	4	5	6	7	

o I have complete control over maintaining physical distance of at least 6 feet from crowds and strangers to reduce the spread of COVID-19.

Disagree	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	Agree
	1	2	3	4	5	6	7	

· Capacity

o How confident are you in maintaining physical distance of at least 6 feet from crowds and strangers to reduce the spread of COVID-19?

Not at all confident	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	Very Confident
	1	2	3	4	5	6	7	

o I believe that I have the ability to maintain physical distance of at least 6 feet from crowds and strangers to reduce the spread of COVID-19?

Very unsure	Extremely	Quite	Slightly	Neither	Slightly	Quite	Extremely	Very sure
	1	2	3	4	5	6	7	

Appendix II: Variables

A2.1 Table of Exposure, Outcome, and Covariates

Covariates		
Demographic Characteristics		
Age	Age in Years	Continuous variable
Sex	Male or Female	Dichotomous categorical variable
Race	Which categories describe you (choose all that apply)?	Categorical Variable
Residence	Where do you currently live?	Categorical Variable
Year in School	What is your year in school?	Categorical Variable
Major School	In what school or college is your major or degree program?	Categorical Variable
Greek Membership	What is your membership status with IUs fraternities and sororities?	Categorical Variable
Relationship Status	Which of the following best describes your current relationship status?	Categorical Variable
General Health	In general, how would you describe your health?	Categorical Variable
SARS-CoV-2 Protective Behaviors		
Frequently washed my hands with soap and water for at least 20 seconds	During the last 7 Days: Never, Rarely, Sometimes, Very Often, Always	Categorical variable
Avoided touching my eyes, nose and mouth with unwashed hands	During the last 7 Days: Never, Rarely, Sometimes, Very Often, Always	Categorical variable
Used disinfectants to clean hands	During the last 7 Days: Never, Rarely, Sometimes, Very Often, Always	Categorical variable

when soap and water were not available

Avoided a social event I wanted to attend	During the last 7 Days: Never, Rarely, Sometimes, Very Often, Always	Categorical variable
Stayed at home from work/school	During the last 7 Days: Never, Rarely, Sometimes, Very Often, Always	Categorical variable
Wore a mask in public	During the last 7 Days: Never, Rarely, Sometimes, Very Often, Always	Categorical variable
Ensured physical distancing in public	During the last 7 Days: Never, Rarely, Sometimes, Very Often, Always	Categorical variable
Avoided contact with high-risk individuals	During the last 7 Days: Never, Rarely, Sometimes, Very Often, Always	Categorical variable

Alcohol/Nicotine Use

Frequency of Alcohol Use	How many days a week do you usually drink alcohol?	Categorical Variable
Number of Alcoholic Beverages Consumed	On a typical night, how many alcoholic beverages do you consume?	Categorical Variable
Drinking Partners	On a typical night, how many people do you usually hang out with when you are drinking alcohol?	Categorical Variable
Tobacco Use	Have you ever used any of the following inhaled tobacco products before today? Check all that apply	Categorical Variable
Frequency of Cigarette Use	During the last 30 days, on how many days did you use <u>cigarettes</u> ?	Categorical Variable
Frequency of E-cigarette Use	During the last 30 days, on how many days did you use <u>E-cigarettes</u> ?	Categorical Variable

Personality Scales

Depression	Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week.	Continuous variable
Impulsivity	Below are a number of statements that describe ways in which people act and think. For each statement, please indicate how much you agree or disagree with the statement.	Continuous variable
Excitement Seeking	A number of statements are shown below that describe some ways in which people act and think. Please indicate for each statement how much you agree or disagree. If you have not experienced that circumstance, please try to describe how you would act or what you think about that situation.	Continuous variable
Risk Taking	A number of statements are shown below that describe some ways in which people act and think. Please indicate for each statement how much you agree or disagree. If you have not experienced that circumstance, please try to describe how you would act or what you think about that situation.	Continuous variable
Perceived Stress	The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate how often you felt or thought a certain way.	Continuous variable

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CURRICULUM VITAE

Ashley Lynn Mayfield

Summary of Qualifications

- **Comprehensive knowledge and understanding** of public health practices and epidemiological methods.
- **In-depth knowledge and understanding** of clinical research studies, health programs, and confidentiality policies regarding protected health information.
- **Computer proficiency skills** with Google Drive, ICON, REDCap, Sharepoint, iRIS, Microsoft Office applications: Word, PowerPoint, Excel, Access and statistical software: SAS, SPSS, and R.
- **Analytical and detail-oriented** with excellent organizational skills to maintain research integrity and reach quality, informative outcomes.
- **Attentive listener and expert communicator** to establish and maintain favorable working relationships with patients, customers, and a host of supportive professionals in the field.

Work Experience

Monroe County Health Department (Environmental Health Division) (05/2018-12/2022)

- Environmental Health Services Manager (9/2021-12/2022)
 - Manager of the Environmental Services Divisions of the Health Department
 - Included Wastewater Sanitation, Food Sanitation, and General Environmental Health
 - Direct oversight over all Environmental Health staff
- Environmental Health Specialist (05/2018-09/2021)
 - Performed duties including data entry, collection, and management, maintaining accurate records related to semi-public and public pools, solid waste haulers and facilities, animal bites, lead inspections, etc., and mosquito surveillance and species identification.
 - Data collection and entry in Microsoft Access databases
 - Mosquito surveillance using mosquito trapping techniques and species identification tools
 - Environmental Site Assessments

Indiana University School of Public Health (Department of Epidemiology/Biostatistics) (08/2017-12/2022)

- Graduate Assistant
 - Performed duties including literature review synthesis, data collection and data entry, grading and assisting with undergraduate coursework and instruction

University of Louisville Division of Infectious Disease (10/2015-07/2017)

- Administrative Research Assistant
 - Performed duties including data collection and entry, cross validation of enrollee information, and informed consent auditing for subjects enrolled into clinical research studies.
 - Data collection and entry into ICON and REDCap databases
 - Cross validation of enrollee information utilizing hospital specific electronic medical records systems
 - Preparation of case report forms for primary data collection by clinical research coordinators
 - Conduct-study specific training
 - Informed consent form auditing and regulatory duties
 - Screening log auditing and regulatory duties
 - IRB Study Application, Continuing Review Application, Deviation/Violation, and Amendment Submissions

Education

Indiana University School of Public Health, Bloomington, IN 47405

- **PhD in Epidemiology (Completion: May 2023)**
- Minor Field of Study: Environmental Health
 - Coursework Completed in 2019
 - Dissertation Proposal Defense Completed in 2021
 - Final Dissertation Defense Completed in 2023

University of Louisville School of Public Health and Information Sciences, Louisville, KY 40202

- August 2015- May 2017
- **Master of Public Health- Epidemiology**
- **Cumulative GPA: 3.8**
- **Practicum Experience (336 hours): University of Louisville Department of Infection Control and Prevention**
 - Student research involving *C.difficile* incidence in the University Hospital
 - Completed an IRB application for a retrospective (chart review) matched case-control study in order to analyze the relationship between *C.difficile* infection and antibiotic use during hospitalization
 - IRB Number 16.0604: Project included a written journal article to be submitted for publication, and a poster to be presented at poster session, Research! Louisville

Valparaiso University, Valparaiso, IN 46383

- August 2011- May 16, 2015
 - MAJOR: Biology
 - MINOR: Human Health Studies

Certification and Licensure

- HIPAA (2021)
- CITI: GCP training, Animal Use OSHA, RCR, Human Subjects and HIPAA Research-Biomedical Research, Research governed by Export Controls, etc. (2021)
- NIMS: 100, 200, 700, 800 (2021)