The Influence of Weapon and Alcohol Cues on Road-Rage in a Driving Simulator

Tyler S Whitlock

The Ohio State University

Abstract

Vehicular crashes are a growing problem in the United States, with an increase of over 10,000 crashes from 2013 to 2014 (Kasich & Born, 2015). One factor implicated in vehicle crashes is aggressive driving. Previous studies of aggressive driving have largely relied on self-reports and after-the-fact analyses. The present study attempts to obtain a more reliable measure of aggressive driving in real time, and to determine whether this behavior is affected by stimuli in the environment. In other studies of aggressive behavior (Subra et al., 2010), features such as the presence of alcohol bottles and weapons have increased aggression. In addition, aggressive behavior seems to be more characteristic of individuals with strong narcissistic personality traits. The present study examined the impact of alcohol cues, weapon cues, and individual differences in narcissism on driving behavior in a driving simulator. Forty university students first completed an online questionnaire that consisted of several narcissism and aggression scales. Participants then drove a pre-designed scenario with instructions to reach the end of the scenario as quickly as possible. Participants were exposed to billboards in the scenario containing advertisements featuring either alcoholic or non-alcoholic beverages, and with either a handgun or a tennis racket on the passenger seat. Driving behavior was measured by examining speed, smoothness of steering, and following distance during driving. Results indicated that the presence of the gun increased driving speed and tailgating behavior, but surprisingly, the presence of non-alcoholic billboards actually produced higher speed and more tailgating behavior. Smoothness of steering was not significantly affected by weapon or alcohol cues.

Introduction

According to the Ohio Department of Public Safety, there were 282,368 total automobile crashes in 2014 in Ohio, a number that was up from the 269,079 crashes reported in 2013 (Kasich & Born, 2014; Kasich & Born, 2015). Given that alcohol was involved in only 4% of these accidents, and 65% occurred during daylight hours, factors other than alcohol or darkness clearly play a role in vehicle crashes. One such factor is aggressive driving, popularly referred to as "road rage." Characteristics of aggressive driving include extensive speed, tailgating, unsafe lane changes, horn honking, etc. When a situation escalates, these behaviors can expand to include verbal outbursts, confrontations, and more extreme and dangerous outcomes. These examples of aggressive driving often make people feel unsafe in their own vehicle and on the road. That alone would make research into aggressive driving a valid activity, but there is even more evidence to suggest its importance. According to a National Highway Traffic Safety Administration survey, an overwhelming majority (98%) deemed doing something about unsafe driving as "important." **(**Nhtsa.gov, n.d**.)** In order to better understand and mitigate unsafe driving, a holistic view of driving, and specifically aggressive driving, needs to be gathered.

To generate solutions to aggressive driving it is important to understand some of the factors that underlie aggressive behavior more generally. These factors are both internal and external. Examining the internal side first can shed some light on why some behaviors may occur in the driving scenario. At one point, a very popular belief was that aggression could be predicted by the internal factor of low self-esteem (Schreer, 2002). The idea behind this line of thinking is that being in a state of low self-esteem is seen as very aversive to the individual and because of that strong negativity the individual will behave violently to relieve it. These aggressive behaviors help to convince the person that the perception of their self-esteem is incorrect.

More recent evidence suggests that this early theory was not correct. A current view is that "threatened egotism" may be the cause of aggression (Schreer, 2002). According to research by Schreer (2002) "inflated self-esteem (i.e., narcissism) was a better predictor of aggressive driving behavior than low self-esteem." **(**p. 338**)**. With respect to aggressive driving, Schreer's view is that the car being driven and the road are seen as "owned" by someone with a very high opinion of themselves and the behavior of the drivers that challenges this opinion may be seen as attacking that ownership (Schreer, 2002**).** This argument has provided solid basis for researchers when examining aggressive driving.

Britt and Garrity (2006) examined road rage through the lens of personality and attributional processing. They first asked participants to recall and think about an experience of three specific scenarios that elicited road rage in them when driving: being tailgated, being cut off, and a person driving slowly in front of them, and then afterwards administered a driving questionnaire and personality battery. They determined that the dimensions of physical aggression, verbal aggression, anger, and hostility scored by the Buss-Perry Aggression Questionnaire "were related to reports of aggressive behavior during all three situations, and were related to reports of anger in two of the situations" (Britt & Garrity**,** p. 142.)

A specific type of personality trait called Narcissism has been frequently linked to aggression. Research by Martinez et al. (2008) examined the relationship between narcissism and aggression with various feedback conditions. Individuals were told they would receive objective feedback about their writing skills compared to another participant, and then compete in a game where they could choose to shock their opponent (and at what levels) following either a win, loss or draw. Participants with high scores on a narcissism scale, when told they would receive feedback about their own writing at the conclusion of the experiment instead of immediately,

shocked the other "participant" significantly more (with the lowest level being 55% of their pain tolerance) despite not being shocked themselves (Martinez et al., 2008). Further work by Reid et al. (2008) in an analogous experiment examined some of the underlying components of narcissism and how they may be related to aggression. Similar to Martinez et al., (2008) they examined aggression based on shocks administered to the opponent. They found two subfactors of narcissism with the greatest associations to aggression: entitlement and exploitativeness, both of which had a moderate effect size (Reid et al., 2008).

Just being predisposed to aggression does not always mean someone will exhibit aggressive behavior. Such behavior is often thought to be prompted by something external. Research on external factors influencing aggression has examined certain kinds of stimuli that might be seen when driving. Bushman and Cooper (1990) conducted a meta-analysis on alcohol and aggression with previous experimentally manipulated research. They found evidence that the effect sizes of alcohol were similar to other variables with aggression (Bushman & Cooper, 1990). Other research has often focused on weapons and their link to aggression. Carlson, Marcus-Newhall, and Miller (1990) also conducted a meta analysis of research and found that aggressive cues (such as weapons can be perceived as) increased aggression significantly when participants were in a negative mood and slightly less so in a neutral mood (Carlson, Marcus-Newhall, and Miller, 1990).

Billboards advertising items similar to those employed in the alcohol and weapon studies described above are often encountered while driving. Many drivers even see weapons like guns in other vehicles. In fact, research by Turner et al. (1975) found that participants honked at a truck with a rifle in a gun-rack significantly more than a truck without a gun in the gun rack, as long as the rifle was perceived as aggressive in nature. Further research by Hemenway, Vrionitis,

and Miller (2006) noted that people who drove with a gun in the car reported using significantly more obscene gestures. These surprising findings may be better explained through research done by Subra, Muller, Begue, Bushman, and Delmas (2010) where alcohol and aggressive cues presented subliminally both similarly automatically increase aggression **(**Subra, Muller, Begue, Bushman, & Delmas, 2010**)**. Participants who were exposed to only to words related to alcohol or aggression were more aggressive to their experimenter by rating them significantly lower on a survey evaluating their performance, even though they were told the rating could affect whether the experimenter kept their job in the future. In essence the research states that just seeing an aggressive word (e.g., assault) or a word related to alcohol (e.g., beer) increases aggression even if the person is not really thinking about it. This is a worrying thought given the number of alcohol billboards and even weapons typically seen along any roadway.

The present study examined road rage and aggressive driving through a synthesis and extension of previous work on internal personality traits and external factors such as weapon/alcohol cues in a more realistic environment than has been used before – a driving simulator. Most previous studies of aggressive driving have had the limitations of only being able to examine behavior after the fact, in situations when the participant may report something different from what actually happened. In the present research all participants drove in the same scenario, just with either the presence or absence of weapon and alcohol cues.

The present study was a 2(presence of weapon vs absence of weapon) x2(presence of alcohol cues vs no alcohol cues) between-subjects design where participants were randomly assigned to one of four groups. Participants were recruited through the Communications Research Experience Program (C-REP) and participated in the study at The Ohio State University Driving Simulation Laboratory. Participants completed some personality

questionnaires to measure narcissism, level of entitlement, and trait aggression. They then drove on a simulated course in a vehicle where there was either a training pistol a tennis racket on the passenger seat. The driving scenario elicited driver frustration, and participants were incentivized to complete the course quickly. Half of the participants were exposed to billboards with advertisements for alcoholic beverages like Budweiser (alcohol cues) and the other half were exposed to billboards advertising non-alcoholic beverages like water.

The present research tested three hypotheses. The first was that participants who were exposed to weapon cues would drive more aggressively, as measured in terms of velocity, tailgating time, and smoothness of steering, than drivers exposed to non-weapon cues. It was expected that participants would become more aggressive when in the presence of the weapon cues and then transfer that generalized aggression to a more specific form of aggression appropriate to driving in the car. The second hypothesis was that participants who were exposed to alcohol cues would drive more aggressively than participants exposed to non-alcohol cues. These participants would similarly become more generally aggressive when in the presence of the alcohol cues and then transfer that general aggression to aggressive driving tendencies. Finally, it was expected that participants who exhibit higher levels of narcissism, entitlement, and trait aggression would also drive more aggressively than participants with lower levels of these traits. In this hypothesis, participants who are more narcissistic would be more likely to react aggressively to the frustrating elements of the scenario (viewing them as attacks on the area owned by them) and drive more aggressively to preserve an inflated sense of self.

Method

Participants

Forty eight participants enrolled in the Communications Research Experience Program of the Communications 1100 class at The Ohio State University participated in the study. Of those participants, 8 were excluded due to simulator errors (4), Simulator sickness (3), or lack of survey data (1)**.** All participants voluntarily signed up for the study, and the two participants with the fastest completion times for the driving scenario received a $25 Amazon gift-card. This study was approved by The Ohio State University's Institutional Review Board, protocol number 2014B0200. Of the 46 total participants, 29 were male, and 11 female. Six participants were removed from final analyses due to simulator errors or simulator sickness issues. No age or other demographic information was recorded.

Materials

Ohio State University Driving Simulator

All participants did their driving at the Ohio State University Driving Simulation Laboratory on the specialized full motion driving simulator. This simulator, manufactured by Realtime Technologies, Inc. (RTI) has a comprehensive setup with a 260 degree screen surrounding the vehicle, simulated LCD side-mirrors, and another projected screen behind the car for a nearly 360 degree viewing experience for the driver. The simulator has a vehicle cab from a 2010 Honda Accord mounted on a 6 degree of freedom motion base, which enables it to move, providing realistic motion cues to the driver. The Honda Accord cab has steering wheel, shifter, simulated dashboard, working turn-signals, gas, and brake pedals.

Realtime Technologies Inc Software

The scenario was designed in a program within RTI's SimCreator software package called Internet Scene Assembler. The course mimicked a two lane road for both sides of traffic. A moderately dense traffic model was used, and traffic was set via javascript to go at 5 mph

below the posted speed limit of 60 mph. Ten billboards were added to the scenario. Five showed advertisements for either alcoholic or non-alcoholic beverages such as vitamin water, and the other five showed advertisements for neutral stimuli like Waffle House. The scenario was constructed to provide a frustrating experience for a driver wanting to complete the course quickly. There were five programmed frustrating events to take place at specific points in the scenario to imitate frustrating elements commonly found in traffic, as follows:

- Pull out car: A car was set to pull out in front of the participant
- Traffic Jam: Participants encountered a traffic jam initiated by a proximity sensor. In the first stage of the traffic jam participants had to wait for 10 seconds, before traffic began moving and then stopped. In the second stage participants waited for 10 seconds before the traffic finally started to move and returned to normal.
- Construction Zone: Participants encountered a construction zone with slowed traffic where there were two poles that required participants and traffic to move into the opposite lane.
- Mimic Car: Participants encountered a mimic car initiated by a proximity sensor. The mimic car positioned in front of the driver, slowed down and would imitate any lane changes made by the participant for 45 seconds before returning to driving normally.
- Short traffic light: Participants encountered a traffic light which was programmed to have a red light on time of 60 seconds and a green light time of 5 seconds. Because only a few cars could move through the green cycle, drivers typically had to wait through multiple cycles of the light before moving past.

Procedures

Participants first signed up online via the Communications Research Experience Program website for a study worth 2.5 credits. The study description was to "examine the factors and length of time that it takes people to adjust to realistically drive in a driving simulator." The description also explained that participants would complete some surveys at the lab and then drive in the driving simulator. All participants were always under the supervision of a moderator, though they were not always in the same room as the moderator.

When arriving at the lab participants first were given a consent form, time to look over that consent form and ask questions if needed before signing. Afterwards participants completed a Qualtrics survey online, which consisted of an Aggression Questionnaire, Psychological Entitlement Scale, Single Item Narcissism Scale, and Narcissism Personality Inventory in that order. Participants completed the survey alone in a separate room with instructions to complete the survey and skip any questions they did not feel comfortable answering.

Once they completed the survey and came out of the room, participants were led to the driving simulator. They were told that the item left on the seat (gun or tennis racket) was part of a previous OSU police study, and that the moderator was supposed to remove it but had not. The moderator for the present study explained that they were not supposed to touch it, so just please leave it alone. Participants were informed that the car was being monitored in case they had a question or felt sick, and to just speak out loud if that was true and they wanted to take a break or stop. They were also told that in the main driving portion of the test that the fastest two participants would receive a $25 gift card at the end of the study. Participants then completed a 3-5 minute drive on a test track to become accustomed to the vehicle. Afterwards they drove on the experimental track for about 15-25 minutes on average.

Once the driving scenario was complete participants were taken out of the simulator, and then debriefed about the true nature of the experiment. Participants were also asked if they would like to withdraw their data (none did). Participants then left and were typically granted credit within twenty-four hours.

Results

To prepare data for analysis, raw driving data collected in the course of testing were first transferred from the RTI software package into spreadsheets. A script was created to parse each individual participant's data and create a master spreadsheet for three measures of driving: average velocity (above 45 mph), tailgating percentage, and steering entropy. The driving scenario was divided into "regions of interest," focused around particular scenario events in the course. This was done to allow examination of driver behavior just before, during, and just after events designed to cause frustration. The script output values for six defined events (start, car pulling out, traffic jam, construction zone, mimic car, and traffic light). Questionnaire responses were also tallied and merged via the Qualtrics ID section of the master spreadsheet. Analyses were then conducted, as described below.

External factors (gun/tennis racket, billboard type)

Mean velocity measures

Figure 2 shows mean velocity above 45 mph and standard error for participants driving with a gun on the passenger seat or a tennis racket on the passenger seat, for each scenario event. Figure 3 shows mean velocity for participants driving a scenario that included billboards advertising alcohol or billboards advertising non-alcoholic beverages, across scenario events. The first dependent variable analyzed was mean velocity above 45 mph. This 45-mph cutoff was chosen to eliminate time spent stopped on the course. Each of the external factors (gun/tennis

racket, type of billboard) was included in the analysis. A three-factor, mixed model analysis of variance (ANOVA) was performed, with between-groups factors of Item (gun vs. tennis racket) and Billboard Type (alcohol vs. non-alcohol advertisements), and a within-groups variable of Scenario Event (the six events described above). The ANOVA yielded a borderline significant main effect of Item, $F(1,36) = 3.049$, $p = .089$. Participants who drove with a gun on the passenger seat drove at a faster speed than those with a tennis racket on the passenger seat.

No significant main effect of billboard type was observed, indicating that participants did not drive at faster speeds in the presence of billboards advertising alcohol. This finding was contrary to our hypothesis that exposure to alcohol cues would increase driving speed. As expected, a highly significant main effect of Scenario Event was observed, $F(4,154) = 16.2$, $p < .001$. This main effect was anticipated because of the highly varied nature of the events. Participant speed would be very different in a construction zone with stopped traffic compared to following a mimic car on the highway.

Analysis of interactions showed a significant Billboard x Event interaction, $F(4, 154) = 3.59$. $p = .006$. Again contrary to our hypothesis, for most scenario events participants driving a course with billboards advertising non-alcoholic beverages drove faster than those exposed to billboards advertising alcohol. No significant interaction was found between Item and Scenario Event or Item and Billboard, and no three-way interaction (Item x Billboard x Scenario Event) was observed.

Tailgating percentage

Figure 4 shows tailgating percentage for participants driving with a gun on the passenger seat and participants driving with a tennis racket on the passenger seat, across scenario events.

Figure 5 shows tailgating percentage for participants exposed to billboards advertising alcohol and billboards advertising non-alcoholic beverages across scenario events.

The second dependent variable analyzed was tailgating percentage. Tailgating percentage was defined as the percentage of total time the participant drove with a following distance behind a lead car of less than two seconds stopping distance. A three-factor, mixed model ANOVA was conducted, with Item (gun vs. tennis racket) and Billboard Type (alcohol vs. non-alcohol advertisements) as between-groups factors, and Scenario Event (the six events described above) as a within-groups variable. Consistent with our hypothesis, there was a significant main effect of Item, $F(1,36) = 5.86$, $p = .02$. Participants who drove with a gun on the passenger seat exhibited a significantly greater percentage of tailgating time than participants who drove with a tennis racket on the passenger seat.

However, contrary to our hypothesis, a significant main effect of Billboard was also found, $F(1, 36) = 11.2$, $p = .002$. Participants who encountered billboards advertising non-alcoholic beverages engaged in a significantly greater percentage of tailgating than participants who encountered billboards advertising alcoholic beverages.

As with velocity, a significant main effect of Scenario Event was observed, $F(4,147) = 21.5$, $p < .001$. Again, because tailgating behavior was not coded for vehicles that were stopped or traveling less than 10 mph, it was expected that tailgating percentage would be very different for different scenario events. A borderline significant interaction between Billboard and Scenario Event was found, $F(4,147) = 2.11$, $p = .08$. As can be seen in Figure 5, differences in tailgating percentage were minimal for the start and traffic light events, but larger for the traffic jam and car pulling out events. No significant interactions of Item x Billboard, Item x Scenario Event, Billboard x Scenario Event, or Item x Billboard x Scenario Event were found.

Steering entropy

Figure 6 shows steering entropy measures for participants driving with a gun on the passenger seat and participants driving with a tennis racket on the passenger seat, across scenario events. Figure 7 shows steering entropy measures for participants exposed to billboards advertising alcohol and participants exposed to billboards advertising non-alcoholic beverages.

Steering entropy was the last driving measure to be evaluated. Steering entropy, used in other studies of driving behavior, is a calculation that reflects the smoothness, or predictability, of steering. A low value for steering entropy indicates a driver who steers smoothly, does not engage in rapid lane changes, and does not jerk the wheel. A three-factor, mixed model ANOVA was performed to assess differences in steering entropy, with Item (gun vs. tennis racket) and Billboard (alcohol vs. non-alcohol advertisements) as between-groups factors, and Scenario Event (from the six defined above) as a within-groups factor. No significant main effects of Item or Billboard type were found, but again as expected, a significant main effect of Scenario Event was observed, $F(3, 125) = 13.1$, $p < .05$. Steering entropy would be expected to differ substantially in different events of the scenario. No significant interactions were observed.

Internal factors (questionnaire data)

Relationships among questionnaire measures

Figure 8 shows the distribution of scores for all participants on the Aggressiveness Questionnaire. This figure shows a slight skew toward lower values of aggressiveness. Figure Figure 9 shows the distribution of scores on the Entitlement Scale. For this measure, a fairly broad distribution of scores was observed. Figure 10 displays scores on the One-item Narcissism Survey. Here, a definite skew toward lower narcissism scores was seen. Finally, Figure 11

shows the distribution of scores on the Narcissism Personality Inventory, which yielded a fairly normally-shaped score distribution.

A multiple correlation analysis (Spearman rank-order correlations) was performed to determine the interrelationships among the questionnaire surveys and between each questionnaire survey and measures of driving performance. The overall result of this analysis is shown in Figure 12. In this figure, dots indicating correlations between performance measures are shown, with positive correlations depicted in blue and negative correlations in red. Only correlations significant at p=.05 are shown. The strength of the correlation is indicated by the color strength and size of the dot.

First, interrelations among the various questionnaire measures were analyzed. Significant correlations among the Aggression Questionnaire, the Personal Entitlement Scale, and the One-question Narcissism Scale were found**.** Somewhat surprisingly, the Narcissism Personality Inventory 16 questions did not correlate significantly with the other questionnaire measures.

Second, correlations across driving measures were analyzed. As expected, a number of these measures were significantly correlated, for example, the various measures of velocity across different scenario regions. Of interest, velocity measures tended to show significant correlations with tailgating percentage. Steering entropy measures did not seem to correlate with other variables.

In Figure 13, a second multiple correlation analysis is shown. For this analysis, measures of velocity, tailgating percentage, and steering entropy were obtained for the entire driving scenario, rather than segregated by regions of interest around scenario events. For this analysis, velocity was limited to speeds above 45 mph. Spearman correlations among the questionnaire measures and driving measures indicate a significant correlation ($\rho = .43$) between the Narcissism

Survey Inventory and mean velocity. In addition, a significant negative correlation ($\rho = -.31$) between the Aggressiveness Survey and steering entropy was found, indicating that individuals with high trait aggressiveness scores tended to exhibit less smooth steering behavior.

Other effects

Although not part of the study's hypothesis, results were also examined to determine if there were any significant effects of participant gender. Because only 11 of the 40 participants were female, this analysis did not have a balanced gender design, and results are thus speculative. No effects of gender were observed for either questionnaire or driving variables in the present study.

Discussion

The present study examined how the influence of alcohol and weapon cues may affect road rage, or aggressive driving, in a driving simulator. As mentioned in the Introduction, there has been considerable research into possible causes of aggressive driving, but most previous research has involved self-reports by drivers after the fact. Little research has experimentally manipulated factors such as alcohol cues or the presence of weapons and evaluated effects on driving.

The present study extended previous research by examining the influence of alcohol and weapon cues, as well as internal traits of aggressiveness, entitlement, and narcissism on driving in real time. There were two main hypotheses for the external factors of weapon and alcohol cues. The first hypothesis was that participants who were exposed to a weapon cue would behave more aggressively. These participants would transfer aggressive tendencies to driving and would thus drive more aggressively than those exposed to a non-weapon cue. The second hypothesis was that participants who were exposed to alcohol cues would also behave more

aggressively. These participants would also transfer that general aggression over to driving and would drive more aggressively than participants exposed to non-alcohol cues.

The research questions were tested with a 2 x 2 (weapon/non-weapon and alcohol cues/no alcohol cues) between-subjects design. The data were first analyzed in terms of these external factors. Our hypothesis that weapon cues would prompt more aggressive driving behavior was substantially supported, with participants exhibiting higher average driving speed and a greater percentage of tailgating time when exposed to the gun on the passenger seat than when exposed to the tennis racket on the passenger seat. This finding is in good agreement with previous studies showing that the mere presence of a weapon in the environment will produce more aggressive behavior (Subra et al., 2010).

However, our hypothesis about alcohol cues was not supported. Contrary to our expectations, exposure to billboards advertising non-alcoholic beverages prompted higher average speed and somewhat higher tailgating percentages than did exposure to billboards advertising alcoholic beverages. It is not clear why this puzzling effect was observed. The study was designed to ensure that participants looked at the billboards in the scenario, by instructing them to look for a billboard that said "Finish," indicating completion of the course. One possibility that bears further investigation is whether the billboards advertising alcohol were intrinsically more interesting to participants, and thus participants drove more slowly and tailgated less when passing a billboard advertising alcohol. This explanation was not specifically addressed in the present study, but future work could examine billboard-related factors in more detail.

Internal factors, measured by questionnaire data, were somewhat correlated with each other. However, it was somewhat surprising that intercorrelations among the various

questionnaire surveys were not stronger. In terms of correlations between questionnaire data and driving measures, of greatest interest here was the significant correlation between the Narcissism Survey Inventory and driving speed. This supports a secondary hypothesis of the present study that individuals with a very strong degree of self-involvement would be more likely to drive aggressively in the face of frustrating events.

There were a number of aspects of the present study that may have impacted the results. The most important of these was that participants were recruited from an introductory college course pool. A number of them had already participated in other research studies and expressed that they were not surprised when the deception aspect of the study was explained to them during debriefing. This general suspicion may have affected their driving performance, as well as their responses on the various questionnaire measures.

A second aspect of the study design that should be considered is the fact that all of the questionnaire measures were completed before driving in the scenario. This was necessary to ensure that responses on the questionnaires were not affected by the frustrating driving experience. Participants had been told that the study would be examining how long it took drivers to become accustomed to driving in the simulator. But the specific personality measures selected for administration may have alerted some participants to the fact that characteristics such as narcissism, aggressiveness, and entitlement were being evaluated in the study, and may have affected their responses and driving behavior. Future work could include other personality trait inventories that would not be of specific interest for the study, but would serve to avert suspicion by participants.

Finally, participants were aware that the experimenter was watching their driving performance on video. Even though the experimenter was not present in the car with the

participant, the fact of being watched could have had an impact on driving behavior. Participants may have felt a need to be on "good behavior," because their driving performance was being observed. In the present study an attempt to minimize this tendency was made by instructing participants that the fastest finishers would receive $25 gift cards. The incentive to complete the course quickly was expected to overshadow any tendencies to behave more conservatively due to being observed. Given all of these possible confounds to the study, it is impressive that a weapons effect was demonstrated.

Although the actual differences between the weapon and non-weapon groups in driving measures, such as speed were not great, it is important to realize that a speed increase of even a few miles per hour can be sufficient to make the difference between an accident and a safe driving experience. Thus, the effects observed in the present study represent a solid contribution to the discussion of factors that impact aggressive driving.

Bibliography

Britt, T. W., & Garrity, M. J. (2006). Attributions and personality as predictors of the road rage response. *The British Journal Of Social Psychology / The British Psychological Society*, 45(Pt 1), 127-147.

Bushman, B. J., & Cooper, H. M. (1990). Effects of alcohol on human aggression: An integrative research review. *Psychological Bulletin, 107*(3), 341-354. doi:10.1037/0033-2909.107.3.341

Hemenway, D., Vriniotis, M., & Miller, M. (2006). Is an armed society a polite society? Guns and road rage. *Accident Analysis & Prevention, 38*(4), 687-695. doi:10.1016/j.aap.2005.12.01

Kasich, J., & Born, J. (2014). *2013CrashFacts* (1st ed., pp. 6-7). Columbus: Ohio Department of Public Safety. Retrieved from http://www.publicsafety.ohio.gov/links/2013CrashFacts.pdf

Kasich, J., & Born, J. (2015). *2014CrashFacts* (1st ed., pp 6-7). Ohio Department of Public Safety. Retrieved from http://www.publicsafety.ohio.gov/links/2014CrashFacts.pdf

Martinez, M. A., Zeichner, A., Reidy, D. E., & Miller, J. D. (2008). Narcissism and displaced aggression: Effects of positive, negative, and delayed feedback. *Personality and Individual Differences, 44*(1), 140-149. doi:10.1016/j.paid.2007.07.012

Martinez, M. A., Zeichner, A., Reidy, D. E., & Miller, J. D. (2008). Narcissism and displaced aggression: Effects of positive, negative, and delayed feedback. *Personality and Individual Differences, 44*(1), 140-149. doi:10.1016/j.paid.2007.07.012

Nhtsa.gov, *Aggressive Driving*. Retrieved 20 September 2015, from http://www.nhtsa.gov/people/injury/aggressive/aggproplanner/page05.htmSchreer, G., (2002).

Schreer, G., (2002). Narcissism and Aggression: Is Inflated Self-Esteem Related to Aggressive Driving? *North American Journal of Psychology*, 4(3), 333-342.

Subra, B., Muller, D., Begue, L., Bushman, B., & Delmas, F. (2010). Automatic Effects of Alcohol and Aggressive Cues on Aggressive Thoughts and Behaviors. *Personality and Social Psychology Bulletin*, 1052-1057.

Subra, B., Muller, D., Begue, L., Bushman, B. J., & Delmas, F. (2010). Automatic Effects of Alcohol and Aggressive Cues on Aggressive Thoughts and Behaviors. *Personality and Social Psychology Bulletin, 36*(8), 1052-1057. Retrieved March 1, 2016.

Turner, C. W., Layton, J. F., & Simons, L. S. (1975). Naturalistic studies of aggressive behavior: Aggressive stimuli, victim visibility, and horn honking. *Journal of Personality and Social Psychology, 31*(6), 1098-1107. doi:10.1037/h0076960

Figure 1. Driving Simulator in motion with a scenario running.

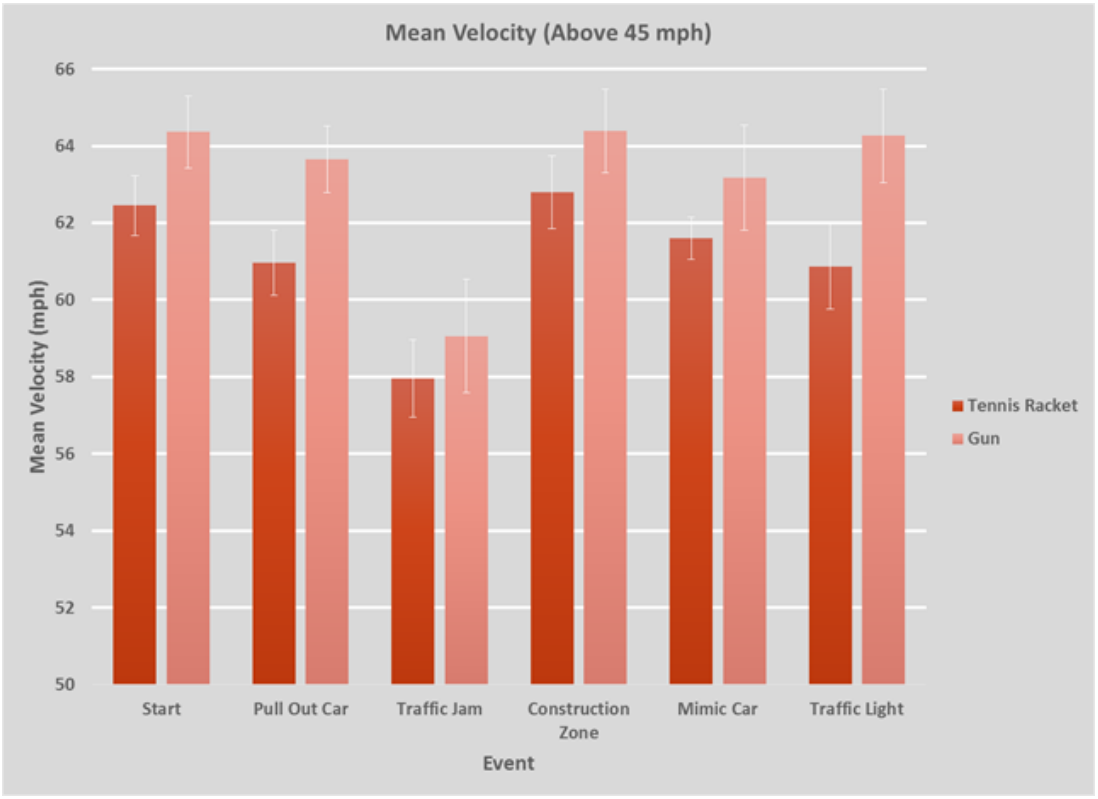

Figure 2. Effects of Item on Mean Velocity above 45 mph, error bars represent standard error.

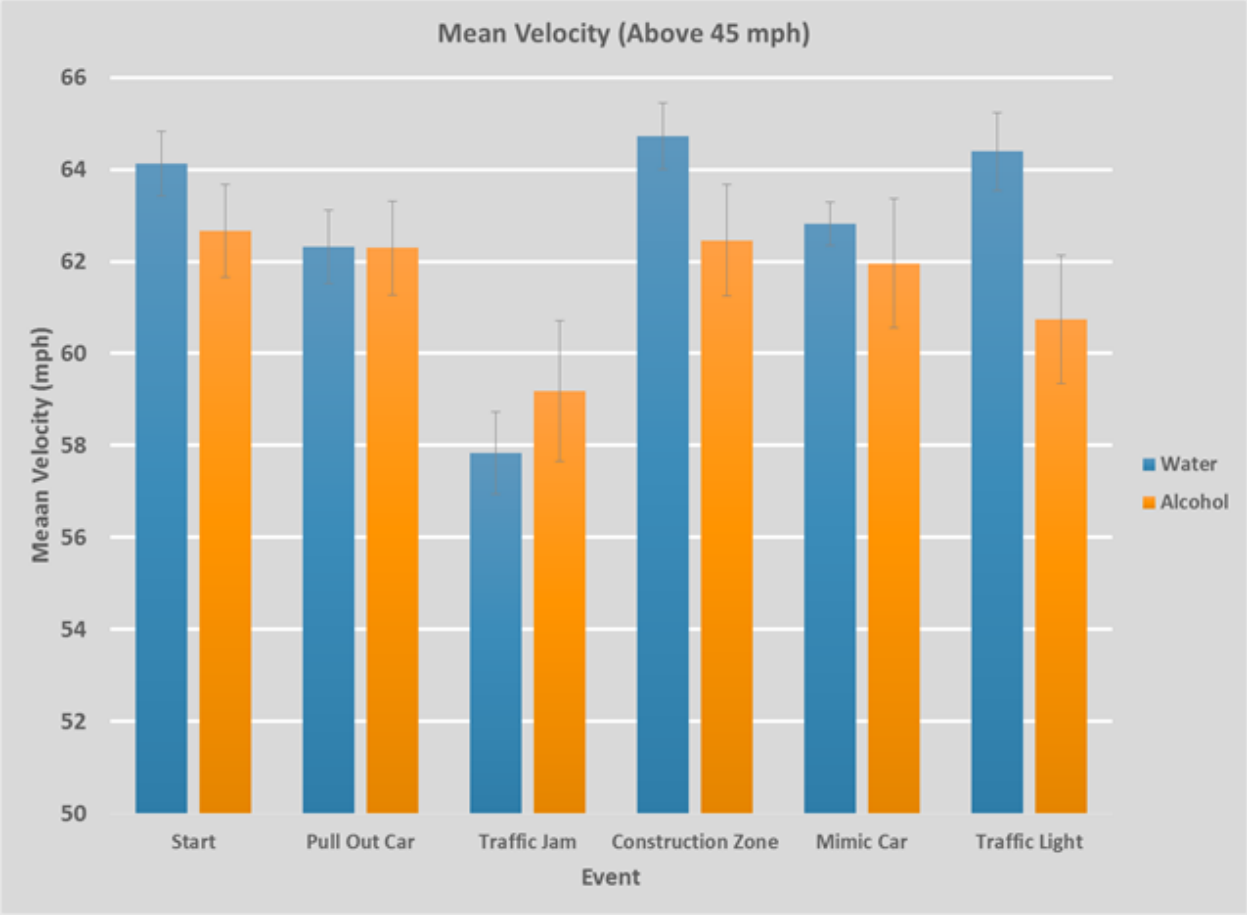

Figure 3. Effects of Billboard Type on Mean Velocity above 45 mph, error bars show standard error.

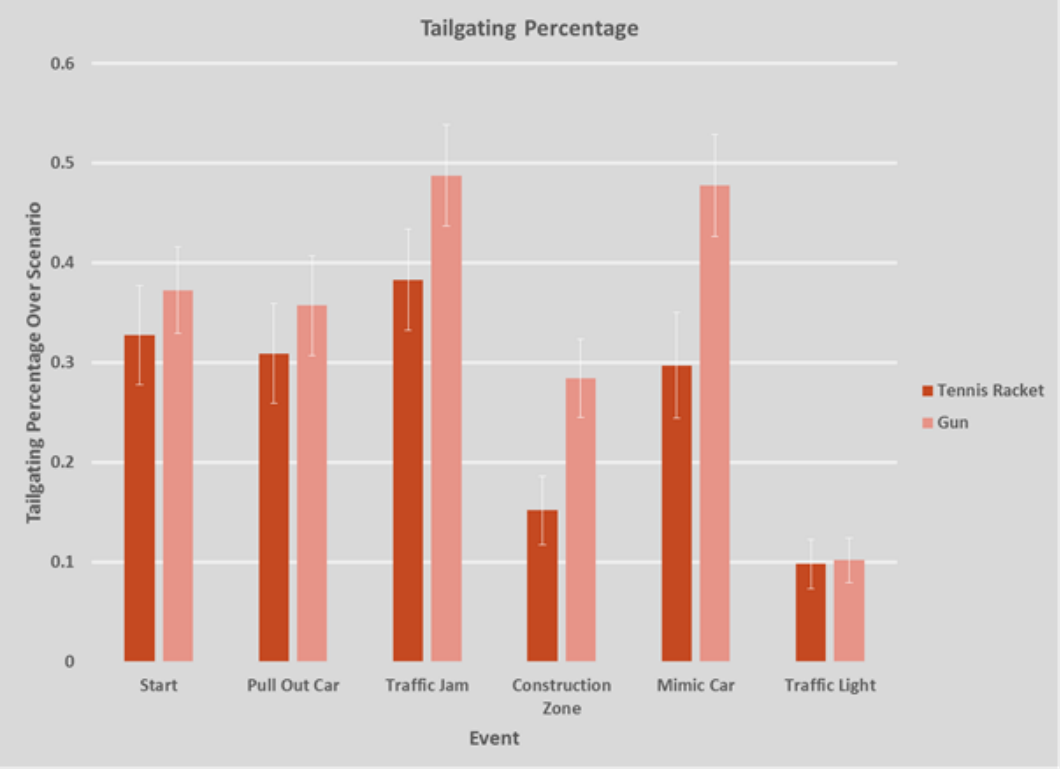

Figure 4. Effects of Item on Mean Velocity above 45 mph, error bars represent standard error.

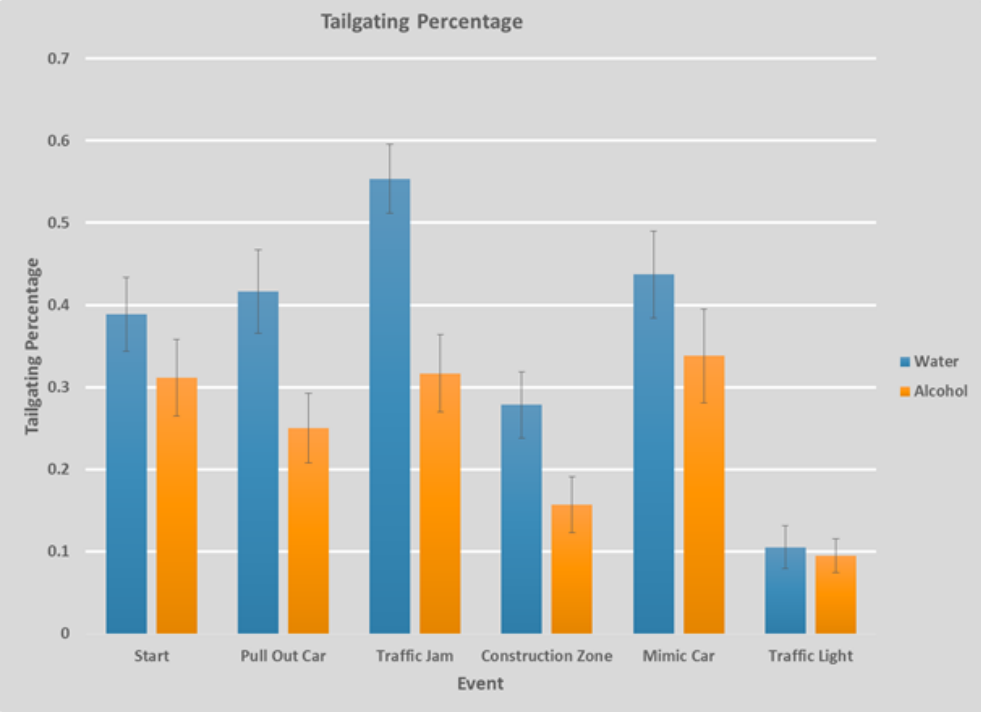

Figure 5. Effects of Billboard Type on Tailgating percentage, error bars represent the standard error of the mean.

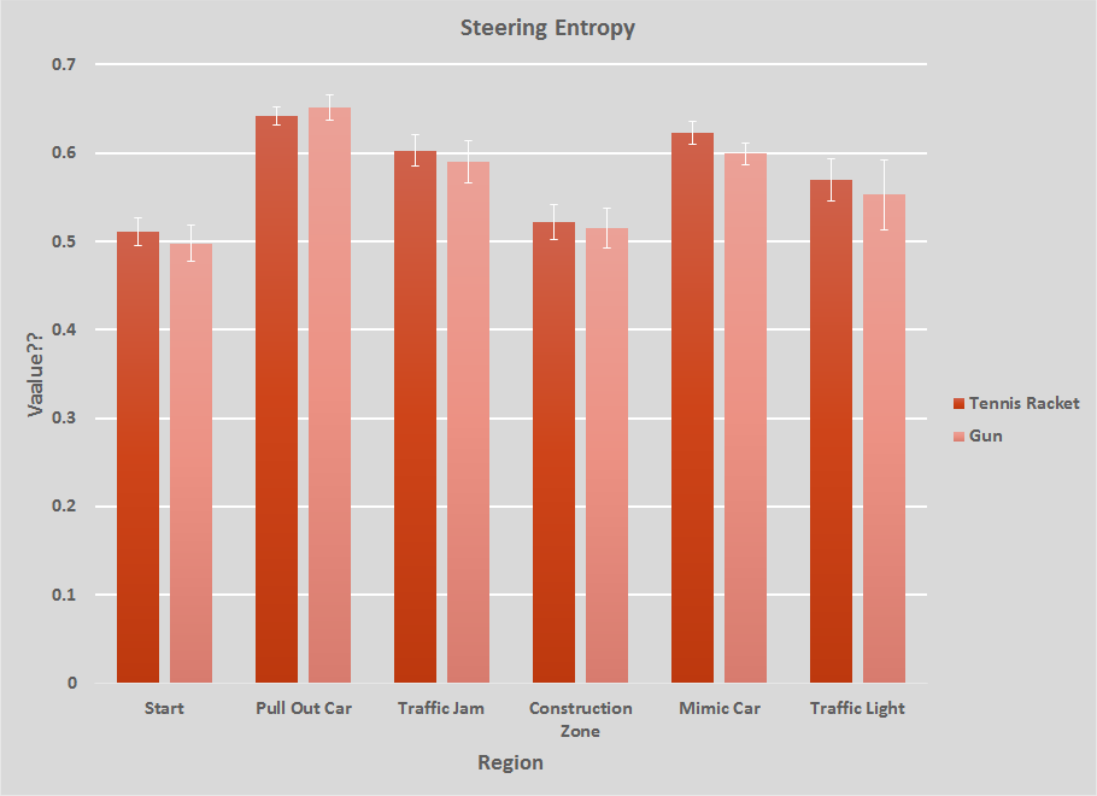

Figure 6. Effects of Item on Steering Entropy, error bars are standard error.

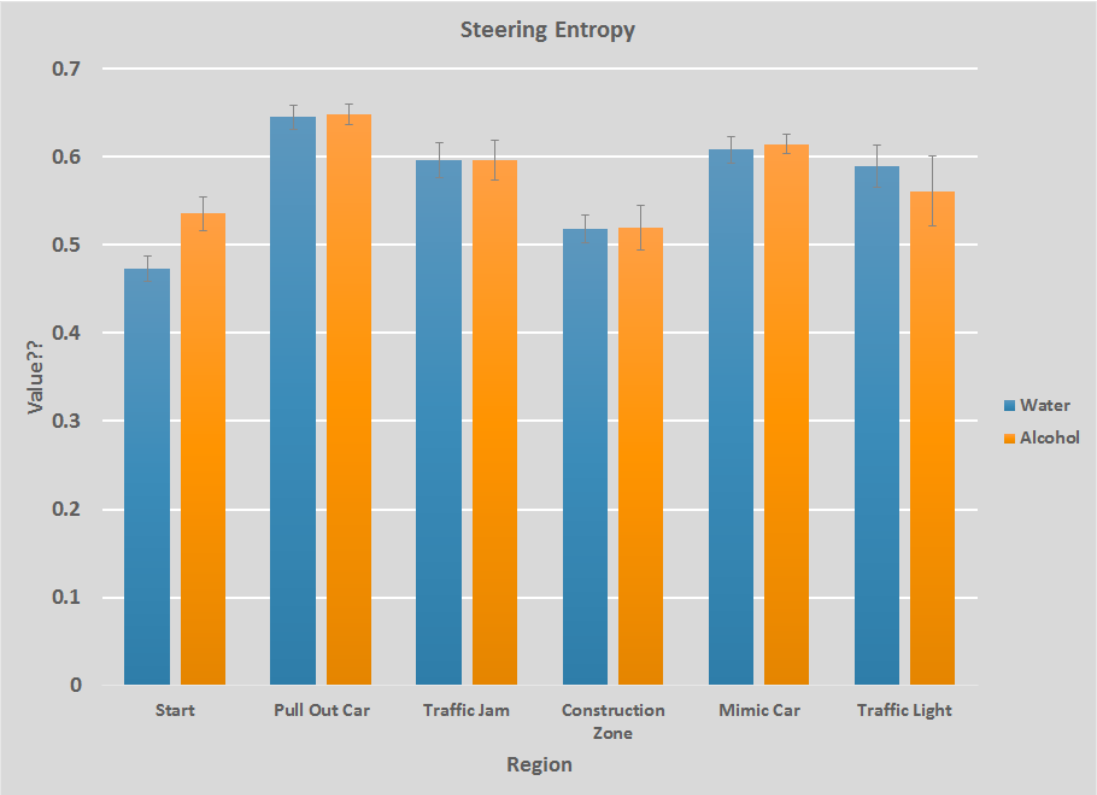

Figure 7. Effects of Billboard Type on Steering Entropy, error bars are standard error.

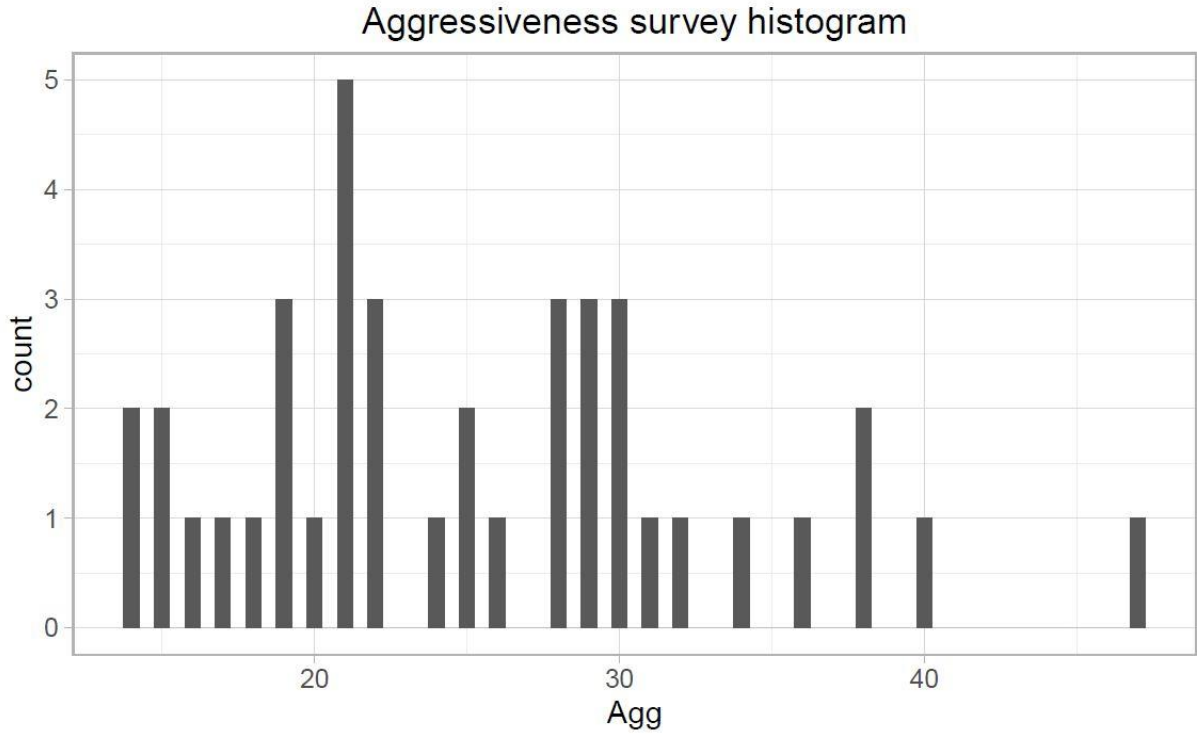

Figure 9. Histogram of responses to the Aggression Questionnaire.

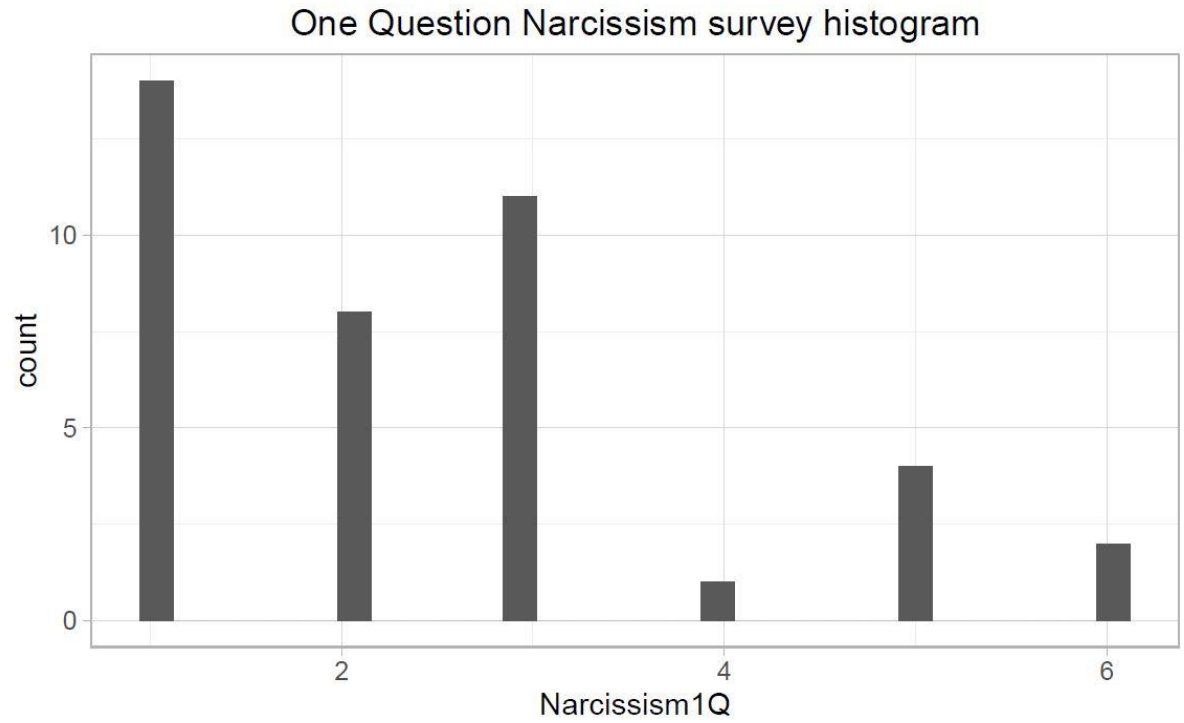

Figure 10. Histogram of responses to the One Question Narcissism Scale.

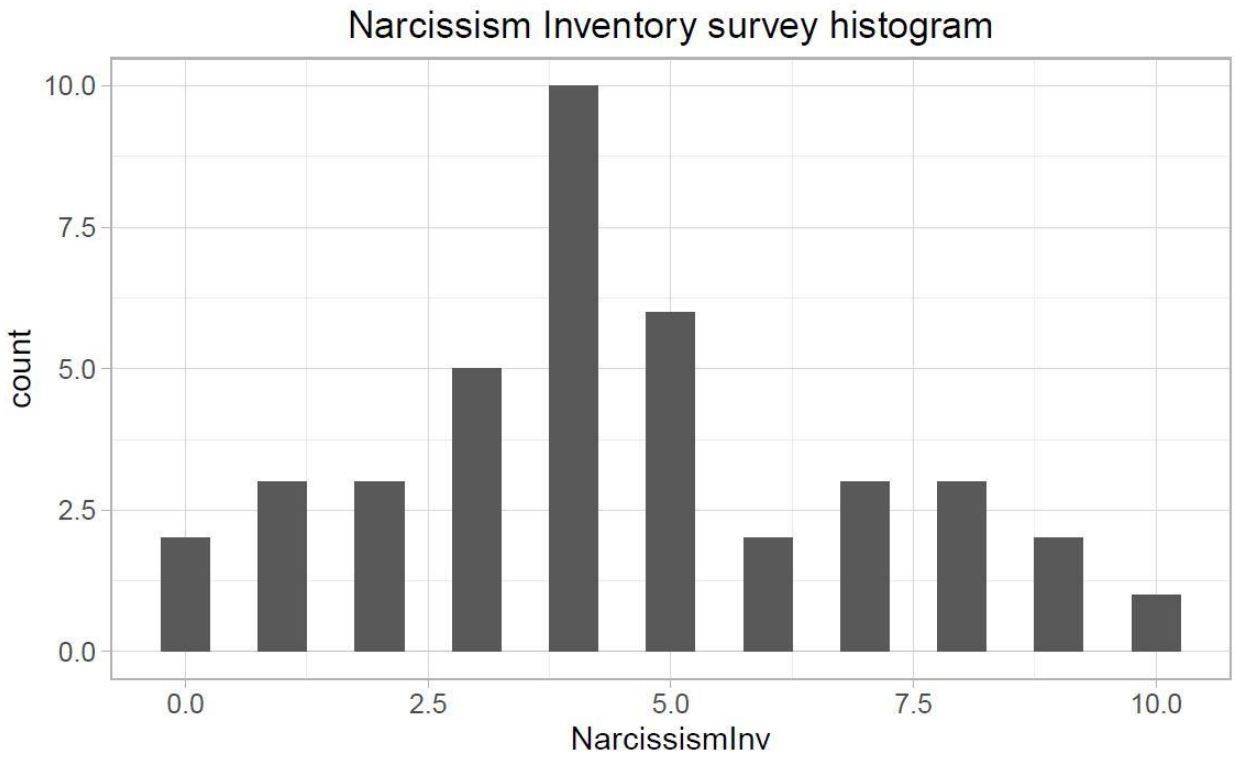

Figure 11. Histogram of responses to the Narcissism Personality Inventory 12 Question Survey.

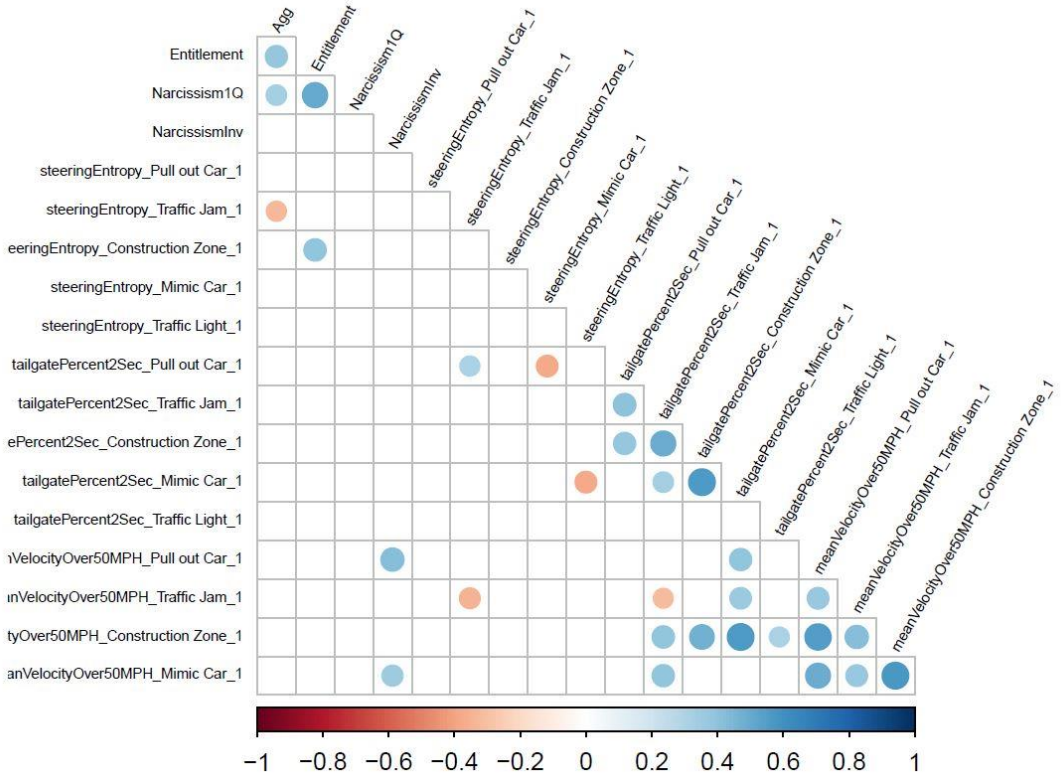

Figure 12. Correlation plot only showing significant correlations, p<.05)

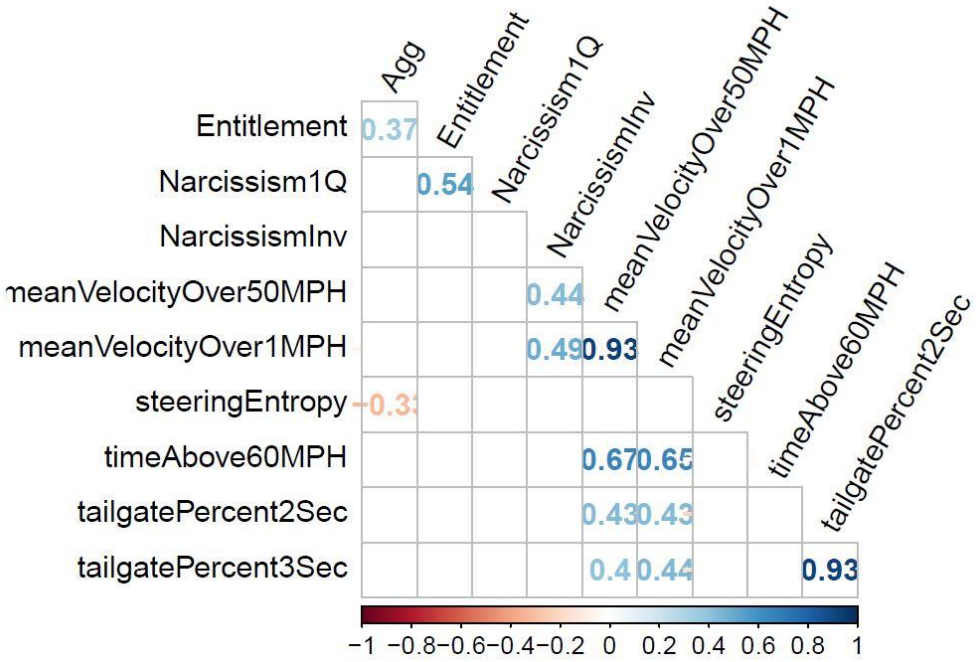

Figure 13. **Correlation plot with only correlations above .4 shown.**