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The Risky Allele: Association Between a Serotonin Transporter Polymorphism, Novelty Seeking, Alcohol Use, And Drunk Driving in College Students

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Abstract

Sixty percent of college students in the U.S. consumed alcohol in the past month and over half of those that do also partake in binge drinking [18]. In 2014, 31% of deaths due to car accidents were caused by alcohol consumption[3]. Thus, drunk driving, and alcohol use on college campuses is an issue of continuing concern. The current study aims to uncover possible associations between the polymorphism in the serotonin transporter promoter region (5-HTTLPR), the novelty seeking (NS) personality trait, cognitive assessment of risk, and risk taking behavior. While research has examined NS, drunk driving, alcohol use, and the 5-HTTLPR polymorphism individually[7,12, 26, 27], this is the first study to our knowledge to examine these variables in one sample. In addition, the Southeastern United States and Atlanta area are unique demographic regions which could yield unique results. Data was obtained through DNA samples (cheek swabs), and completed questionnaires from student volunteers (n=201). A significant negative correlation was found between the risk assessment of heavy alcohol consumption and frequency of engagement in males ($r=-0.38$, $p<0.05$) (n=62), but not females ($r=-0.08$, $p>0.05$) (n=138). Preliminary genotyping indicates that there is no difference between the LL ($M = 17.6 \pm 7.8$), LS ($M = 17.3 \pm 6.4$), and SS ($M = 16.6 \pm 7.2$) genotypes and their novelty seeking scores ($p>0.05$) (n=42).

Keywords: Serotonin Transporter Polymorphism, Novelty Seeking, Alcohol Use

1. Introduction

College can be an exciting time for many young adults to branch out and try new things with their independence. This new environment may also bring opportunities for young adults to engage in risky alcohol use. In 2014, a study found that 60% of college students consume alcohol in a given month and over half of those who consume alcohol partake in binge drinking[18]. Binge drinking is also more common in college students (35.4%) than individuals not in college (29.3%) [19]. Heavy alcohol consumption may also result in drunk driving. On average, every 53 minutes in the U.S. an individual dies due to a drunk driver[3]. In 2014, alcohol consumption contributed to 31% of deaths due to car accidents[3].

Many studies have reported that alcohol use, and drunk driving is correlated with a polymorphism in the promoter region of the SLC6A4 serotonin transporter gene (5-HTTLPR)[7, 12, 24, 26, 27]. Serotonin, or 5-hydroxytryptamine (5-HT), is a neurotransmitter that has been linked to feelings of joy and contentment[29]. Alcohol consumption results in a spike in serotonin in the brain, therefore increasing feelings of contentment[16]. A serotonin transporter is a protein that brings serotonin back into the presynaptic cell. This process is called reuptake[6]. Reuptake can lower the amount of serotonin the postsynaptic cell receives[6].

The SLC6A4 gene is located on chromosome 12[14, 15] and the two most common alleles in the promotor region are the long and short alleles ("L" and "S", respectively)[14]. Within the promoter there is a variable nucleotide repeat of

20-23 base pairs. The short allele contains 14 copies of this repeat, while the long allele contains 16 repeats. There are three different genotypes of the SLC6A4 promoter polymorphism: homozygous SS, heterozygous LS, and homozygous LL[14, 15]. Due to lower expression efficiency, the S allele presumably reduces reuptake in the human brain, causing increased available serotonin in the synapse[15]. The L allele has greater expression (i.e. more transporters.) Therefore, the L allele has more reuptake and less serotonin in the synapse[15].

Those who have the SS genotype have increased risk for psychological disorders[15] and increased alcohol use[7, 12, 17, 24, 26, 27]. The LL genotype is correlated with novelty seeking as well, but in different ways. Most recent research supports the SS genotype being related to novelty seeking and risk taking behaviors [17], especially the association between the 5-HTTLPR polymorphism, alcohol, and drunk driving [17, 26]. Those who have the SS genotype are more likely to use and be addicted to alcohol, and to use alcohol for longer amounts of time in comparison to those with the LL or LS genotypes[7, 17, 24].

Alternatively, there is support for the LL genotype being involved with risk taking behaviors[13, 17]. For instance, those with the SS genotype are not as likely to exhibit impulsive behavior and are more inhibited in their behavior (e.g. displaying more worry, sensitivity, and fearfulness) when responding to stimuli than those with LS or LL genotypes[20].

1.1 Alcohol And Genetic Factors

Alcohol remains the most commonly abused drug in America [19]. Interestingly, the 5-HTTLPR polymorphism is associated with drinking and risk taking[26]. For instance, college students who have the SS genotype drove under the influence of alcohol, had higher levels of intoxication, drank due to stress, and drank more alcohol during their teenage and young adult years than those with the LL or LS genotype[7, 26]. They also drank more alcohol during a social event, participated in binge drinking, and drank in order to become drunk more often than those with the LS or LL genotypes [7, 12].

One study that had individuals fill out a daily survey for one month found that those who were sophomores and had the SS genotype consumed alcohol around 50% of the days they were surveyed[7]. In addition, those with the LL genotype were far less likely to drink, with little likelihood of drinking due to stressful events[7]. Moreover, the likelihood of becoming intoxicated and driving under the influence decreases with the presence of an L allele in the genotype of an individual[26]. There may be a biopsychological motivation for drinking in college students, especially when they experience recent stressful or traumatic events, which appears to be mediated by the 5-HTTLPR polymorphism[7].

As stated above, SS individuals are more likely to use alcohol. Consistent with those findings, persons with the SS genotype have higher rates of addiction to alcohol than those with the LS or LL genotypes[24]. In fact, with the presence of an S allele, the likelihood of having alcohol addiction increases by 15% [17]. Interestingly, 56% of young adults with the SS genotype had higher alcohol tolerance[27]. This may explain why those with the SS genotype are more likely to be addicted to alcohol than other genotypes[24, 27]. However, there is still much about the brain that has yet to be understood, especially in the case of addiction[27].

1.2 Drunk Driving And Genetic Factors

As mentioned above, alcoholism is influenced by genetic factors. There also is a possible connection between drunk driving (which is closely tied to alcoholism) and genetics[22]. In a study using 278 monozygotic twins, 52% of variance in drunk driving was correlated to the participants' genes, suggesting a strong genetic correlation[22]. Other factors correlated with drunk driving included adult alcohol (18 and above) and binge drinking consumption, as well as teen alcohol (under 18) and binge drinking consumption[22].

Drunk driving may be a symptom of alcohol use disorder, and alcohol use disorder may be where the genetic correlation lies[22]. However, 70% of drunk driving was found to be independent of alcohol use disorder[22]. Perhaps drunk driving is genetically correlated to personality. Indeed, individuals with the S allele (SS or SL) drank more alcohol, and were more intoxicated than those with the LL genotype, with the SS genotype having the highest intoxication[26]. In particular, breath alcohol concentration (BrAC) tests revealed that SS individuals had higher BrAC's after leaving bars compared to other genotypes[26]. Perhaps most interestingly, those with the SS genotype were three times more likely to plan to drive while intoxicated than those with the LL genotype, while those with the SL genotype had intermediate intoxication levels[26].

1.3 Novelty Seeking

One personality trait linked to drunk driving and alcohol use is novelty seeking[1, 8, 10, 12, 25]. Novelty seeking is a personality trait from the (TCI-9) Temperament and Character Inventory created by Robert Cloninger[5]. Novelty seeking can be defined as a predisposition to impulsive risk taking and seeking out new stimulating experiences[5]. One study found that the more alcohol participants consumed, the higher their novelty seeking score was[25].

1.4 Drunk Driving And Novelty Seeking

One issue correlated with both novelty seeking and alcohol use is drunk driving [1, 8,10, 12, 23]. There are correlations between sensation seeking, self-centeredness, and drunk driving in teenagers[1]. Almost 50% of the participants reported driving while intoxicated at some point in their lives, while another 29% had known an individual who had been seriously hurt or killed by a drunk driver[1]. Those who had higher sensation seeking scores were more likely to drive while intoxicated. Those who did drive drunk were more likely to find it less dangerous (e.g. less likely to get in a car accident, or get pulled over, etc.), than those who did not participant in drunk driving[1]. In another study, 60% of the participants reported having engaged in repeated heavy alcohol consumption, and 23% rode in a car with a drunk driver[28]. There was a significant correlation between sensation seeking, repeated heavy alcohol consumption, and riding with a drunk driver[28]. Perhaps the individuals may not necessarily intend to drive while drunk, but they simply become so intoxicated that they lose inhibition[1]. This may also explain why some individuals ride with drunk drivers[28].

1.5 Drunk Driving, Novelty Seeking And Gender

Gender may contribute to novelty seeking and drunk driving. For instance, females who had been convicted of a drunk driving offence are more likely to have sensation seeking tendencies and higher rates of impulsivity in comparison to those who have not been convicted of drunk driving[8]. However, this correlation was only statistically significant for females, not males[8]. In contrast, there is a stronger correlation in male participant's risk taking scores and their confidence in safely driving home while drunk in comparison to female participants[23]. The male participants were found to have drunk more alcohol and to be more intoxicated than female participants. On average, the participants were more likely to have less confidence to drive the higher their breath alcohol levels were[23]. However, many of the males were the opposite, they reported high confidence in driving safely home with higher breath alcohol levels (even if they knew their scores were above the legal limit to drive) [23]. In fact, of this subgroup of male participants, the bulk of them knew their scores were of a dangerous and illegal level[23].

Another study found similar gender differences in participant's drunk driving and risk taking behavior. Male participants were found to partake in drunk driving more often than female participants[10]. They also felt their families viewed drunk driving more favorable than the female participants[10]. In other words, the female participants felt their families would have stronger negative views on drunk driving. Male participants had more DUIs than females, and were found to exhibit alcoholic behavior more than females[10]. Those with higher novelty seeking scores were more likely to believe that their families would view drunk driving as insignificant, partake in drunk driving, have more traffic violations, and suffer from alcoholism[10]. Additionally, those with high novelty seeking scores drive more dangerously, and consume more alcohol[10].

Considerable research has been done to study novelty seeking, alcohol, or drunk driving use in relation to the 5-HTTLPR polymorphism, particularly in college students[7, 12, 26, 27]. However, with this study, we tested a combination of these variables. To our knowledge, this is the first study to examine all of these variables in combination in the diverse Atlanta/metropolitan area. This study aims to uncover associations amongst the 5-HTTLPR serotonin polymorphism, drunk driving, alcohol use, and the novelty seeking personality trait in college students.

1.6 Hypotheses

With the previous research in mind, we predicted that:

(1) The SS genotype will be positively associated with the novelty seeking personality trait.
(2) The rates of drunk driving, alcohol and drug use will be higher in those with the SS genotype

(3) Novelty seeking will mediate drunk driving, alcohol and drug use.
(4) Heavy alcohol consumption will be negatively correlated with heavy alcohol risk assessment
(5) Drunk driving will be negatively correlated with drunk driving risk assessment.
(6) Males will have increased alcohol consumption and drunk driving in comparison to females.

2. Methodology

2.1 Participants

This Institutional Review Board (IRB) approved study was performed at Georgia Gwinnett College in Lawrenceville, Georgia. This is the first study at Georgia Gwinnett College to perform human genetic testing. Participants of the study were obtained from various Biology and Psychology courses on a volunteer basis. The students included male and female students, and ranged in age from 18 to 52 years old. There were 201 subjects total; 138 of the participants were female, 62 were male, and 1 participant identified as "other". For genotype analysis, only 42 participants (28 female, 14 male) have been processed at this time. For the future, we plan to genotype all 201 participants.

2.2 Procedure

At the start of each data collection session we read a script with instructions to participants. No students were allowed to enter the room after the start of the data collection session in order to preserve the integrity of the data collected. The reading of the script informed participants on the procedures of the study. They were informed of their right to leave at any time, and assured of their anonymity in the study. Students were required to complete a consent form at the beginning of every session before they could take the surveys.

Next, students rinsed their mouths with water before giving a DNA sample (buccal cheek swab.) Then, they rubbed the inner surface of their cheeks at least 20 times with the cotton swab from their sample tube. Finally, they placed the cotton swab back into their plastic sample tube (with the top of the swab facing down) to be collected. In order to collect the DNA samples, we put on a clean pair of rubber gloves and picked up the cotton swab containers. Then, we opened the containers to place the cotton swab tops facing upwards. This allowed the swab to air dry before being frozen. After 15-20 minutes, we put on a new pair of rubber gloves, and placed the samples back into their containers and stored for up to 1 week at -20°C prior to DNA extraction.

A second method of data collection was performed after the initial pilot study. In this method, students provided a DNA sample, and were allowed to take their surveys online at a location of their choosing within several days of the DNA sample collection. However, similar to the pilot study, we began each data collection session by reading a script with instructions to the participants. Students were also required to complete a consent form before providing a DNA sample. At this point, students rinsed their mouths with water and rubbed the inner surface of their cheeks with the sample cotton swab. We then read instructions on how to complete the surveys at home. After the participants left, we uncapped their DNA samples to air dry for 15 min and re-capped them to be frozen at -20°C degrees.

2.3 Assessment Measures

Surveys were completed via computers on an online system (SONA). The surveys were counterbalanced in order to assure that data was influenced by ordering effects. The surveys that were completed include: a physical risk assessment inventory (PRAI), a physical risk frequency inventory (PRFI), a sociodemographic survey, and a revised version of Cloninger's Temperament and Character Inventory (TCI-9).

The physical risk assessment and frequency inventories were used to assess how risky participants find 28 different activities (including alcohol and drug use and drinking and driving) to be, and how often they partook in them. The physical risk assessment is scaled from 0-6, with 0 being none, 1 being little, 2-4 being moderate, and 5-6 being extreme. The physical risk frequency inventory allows participants to report the level they engage in each specific activity: never engaged in activity (0), tried the activity 1-3 times in lifetime (1), or engage in the activity on a regular basis (2-7, with each value representing a greater number of days per year the activity was engaged in).

The sociodemographic survey requested information on gender, age, ethnicity, the student's class in college (e.g. freshman, sophomore, junior, or senior), occupation, history of addiction (if any), and a history of injury (i.e. concussion). The Temperament and Character Inventory (TCI-9) is a personality questionnaire with 240 true or false

statements related to the personality traits reward dependence, harm avoidance, novelty seeking, and persistence[5]. It also had questions pertaining to the character traits cooperativeness, self-directedness, and self-transcendence. The questions themselves covered topics such as attitudes, moral beliefs, spiritualty, and behaviors. For this study, novelty seeking, which covers 30 true or false statements, will be the only personality trait studied from the TCI-9.

2.4 DNA Analysis

DNA (buccal check swab) samples were taken from each participant following the Epicentre Biotechnologies protocol in order to determine their 5-HTTLPR genotype. We determined the 5-HTTLPR genotypes of the participants using polymerase chain reaction (PCR) with specific primers (Integrated DNA technologies). For the master mix used for PCR, we used ultra-pure water at 31 µL, Deoxynucleotide (dNTP) at 2 µL (final concentration of 2 µM), TAQ buffer (Go Taq) at 10 µL, one primer (JP) at 1 µL, a second primer (GR) at 1 µL, and TAQ enzyme (GoTaq) at 1 µL. 46 µL of master mix was added to 4 µL of DNA template. The sequence of the JP primer is 5' - ATG CCA GCA CCT AAC CCC TAA TGT – 3'. The sequence of the GR primer is 5' - GG ACC GCA AGG TGG GCG GGA – 3'. The thermocycler (Arktik Thermal TCA0096) was set for a 95 °C two minutes' start and 40 cycles of 95 °C for 30 seconds, 62°C for 30 seconds, 72°C for 30 seconds, and a final 10 min extension at 72°C following the 40 cycles. We loaded the resulting reactions in a 2% agarose gel for electrophoresis (Fisher Scientific FB3000 and FisherBioTech FB-SB-1316). Sybr Green was added to the gel in order to see the reactions under UV light in a UVP BioDoc-It 220 Imaging System (transilluminator). The gel was run at 120 volts for 3 hours.

2.5 Statistical Analysis

Excel and SPSS were used to calculate descriptive and inferential statistics. Pearson correlations were run to determine correlation coefficients for all behavioral and cognitive variables. Mean differences in the behavioral variables (heavy alcohol consumption and drunk driving) and cognitive variables (personality trait and risk assessment of behaviors) were tested via one-way ANOVAs (Analysis of Variance) and, independent sample t-tests for genotype and gender.

3. Data

3.1 Genotype Frequencies And Correlations

At this time, genotype analysis is still under way. However, initial genotype results are presented below:

Table 1. Shows the differences between genotype, personality, and behavior (drunk driving, heavy alcohol comsumption) outcomes.

	LL (n=13)	LS (n=18)	SS (n=11)	
Variables	M=+/- SD	M=+/- SD	M=+/- SD	Significance
Novelty Seeking	17.6 ± 7.8	17.3 ± 6.4	16.6 ± 7.2	n/s
Heavy Alcohol Consumption Engagement	1.0 ± 1.9	0.7 ± 1.5	0.5 ± 0.5	n/s
Drunk Driving Engagement	1.8 ± 1.9	1.2 ± 1.8	1.8 ± 2.0	n/s
*** P<0.001, ** P<0.01, * P<0.05, n/s P>0.05				

Those with the LL genotype have, on average, a novelty seeking score of 17.6. Those with the LS and SS genotypes have novelty seeking scores of 17.3 and 16.6, respectively (Table 2). A one-way ANOVA test revealed no significant difference between the different genotypes ($p>0.05$).

Table 2. Comparison of average estimation of 5-HTTLPR allele frequencies by race from previous studies and the current study's sample.

Published Studies				Our Study (n=42)			
Race	Genotype Ratio			Race	Genotype		
	LL	LS	SS		LL	LS	SS
European American	32%	50%	18%	European American (n=15)	34%	53%	13%
African American	54%	37%	9%	African American (n=10)	40%	40%	20%
Asian American	11%	44%	45%	Asian American (n=7)	28%	29%	43%
Hispanic (North American)	33%	42%	25%	Hispanic (North American) (n=8)	14%	57%	29%
				Multi-Racial (n=3)	33%	0%	67%
				Total	31%	43%	26%
(Haberstick, 2015; Noskova, et al., 2008; Surtees, 2006)							

Our average 5-HTTLPR genotypes are fairly consistent with the national averages[11, 21] (Table 1). However, it should be noted that only 42 out of the 201 DNA samples have been processed at this time. This may account for the slight differences in frequencies (e. g. African Americans with the LL genotype making up 54% of the national average, versus our sample which made up 40%). As we process more samples, our averages may level out to be close to the national averages. On average, the LS genotype was the most common (43%), with LL being the second most common (31%), and SS the least common (26%).

3.2 Novelty Seeking Behaviors, Frequencies And Correlations

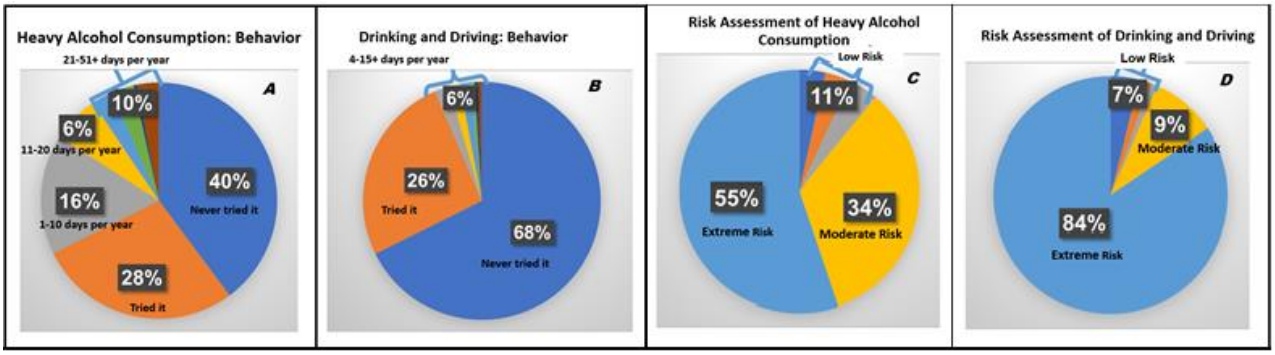

Figure 1. Shows the different ratios of risk assessment and engagement in drunk driving (D, B) and heavy alcohol consumption (C, A).

Nearly half of our participants reported never having heavily consumed alcohol, making it the most common answer (fig.1-A). Most participants have not tried drunk driving (fig.1-B). Interestingly, the risk assessment for both behaviors was also found to be extremely risky by most participants.

Table 3. Correlations between risky behaviors, risk assessment, and novelty seeking.

Correlations	Results
Risk Assessment of Drinking Large Amounts of Alcohol and Frequency of Engagement	r=-0.18*
Frequency of Drinking Large Amounts of Alcohol and Drunk Driving	r=0.42*
Risk Assessment of Drinking Large Amounts of Alcohol and Drunk Driving	r= 0.60*
*** P<0.001, ** P<0.01, * P<0.05, n/s P>0.05	

There was a significant negative correlation (r=-0.18, p<.05) between heavy alcohol use and heavy alcohol risk assessment in men and women (Table 3). This finding is to be expected, as it is consistent with findings from previous studies[4]. A significant positive correlation (r=0.42, p<0.05) was also found between heavy alcohol consumption and drinking and driving in men and women (Table 3). Similar to the previous finding, a significant positive correlation (r= 0.60, p<0.05) was found between risk assessment of heavy alcohol consumption and drinking and driving (Table 3). The correlations between other key variables, particularly novelty seeking, were not significant.

Table 4. Correlations between risky behaviors, risk assessment, and novelty seeking in males and females.

Correlations	Results
Novelty Seeking and Risk Assessment of Drunk Driving	r=-0.06, n/s
Novelty Seeking and Risk Assessment of Drinking Large Amounts of Alcohol	r=-0.02, n/s
Novelty Seeking and Drunk Driving	r= -0.06, n/s
Novelty Seeking and Drinking Large Amounts of Alcohol	r=-0.01, n/s
Risk Assessment of Drunk Driving and Frequency of Engagement	r=-0.02, n/s
Risk Assessment of Drinking Large Amounts of Alcohol and Frequency of Engagement	r=-0.18*
Frequency of Drinking Large Amounts of Alcohol and Drunk Driving	r=0.42*
Risk Assessment of Drinking Large Amounts of Alcohol and Drunk Driving	r= 0.60*
*** P<0.001, ** P<0.01, * P<0.05, n/s P>0.05	

After running pearson correlation tests on all variables, we split them up between males and females. The majority of the correlations found in Table 4 are similar to findings found in Table 3. However, interestingly, a statistically significant negative correlation was found between the risk assessment and frequancy of engagement of drunk driving in males (r=-0.38, p<0.05), but not for females (r=-0.08, p>0.05).

3.3 Male And Female Differences In Behavior And Assessment

A gender analysis revealed no significant differences between the male and female averages for novelty seeking, heavy alcohol consumption, drunk driving, or risk assessment of behaviors, (p>0.05).

3.4 Drinking, Drinking And Driving, And Non-Participation Differences

After calculating the frequencies of our sample grouped as either male or female, we then grouped our sample by either heavy drinkers and non-heavy drinkers, as well as drunk drivers and non-drunk drivers. Heavy drinkers were defined as individuals who engaged in drinking 21-51+ days per year; with 20 or less being non-heavy drinkers. Drunk drivers were defined as individuals who engaged in drunk driving 7-15+ days per year; with 6 or less being non-drunk drivers. Analysis revealed no significant differences between the groups, ($p>0.05$).

4. Discussion and Conclusion

Alcohol use and drunk driving are serious issues in college students. The fact that sixty percent of college students engage in drinking, and that 31% of deaths due to car accidents are caused by alcohol consumption is a cause for concern[3, 18].

We found no correlation between novelty seeking and drunk driving, heavy alcohol consumption, and risk assessment. A fair assumption after reading the literature behind novelty seeking is that individuals with high novelty seeking are prone to find heavy alcohol consumption less risky[25]. However, this does not appear to be the case in our group of participants. Perhaps alcohol consumption is not one of the ways that the participants engage in novelty seeking behavior. Possibly, they engage in risky sexual activities, drug use, or extreme sports. In future studies, we can further investigate how GGC students engage in novelty seeking behaviors.

One of our strongest findings was our correlation between heavy alcohol consumption and risk assessment. We found the more the participants engaged in heavy alcohol consumption, the less risky they found it to be. This is consistent with other studies that have found individuals who viewed alcohol consumption as unhealthy or a risk to their health were less likely to drink it [4]. In other words, heavy alcohol consumption and the risk assessment of engaging in it seems to vary across different studies.

Similar to our findings on heavy alcohol consumption, many GGC students do not partake in drunk driving. In fact, only 6 participants reported driving drunk on a regular basis (4-15+ days per year). When we separated participants into either drunk drivers or non-drunk drivers, we found no difference in their risk assessment of drunk driving. Once again, this may be due to our small sample size of drunk drivers (n=6). Participants found drunk driving to be a far riskier behavior than heavy alcohol consumption. This is an interesting finding, as it speaks on the social climate and attitudes that college students have about alcohol. However, this may be due to the fact that heavy alcohol consumption is legal, while drunk driving is illegal. Although only 6 participants reported drunk driving, it is still concerning that any participants reported drinking and driving at all. Drinking and driving has dangerous consequences. Proper prevention measures need to be taken to reduce this statistic.

A good prevention measure would be to use designated drivers. However, designated drivers may also consume alcohol. One study even found that college students who partook in higher rates of alcohol consumption, were more likely to ride with designated drivers that had already drunk alcohol as well[9]. In fact, 45% of the participants admitted to riding with a designated driver who drank alcohol at some point in their lives[9]. They also found a correlation between the start of drinking age of the participant and riding with a drunk designated driver. Of all the participants in the study, only 7.6% were over 21 years of age, the legal drinking age in the United States[9]. In other words, drinking and driving is an issue that appears to be starting at a young age. Better education methods must be started at a young age to decrease the rate of drinking and driving.

There were some limitations to this study, such as a small sample size, restricting analysis to one polymorphism (5-HTTLPR) and the inherent issues with survey data. However, in the future, we hope to look at possible associations between other genes and polymorphisms with risk taking behaviors, as studies do support the interaction between many genes and novelty seeking behaviors[20]. It would be an interesting area of research to combine polymorphisms in our future studies. Also, beyond these preliminarily findings we have, we want to continue researching 5-HTTLPR. We are recruiting more participants, and continue determining their genotypes. Finally, we would like to look at other drugs in relation to novelty seeking and the 5-HTTLPR polymorphism, as other studies have found increased novelty seeking scores in those who use cocaine[25].

Ultimately, though, why should we care about the findings of this study? As mentioned above, alcohol use on college campuses is an issue of growing concern for not just individual students and faculty, but the greater society at large. These findings could help inform others on the biological predispositions influencing risk taking behaviors. These findings can also help shed light on personalized treatment for the individual's specific addictions and needs. They

may also help shape education and prevention methods to better inform students about the risks of their behaviors. Although our findings are preliminarily, we are optimistic of the potential results to come for such a fascinating and complex topic of research.

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