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Alcohol Outlet Density, Heavy Episodic Drinking, and Sexual Violence Perpetration: A Multilevel Mediation Model

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ALCOHOL OUTLET DENSITY, HEAVY EPISODIC DRINKING, AND SEXUAL

VIOLENCE PERPETRATION: A MULTILEVEL MEDIATION MODEL

by

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Under the Direction of Kevin Swartout, PhD

ABSTRACT

Current campus sexual violence prevention strategies have focused almost exclusively on person-level change by targeting individuals' attitudes and behaviors. However, few of these programs have demonstrated effectiveness and few studies have investigated alternative prevention strategies that could be implemented across multiple levels of analysis. One potential promising community-level prevention strategy is alcohol availability. Alcohol is a significant predictor of sexual violence perpetration and alcohol outlet density is a significant positive predictor of violence and crime in campus and community samples. However, no study to date has assessed the effect of alcohol availability on campus sexual violence. The current study examined the extent to which alcohol availability, defined as alcohol outlet density within a

specified radius, was a community-level risk factor for sexual violence perpetration on college campuses. Using publicly-available alcohol license data and self-report data from a recently-completed longitudinal cohort study of college men, a three-level mediation model was estimated to investigate the effect of institution-level alcohol availability on college men's alcohol use and sexual violence perpetration. Institution-level alcohol availability within a three-mile radius did not predict college men's heavy episodic drinking or sexual violence perpetration and heavy episodic drinking did not mediate the relationship between alcohol availability and person-level sexual violence perpetration. Although these findings are surprising, alcohol availability is more complex than alcohol outlet density and there are several other factors that may be important to understand alcohol availability, especially near college campuses (e.g., alcohol control policies, enforcement of legal drinking age laws, culture of alcohol outlets). Findings from the post-hoc exploratory model suggest that changing norms related to drinking may be a way to both reduce heavy episodic drinking and prevent sexual violence perpetration. Perceptions of drinking behavior, aggregated at the institution-level, significantly predicted heavy episodic drinking, which mediated the relationship between perceptions of drinking behavior and sexual violence perpetration. Combining these findings with evidence of successful social norms campaigns related to drinking provides some hope for identifying potential community-level risk factors for sexual violence perpetration.

INDEX WORDS: Alcohol outlet density, Sexual violence perpetration, Binge drinking, Heavy episodic drinking, Multilevel SEM, Alcohol availability

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DEDICATION

I dedicate this dissertation to KLB, MKB, BNC, and my VAWP/IPB family (past and

present). Your support and love has been invaluable and allowed me to accomplish this goal.

Without you all, I would not be here. Thank you.

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1   INTRODUCTION

Sexual violence (SV) on college campuses is a serious public health concern. With very few exceptions, current campus SV prevention strategies have focused on person-level change by tailoring programs to target individuals' attitudes and behaviors (DeGue et al., 2014; Newlands & O'Donohue, 2016). Although person-level prevention strategies are a necessary component of a comprehensive approach; these efforts alone are unlikely to lead to large scale change (DeGue et al., 2012). More research is needed to examine prevention strategies that can be implemented across multiple levels of analysis (e.g., person, community, societal). Alcohol use, specifically heavy episodic drinking (i.e., binge drinking), is one of the strongest and most consistent predictors of campus SV perpetration (e.g., Abbey, Wegner, Woerner, Pegram, & Pierce, 2014). Alcohol availability around campuses is therefore an area ripe for further investigation and potential intervention. In fact, preliminary research suggests changing policies to reduce alcohol availability may reduce rates of drinking, crime, and violence in communities and on college campuses (Lippy & DeGue, 2014; Toomey, Lenk, & Wagenaar, 2007). These initial findings are promising, but there has yet to be a study to fully test the effect of campus alcohol availability on college SV perpetration. The current study will address this gap by investigating the effect of institution-level alcohol availability on college men's self-reported heavy episodic drinking and sexual violence perpetration.

Sexual violence – defined as coerced, non-consensual sexual activity – includes coerced sexual contact, completed or attempted drug-facilitated penetration, and completed or attempted penetration using threats or physical force (Basile, Smith, Breiding, Black, & Mahendra, 2014). Rates of SV perpetration on college campuses are staggering: nearly one quarter of college men reported perpetrating some form of SV during college in a national study from the 1980s (Koss,

Gidczy, & Wisneski, 1987). More recent studies conducted on individual college campuses have found between 12% and 14% of college men report perpetrating some form of sexual violence in the past year (Abbey & McAuslan, 2004; Thompson, Swartout, & Koss, 2013). Due to these high rates of perpetration, prevention of SV on college campuses is a federal priority. The previous presidential administration launched the "Not Alone" campaign and named the White House Task Force to Protect Students from Sexual Assault with the explicit goal of "measuring the success of prevention and response efforts at institutions" (Obama, 2014). Colleges and universities across the country have conducted climate surveys and invested in prevention programming in an effort to reduce sexual violence on their campuses (Krebs, Lindquist, Berzofsky, Shook-Sa, & Peterson, 2016). Unfortunately, recent reviews have concluded that to date only a few prevention strategies have demonstrated positive effects on behavioral outcomes (i.e., sexual violence victimization and perpetration; Coker, et al., 2017; DeGue et al., 2014; Newlands & O'Donohue, 2016). Of these effective strategies, two were implemented at the person-level. Person-level prevention efforts are unlikely to lead to large scale change due to the cultural and environmental context that continues to support and encourage violence against women (DeGue et al., 2012). Even if these person-level programs could be implemented across the population, it is unlikely they would be a cost-effective solution due to the large amount of resources necessary to implement many of these programs. Therefore, it is imperative that researchers investigate alternative prevention strategies that can be implemented at the community-level. To date, only two studies have examined community-level risk factors for gender-based violence and findings from these studies are mixed (Tharp et al., 2013). One study, from India, examined the effect of average education and community norms related to physical abuse and found that community norms related to physical abuse were related to physical

violence perpetration (Koenig, Stephenson, Ahmed, Jejebhoy, & Campbell, 2006). The second study, from Germany, found rates of sexual violence perpetration were higher among the men who were from East Germany but did not investigate or explain the specific community-level factors that might have contributed to this difference (Krahe, 1998). These two studies represent a small first step in investigating the role community-level factors may play in perpetration of sexual violence. Additional research is needed to understand the potential community-level risk and protective factors that might be effective prevention targets.

One potential community-level risk factor for perpetration of sexual violence may be alcohol availability around college campuses. Research suggests that a higher number of alcohol outlets near campus is related to increased alcohol consumption, more alcohol-related problems, and higher rates of general campus violence (Campbell et al., 2009; Kypri, Bell, Hay, & Baxter, 2008; Scribner et al., 2008; Scribner et al., 2010; Wechsler & Nelson 2008; Weitzman, Folkman, Folkman, & Wechsler, 2003). Reducing alcohol availability may therefore be an effective community-level prevention strategy. Policies that reduce access to alcohol by increasing taxes, reducing the days and hours that alcohol is for sale, and banning the sale of alcohol in a specific municipality can have positive effects on alcohol consumption, self-reported physical assault victimization, and alcohol-related injuries (Campbell et al., 2009; Hahn et al., 2012; Weschler, Lee, Gledhill-Hoyt, & Nelson, 2001; Weschler, Lee, Hall, Wagenaar, & Lee, 2002a, see Lippy & DeGue, 2014 for a review). On college campuses, policies that prohibit alcohol either in general or in specific residence halls have demonstrated beneficial effects on alcohol consumption and self-reported sexual violence victimization (Weschler et al., 2001; Weschler et al., 2002a). In general, rates of alcohol consumption and heavy episodic drinking were lower on campuses with general alcohol bans. Students at colleges with general alcohol bans also reported experiencing

secondhand effects of drinking (e.g., being insulted, having a serious argument, experiencing an unwanted sexual advance) at lower rates than students at colleges without a general ban, but they did not report experiencing sexual assault victimization at lower rates (Weschler et al., 2001). Students who reported living in controlled living arrangements (e.g., substance free dorms) reported less binge drinking and fewer second-hand effects, including sexual violence victimization, when compared with students living in uncontrolled living arrangements (e.g., fraternity or sorority housing, non-substance free dorms; Weschler et al., 2002a). Alternatively, more permissive alcohol policies, such as privatization and permissive licensing, are associated with negative outcomes (e.g., increased consumption, more alcohol related harms; Campbell et al., 2009; Hahn et al., 2012). Privatization, which occurs at the state- or local-level, allows for the sale of alcoholic beverages by private companies instead of government-controlled monopolies. Across seventeen studies, privatization lead to an increase in alcohol sales, which is often used as a proxy for alcohol consumption. The median increase in alcohol sales across the studies was 42%, suggesting that alcohol privatization led to a 42% increase in alcohol consumption (Campbell et al., 2009). Additionally, more permissive alcohol licensing was related to higher alcohol consumption and more alcohol-related harms due to an increase in the number of alcohol outlets (Campbell et al., 2009).

1.1   Theoretical Overview

The current study is guided by two overarching theories: the Alcohol Myopia Model (AMM; Steele & Josephs, 1990), which helps to explains the link between alcohol consumption and violence at the person-level, and Gruenewald's (2007) social ecological theory, which describes how an increase in the number of alcohol outlets leads to an increase in crime at the community-level. Together, these two theories, which operate at different levels of analysis, help

to explain how and why alcohol outlet density may lead to an increase in sexual violence perpetration by creating situations in which perpetrators have greater access to alcohol that impairs their perception and processing of cues, support from similar peers, and opportunities to encounter potential victims.

There is a well-established link between alcohol and violence. Research suggests that alcohol consumption is related to committing violence such as homicide, assault and battery, and intimate partner and sexual violence (Brewer & Swahn, 2004; Steele & Josephs, 1990). There are numerous explanations for this link, but alcohol myopia is currently the most promising theory for explaining the link between alcohol and violence (Chermack & Taylor, 1995; Giancola, Josephs, Parrott, & Duke, 2010; Quigley & Leonard, 2006). The Alcohol Myopia Model (AMM), a general model that explains the effects of alcohol on behavior, posits that impairment of perception and information processing can explain the effects of alcohol despite wide variations in individuals' reactions to alcohol consumption (Steele & Josephs, 1990). Myopia – impairment of information processing – interacts with environmental factors to influence social behavior. Drunken excess, which refers to excessive and extreme social actions often the result of consumption, is a type of effect that is at the root of many negative and destructive behaviors (e.g., gambling, aggression). The pharmacological effects of alcohol, which both restrict the number of cues that individuals can attend to and limit individuals' ability to make meaning of those cues, can explain this type of effect (Steele & Josephs, 1990). This general model has been extended to explain how myopia leads to the perpetration of sexual violence (Abbey, 2002; Abbey et al., 2014). Alcohol myopia may lead an intoxicated person to ignore cues related to non-consent in favor of those most immediate and salient, such as sexual arousal or sense of entitlement, thus leading to action without consideration of the consequences

(Abbey et al., 2014). However, pharmacological impairment following alcohol consumption does not completely explain how alcohol might facilitate sexual violence. Contextual factors of alcohol consumption, such as the situations and places where people drink and the cultural and psychological factors related to drinking, interact with alcohol myopia to influence social behavior. In the case of sexual violence, alcohol is often considered a situational predictor because assaults usually occur on dates and at parties where alcohol is being consumed (Abbey, 2002; Abbey et al., 2014). Certain cultural and psychological expectations exist in these situations which may influence the way cues are perceived and expectations for social behavior. For example, drinking on a date may signal expectations related to sexual scripts, such as women acting as gatekeepers who say "no" when they mean "yes" (Shotland & Hunter, 1995). Drinking in a bar or at a party provides more opportunities to encounter potential victims who may also be intoxicated (Abbey et al., 2014). Both alcohol myopia and contextual factors of alcohol consumption can help to explain perpetration of sexual violence at the person-level. Alcohol myopia and contextual factors interact to reduce individuals' ability to make meaning of internal and external cues, which leads to negative social behaviors such as sexual violence perpetration (Abbey et al., 2014; Steele & Josephs, 1990).

In his iteration of social ecological theory, Gruenewald (2007) argues that the link between alcohol outlet density and crime is driven by two factors. First, an increase in the number of alcohol outlets leads to an increase in the number of alcohol consumers. An increase in alcohol consumers does not explain an increase in crime alone; therefore, Gruenewald argues that the increased stratification of drinkers leads to an increase in crime (Gruenewald, 2007). Stratification is a natural result of increased diversity of alcohol outlets and may result in concentrations of high risk drinkers around certain alcohol outlets. Creating niches where high

risk drinkers concentrate leads to hotspots for crime. Additionally, the groups that visit alcohol outlets tend to attract other similar groups who mutually support and reinforce negative attitudes and behaviors. Together, an increase in consumers and the stratification of high risk drinkers into high risk niches explains the link between increased alcohol outlet density and crime (Gruenewald, 2007).

1.2 Alcohol and Sexual Violence Perpetration on College Campuses

Frequent drinking and heavy episodic drinking (HED) by college students has been identified as a major public health concern by the U.S. Surgeon General and the U.S. Department of Health and Human Services (Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism, 2002). HED is defined as consuming five drinks or more in a two-hour period for men or four drinks in the same amount of time for women (NIAAA, 2004). Nearly half of all college students report HED and 1 in 5 are frequent bingers, meaning that they report HED on three or more occasions during a two-week period (Wechsler, Davenport, Dowdall, Mooeykens, & Castillo, 1994). HED is linked to serious health and social problems, including injury, violent behavior, and death (Brewer & Swahn, 2004). Students report more HED when alcohol is cheap and easy to access (Weitzman et al., 2003). Lower drink pricing and more promotions or specials are associated with higher rates of binge drinking. Availability of high volume containers of beer and discounts for purchasing in bulk are also associated with higher rates of binge drinking (Kuo, Wescher, Greenberg, & Lee, 2003).

There is a well-established link between drinking and sexual violence perpetration (e.g., Abbey, McAuslan, & Ross, 1998; Abbey & McAuslan, 2004; Zawacki, Abbey, Buck, McAuslan, & Clinton-Sherrod, 2003). Alcohol consumption, specifically heavy drinking, is significantly related to sexual violence perpetration (Abbey et al., 2014; Carr & VanDeusen,

2004; Koss & Gaines, 1993). Roughly half of all sexual assaults on college campuses involve drinking, either by the perpetrator, the victim, or both parties (Abbey et al., 1998). Research investigating the link between alcohol and sexual violence perpetration has examined the role of alcohol in several different ways. Much of the survey research has compared perpetrators' and non-perpetrators' alcohol consumption using distal (e.g., general drinking behavior) and proximal (e.g., drinking in dating or sexual situations) measures of alcohol use (Abbey et al., 2014). Perpetrators report more frequent drinking and more heavy drinking than non-perpetrators (Abbey, McAuslan, Zawacki, Clinton, & Buck, 2001; Koss & Gaines, 1993). College men who report being drunk often are more likely to report higher rates of sexual violence perpetration (Swartout, Thompson, Koss, & Su, 2014). In dating and sexual situations, college men who report drinking heavily report more sexual violence perpetration (Parkhill & Abbey, 2008). Additionally, perpetrators who report heavier drinking use more aggression and commit more severe assaults (Abbey, Clinton-Sherrod, McAuslan, Zawacki, & Buck, 2003; Parkhill, Abbey, & Jacques-Tiura, 2009). Findings from experimental research investigating the link between alcohol consumption and sexual violence perpetration are somewhat mixed. Although studies using written vignettes as a proxy for sexual violence perpetration have not found significant effects of alcohol consumption on self-reported likelihood of behaving like the male character (e.g., engaging in sexually violent behavior; Norris & Kerr, 1993; Norris, George, Davis, Martell, & Leonesio, 1999; Norris, Davis, George, Martell, & Heiman, 2002), perceptions of the situation described in the vignette (e.g., woman's level of sexual arousal) mediate the relationship between alcohol consumption and self-reported likelihood of behaving like the male character (Davis, Norris, George, Martell, & Heiman, 2006). Studies that employ more immersive methods like video tapes have found a link between alcohol consumption and men's

self-reported willingness to force sex in similar situations (Johnson, Noel, Sutter-Hernandez, 2000; Noel, Maisto, Johnson, & Jackson, 2009). Little research has examined the effect of the broader context of alcohol consumption on sexual violence, and much of the research that exists has used observational methods investigating the influence of a bar context (e.g., smoking vs. non-smoking, cleanliness, size of crowd; Graham et al., 2014; Leonard, Collins, & Quigley, 2003).

1.3   Alcohol Outlet Density and Crime

Examining the density of alcohol outlets – places that serve or sell alcohol (e.g., liquor stores, bars, restaurants) – in a community provides a practical way to understand effects of alcohol availability around college campuses. Research with college populations has demonstrated that alcohol outlet density is related to heavy drinking, frequent drinking, and drinking-related problems (Campbell et al., 2009; Kypri et al., 2008; Scribner et al., 2008; Scribner et al., 2010; Wechsler & Nelson 2008; Weitzman et al., 2003). Using data from the Harvard College Alcohol Study, alcohol outlets at eight institutions were mapped and densities were calculated based on student enrollment. Higher alcohol outlet density was associated with more heavy and frequent drinking and drinking-related problems (e.g., getting behind in school work, getting injured, requiring medical treatment for an alcohol overdose; Weitzman et al., 2003). In New Zealand, alcohol outlet densities were calculated for five of the country's eight institutions of higher education. Even when controlling for high school drinking behavior, higher alcohol outlet density was associated with more negative outcomes, including hangovers, blackouts, unprotected sex, and arrests for drunken behavior (Kypri et al., 2008).

Although the specific link between alcohol outlet density and campus SV perpetration has not been investigated, the effect of this community-level predictor has been assessed on other

forms of violent, criminal, and risk behavior. Researchers have incorporated publicly-available crime data to examine the associations between alcohol outlet density and crime on college campuses (Scribner et al., 2010; Snowden & Pridemore, 2013). In an ecological analysis of thirty-two colleges across the U.S., alcohol outlet density predicted rates of overall campus violence, including rates of rape (Scribner et al., 2010). Additionally, rates of student drinking mediated the relationship between outlet density and campus violence, such that campuses with higher alcohol outlet density had higher levels of drinking and higher levels of campus violence. In a study of alcohol outlet density in one non-metropolitan college town, alcohol outlet density was related to simple assault density (Snowden & Pridemore, 2013). Off-premise alcohol outlet and bar density were related to aggravated assault density. Total and off-premise alcohol outlet density predicted intimate partner violence perpetration, measured by data collected from police reports, even when controlling for other characteristics, such as poverty and population density, that might be related to intimate partner violence perpetration (Snowden, 2016). Interestingly, on-premise alcohol outlets were not associated with intimate partner violence perpetration.

Links between alcohol outlet density, consumption, and crime have also been found in numerous community studies across the United States and internationally. A study of crime location proximity in Savannah, Georgia found that higher crime densities were located closer to alcohol serving businesses (Kumar & Waylor, 2003). Using neighborhoods as the level of analysis, alcohol outlet density was significantly correlated with violent crime in Minneapolis, Minnesota (Britt, Carlin, Toomey, & Wagenaar, 2005). A study of census tracts in Houston, Texas, concluded that off-premise alcohol outlet density was a significant predictor of violent crime, including murder, rape, robbery, and aggravated assault, even when taking into account drug and other crime data (Gorman, Zhu, & Horel, 2005). In a longitudinal analysis of alcohol

outlet densities and hospitalizations for assault injuries in California across 13 years, bar density was related to an increase in number of assaults (Mair, Gruenewald, Ponicki, & Remer, 2013). In a study of alcohol outlet density in Sacramento, California, off-premise alcohol outlet density was associated with an increased risk for both police calls and crime reports for intimate partner violence (Cunradi, Mair, Ponicki, & Remer, 2011). Using Washington, D.C. census tract data and publicly available crime data, higher alcohol outlet density was significantly associated with more reported violent crime and sex offenses (Franklin, LaVeist, Webster, & Pan, 2010). A national study investigated the relationship between alcohol outlet density by zip code and self-reported drinking and perpetration of intimate partner violence among adult couples; an increase in alcohol outlet density was related to increased risk of male perpetrated intimate partner violence, and this relationship was stronger for couples who reported alcohol dependence and social consequences for drinking (McKinney, Caetano, Harris, & Ebama, 2009). In Melbourne, Australia, on-premise, and off-premise alcohol outlet density significantly predicted rates of intimate partner violence, such that an increase in one on-premise outlet per 1,000 people led to a 2.3% increase in rates of intimate partner violence and an increase in one off-premise outlet per 1000 people lead to a 28.6% increase (Livingston, 2011). Finally, an international meta-analysis on alcohol outlet density and alcohol-related harms concluded that higher alcohol outlet density was related to higher rates of alcohol consumption and more alcohol-related harms (e.g., trauma and social problems; Popova, Giesbrecht, Bekmuradov, & Patra, 2009).

1.4   The Current Study

Although alcohol outlet density is a significant positive predictor of violence and crime in campus and community samples, no study to date has assessed its specific effect on campus sexual violence. The current study examined the extent to which alcohol availability, defined as

alcohol outlet density within a specified radius, was a community-level risk factor for sexual violence perpetration on college campuses. Using publicly-available alcohol license data and self-report data from a recently-completed longitudinal cohort study of college men, a three-level mediation model was estimated to investigate the effect of institution-level alcohol availability on college men's alcohol use and sexual violence perpetration. Specifically, the research questions were (1) How does alcohol availability differ across the colleges?; (2) Does greater institution-level alcohol availability predict an increase in rates of men's heavy episodic drinking?; (3) Does greater institution-level alcohol availability predict an increase in college men's sexual violence perpetration?; (4) Does college men's heavy episodic drinking mediate the effect of institution-level alcohol availability on men's sexual violence perpetration? Differences in alcohol availability were examined across license type (i.e., retail, consumption on-premise), business type (e.g., bars, restaurants, convenience stores, liquor stores, grocery and department stores), and whether outlets served liquor. Previous research has examined the differences between on- and off-premise outlets and between different types of businesses (e.g., bars and restaurants; Scribner et al., 2010; Weitzman et al., 2003; Kypri et al., 2008; Snowden & Pridemore, 2013). Institution-level alcohol availability was expected to predict men's heavy episodic drinking and sexual violence perpetration. I also hypothesized that the effect of institution-level alcohol availability on men's sexual violence perpetration would be mediated by men's heavy episodic drinking.

2   METHOD

The current study employed integration and analysis of two data sources: publicly available alcohol outlet data and survey data from a longitudinal cohort study. Combining these two

sources of data allowed for a multilevel examination of the effects of alcohol availability on college men's reported heavy episodic drinking and sexual violence perpetration.

2.1 Alcohol License Data

Alcohol license data was collected from the Georgia Tax Center through the Alcohol License Search feature during the spring of 2015. Data included the name, address, license type (e.g., retail, consumption on premise), business type (e.g., bars, restaurants, convenience stores, liquor stores, grocery and department stores), and type of alcohol sold (e.g., beer, wine, liquor). Alcohol outlets were geocoded using Geocodio and mapped using the QGIS software program (Geocodio, 2017; QGIS Development Team, 2017). Only data from licenses active as of the spring of 2015 were collected, which corresponds with the overlap between data collection periods for all three cohorts of the longitudinal survey (i.e., data collection of wave 4 for cohort 1, wave 3 for cohort 2, and wave 2 for cohort 3). Licenses that were active during the spring of 2015 were current during the time of survey data collection.

2.2 Online Survey Data

The current study incorporated online survey data collected as part of a longitudinal cohort study – The FreshMEN of Georgia project. This study was a multi-phase project that involved data collection at the person-level from a sample of male college freshmen and at the institution-level from a sample of college administrators. Additionally, institution-level data were collected from college websites and college policy documents (e.g., sexual misconduct policies, annual security reports).

2.2.1 Procedure

Participants were recruited during the Fall of 2013 for cohort 1, Spring of 2014 for cohort 2, and Fall of 2014 for cohort 3. Several recruitment strategies were employed including:

Facebook advertisements, campus tabling events, classroom announcements, and peer referrals. Interested students were directed to the study website, which provided information about the study, and asked to complete a brief online screening instrument. Eligible students – those who were male, between the ages of 18 and 24, and first-year students currently enrolled in one of the thirty colleges - were then directed to an online consent form and asked to provide their contact information. Emails with confirmation links were sent to participants at their school email addresses. Those who confirmed their status as students by clicking the confirmation link were enrolled in the study. Participants were then instructed to return to the website to complete the first survey. The first survey, which served as a baseline, took approximately 30 minutes to complete and participants were compensated $25. Participants were contacted 6 months, 12 months, and 18 months later to complete follow-up surveys. Participants were compensated $10 for the second survey, which took approximately 15 minutes to complete, $30 for the third survey which took approximately 30 minutes, and $35 for the final survey which also took 30 minutes. Retention across all four waves was excellent with over 76% of the sample completing all four waves.

2.2.2 *Institutions*

All of the thirty institutions included in the study were four-year bachelor's degree granting institutions. The majority of the thirty institutions included in the sample were public (73.3%) and residential (70%). Institutions ranged in size (large: 23.3%, medium: 50%, and small or very small: 26.7%) and campus environment (urban: 43.4%, suburban: 23.3%, mid-size city: 10%, town: 13.3%, and rural: 10%; Carnegie Classification of Institutions of Higher Education, n.d.; College Navigator, n.d.). On average across the campuses, 55% of the student body was female and the majority of first year students (70%) lived on campus. Approximately

half of the institutions (51.7%), allowed students who are of legal drinking age to possess alcohol in the residence halls.

2.2.3   Participants

Participants (*N*=1,144) were first year male college students enrolled at one of thirty four-year colleges and universities in the state of Georgia. Participants were between the ages of 18 and 24 years old (*M*=18.3). Just over half of the participants were Caucasian (55.4%), 19.6% Black or African American, 15.8% Asian or Pacific Islander, and 7% Hispanic. The majority lived on campus (74.7%) and were single (64.4%). Some were varsity athletes (13.9%) or members of Greek fraternities (19.7%).

2.3   Measures

2.3.1   Alcohol Availability

The current study used three measures of alcohol availability: (1) the number of alcohol outlets within a specified radius of each campus (Kypri et al., 2008; Weitzman et al., 2003), (2) the number of alcohol outlets within a specified radius per 1,000 undergraduate students enrolled (alcohol availability per capita; Scribner et al., 2008; Scribner et al., 2010), and (3) the proportions of bars, retail outlets, on-premise outlets, and liquor-serving outlets to the total number of outlets within a specified radius (Mair et al., 2013). These three methods of calculating alcohol availability were used in an effort to capture the variability across campuses and account for the differences in population size and setting of the campuses (Auchincloss, Gebreab, Mair, & Diez Roux, 2012). Following previous research, a three-mile radius – centered around a previously determined central campus location – was used to create buffer zones around each campus (Scribner et al., 2010; Weitzman et al., 2003). In addition to a three-mile buffer,

additional sensitivity analyses were conducted using alternate radii of one-half, one, and five-miles.

2.3.2 Institutional Characteristics

Four institutional characteristics – public vs. private distinction, institution size, campus environment, and residence hall alcohol policy – were collected from institutional websites, the Carnegie Classification of Institutions of Higher Education online database, and the National Center for Education Statistics' College Navigator online database (Carnegie Classification of Institutions of Higher Education, n.d.; College Navigator, n.d.).

2.3.3 Heavy Episodic Drinking

HED was assessed at each time point using one question from NIAAA's recommended question set (NIAAA, n.d.), "Thinking back over the LAST THIRTY DAYS, how many times, if any, have you had FIVE OR MORE ALCHOHOLIC DRINKS at a sitting?" Participants reported, using a nine-point scale from none to nine or more, the number of times they engaged in heavy episodic drinking.

2.3.4 Perceived Drinking Behavior

Post-hoc models included aggregated measures of participants' perceptions of the drinking behavior of typical students on their campus. Perceived drinking behavior was assessed at each time point using one question, "How many alcoholic DRINKS do you think THE TYPICAL STUDENT AT YOUR COLLEGE had the last time he/she "partied"/"socialized?" Participants reported an estimated count of the number of drinks, defined as one standard drink (e.g., 1 12 oz. beer, 1 12 oz. wine cooler, 1 5 oz. glass of wine, 1 shot of liquor, 1 malt beverage, 1 mixed drink), they believed the typical student on their campus consumed, ranging from zero drinks to 75 drinks. This construct was aggregated at the institution level for analysis.

2.3.5 *Sexual Violence Perpetration*

Sexual violence perpetration (SVP) was assessed at each time point using the revised Sexual Experiences Survey Short Form (SES-R; Koss et al., 2007). The SES is a widely-used, behaviorally-based measure of sexual violence perpetration among college students. The SES is divided into seven acts crossed with five tactics for a total of thirty-five items that assess four different categories of sexual violence perpetration: unwanted sexual contact, sexual coercion, attempted rape, and rape. For example, participants were asked the number of times they attempted to perpetrate rape by taking advantage of someone who was drunk: "Even though it did not happen, I tried to put in my penis or I tried to put my fingers or objects into a woman's vagina without their consent by taking advantage when they were too drunk or out of it to stop what was happening." In Wave 1, participants were instructed to report the number of times, using a four-point scale ranging from 0 to 3+, they engaged in each behavior within two time periods: from age 14 to one year before college, and in the year before college. In Wave 2, participants were instructed to report the number of times since they began college. In Waves 3 and 4, participants were instructed to report the number of times since their last survey. The current study utilized a dichotomous scoring system, whereby participants were labeled "perpetrators" (1) if they reported perpetrating any form of sexual violence during Waves 2, 3, or 4 or "non-perpetrators" (0) if they did not report perpetrating sexual violence.

2.4 Analysis Strategy

First, alcohol availability near the college campuses was described in three ways: (1) total number of alcohol outlets within the specified radii; (2) alcohol outlets by license type (i.e., retail, consumption on premise); (3) alcohol outlets by business type (i.e., bars, restaurants, convenience stores, liquor stores, grocery and department stores). Then, the density per capita

and the proportions of each subcategory to the total number of outlets was calculated at each of the specified radii for the following subcategories: on-premise outlets, retail outlets, bars, and liquor-serving outlets. Next, alcohol availability using the total number of outlets and totals for each of the subcategories at all radii (i.e., half mile, one mile, three miles, and five miles) was compared across institutional characteristics (i.e., public vs. private, institution size, campus environment, residence hall alcohol policy) to describe the differences between alcohol availability at different types of institutions. Independent samples t-tests and one-way ANOVAs were conducted with IBM SPSS Statistics, Version 23, for Windows to determine if there were significant differences between the groups of institutions.

Then, Multilevel Structural Equation Modeling (MSEM; Lachowicz, Sterba, & Preacher, 2015) was utilized to build a three-level mediation model examining the relationships between institution-level alcohol availability within a three-mile radius, person-level heavy episodic drinking (HED), and person-level sexual violence perpetration (SVP) taking into account assessment-level effects of time. This study examined assessments (level 1) nested within people (level 2) nested within colleges (level 3). At the person-level (level 2), assessment-level (level 1) effects were averaged across waves 2, 3, and 4, approximately spanning the first two years of college. Multilevel structural equation modeling is a method of analyzing nested data within a structural equation modeling framework which produces unbiased estimates for between cluster indirect effects (Lachowicz et al., 2015). This method treats group means as latent variables and allows for examination of between cluster mediation. Due to the dichotomous nature of the sexual violence perpetration outcome, Bayesian estimation was used to estimate a binary probit model (Muthen & Muthen, 2012).

Three initial random intercept models were estimated in Mplus Version 7.3 to examine the individual paths represented in the hypothesized MSEM 3-2-2 mediation model (Muthen & Muthen, 2012). First, the effect of institution-level alcohol availability within a three-mile radius on person-level HED was estimated (path A), see Figure 2.1. Second, the effect of person-level HED on person-level SVP was estimated (path B), see Figure 2.2. Third, the effect of institution-level alcohol availability within a three-mile radius on person-level SVP was estimated (path C), see Figure 2.3. Next, a MSEM 3-2-2 mediation model to examine whether person-level HED mediates the relationship between institution-level alcohol availability within a three-mile radius and person-level SVP was estimated (see Figure 2.4). The effect of person-level HED on person-level SVP was estimated at both the person- and institution-levels and added together to represent the total effect of HED on SVP (Lachowicz et al., 2015). The effect of institution-level alcohol availability on HED was estimated at the institution-level and multiplied by the total effect of HED on SVP to calculate the compositional indirect effect.

Additional sensitivity analyses were conducted to further investigate the effect of institution-level alcohol availability on person-level HED and SVP. First, sensitivity analyses, using alternative radii of one-half, one, and five-mile buffer zones, were conducted to examine the effect of alcohol availability measured at different radii. Then, spatial analyses were conducted in Geoda version 1.8.16.4 to investigate and account for the presence of spatial autocorrelation (Anselin, Syabri, & Kho, 2006). Spatial autocorrelation was assessed using a k-nearest neighbors weight matrix. A k-nearest neighbors weight matrix was used as the buffer zones represent points and do not have adjacent borders. Simple one-level spatial regression analyses were conducted to examine the effect of alcohol availability within a three-mile radius on HED and SVP.

Finally, an exploratory MSEM mediation model was estimated to examine the effect of perceptions of drinking behavior aggregated at the institution-level on HED and SVP. Following the approach outlined above, two initial random intercept models were estimated to examine the individual paths of the exploratory MSEM mediation model. The effect of institution-level perceptions of drinking on person-level HED was estimated (path A, see Figure 2.5) and the effect of institution-level perceptions of drinking behavior on person-level SVP was estimated (path C, see Figure 2.6). Then, the exploratory MSEM 3-2-2 mediation model, which examined person-level HED as a potential mediator of the relationship between perceived drinking behaviors aggregated at the institution-level and person-level SVP, was estimated (see Figure 2.7) The effect of person-level HED on person-level SVP was estimated at both the person- and institution-levels and added together to represent the total effect of HED on SVP (Lachowicz et al., 2015). The effect of perceptions of drinking behavior aggregated at the institution-level on HED was estimated at the institution-level and multiplied by the total effect of HED on SVP to calculate the compositional indirect effect.

2.4.1 *Power Analysis*

A Monte Carlo Simulation study was conducted in Mplus Version 7.3 to determine the power necessary to detect a moderate effect using a multilevel mediation model (Muthen & Muthen, 2012). As the current study utilized secondary data analysis, the actual sample and cluster sizes were used in the simulation study. Additionally, a probit model was estimated to account for the dichotomous nature of the outcome variable. In predicting the person-level intercept, there is 97% power to detect an odds ratio of 1.16 (a relatively small effect). In predicting the institution-level intercepts, there is 85% power to detect an odds ratio of 1.19 and 93% power to detect an odds ratio of 1.24 (also relatively small effects). In predicting the

indirect effect, there is 80% power to detect an odds ratio of 1.03 for the dichotomous outcome variable. These odds ratios represent a multiplicative change in the rate of the outcome for every one-unit increase in the predictor. For example, there will be 85% power to detect an increase in the rate of sexual violence perpetration by a multiplicative factor of 1.19 for every one-unit increase in institution-level alcohol availability.
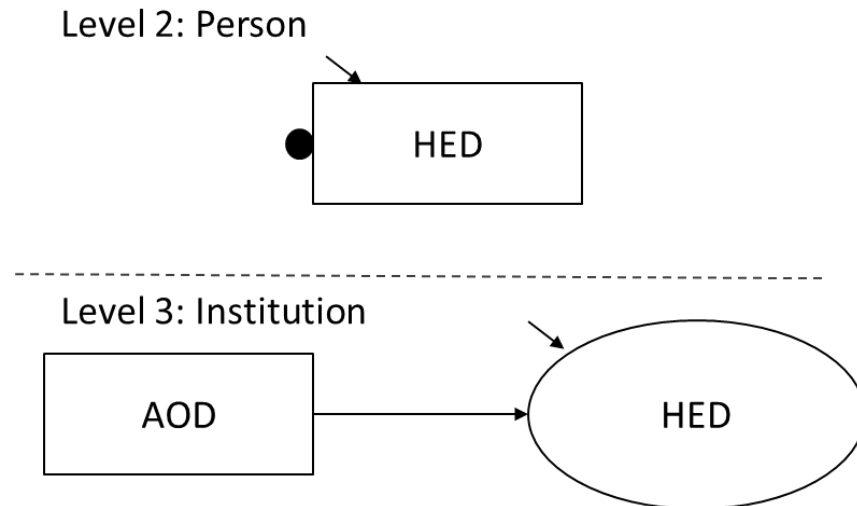
Figure 2.1 Initial Random Intercepts Model of the Effect of Institution-Level Alcohol Availability on Person-Level Heavy Episodic Drinking

Level 2: Person
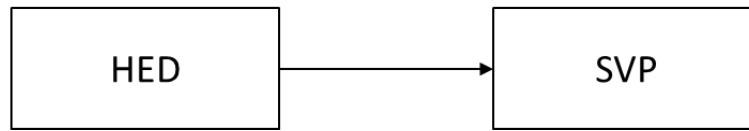
Figure 2.2 Initial Random Intercepts Model of the Effect of Person-Level Heavy Episodic Drinking on Person-Level Sexual Violence Perpetration
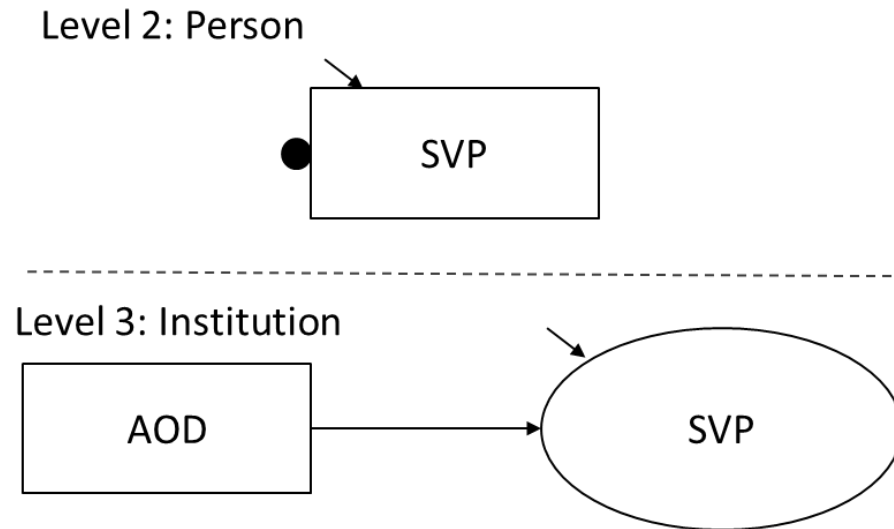
Figure 2.3 Initial Random Intercepts Model of the Effect of Institution-Level Alcohol Availability on Person-Level Sexual Violence Perpetration

Level 2: Person

HED

SVP

Level 3: Institution

HED

AOD

SVP
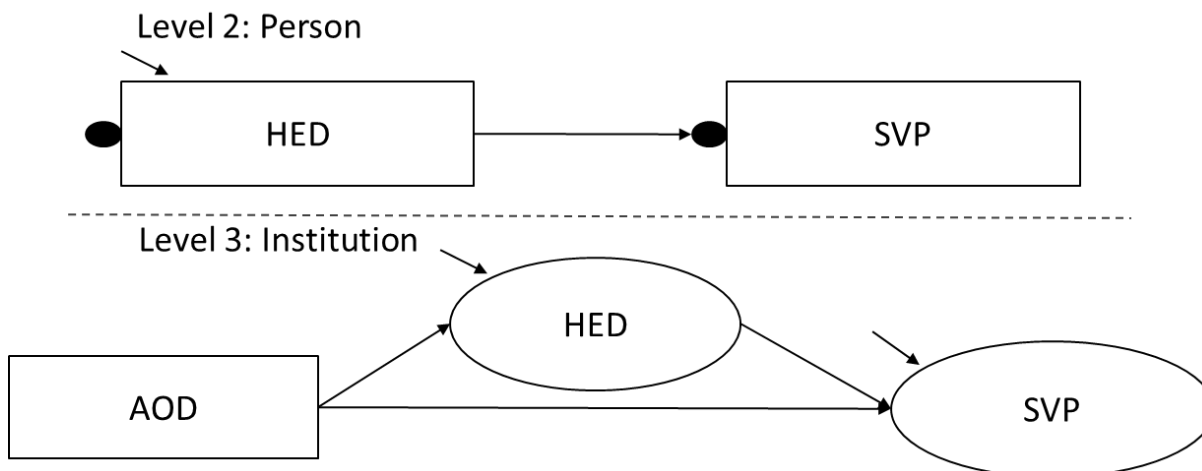
Figure 2.4 Hypothesized Multilevel SEM 3-2-2 Mediation Model
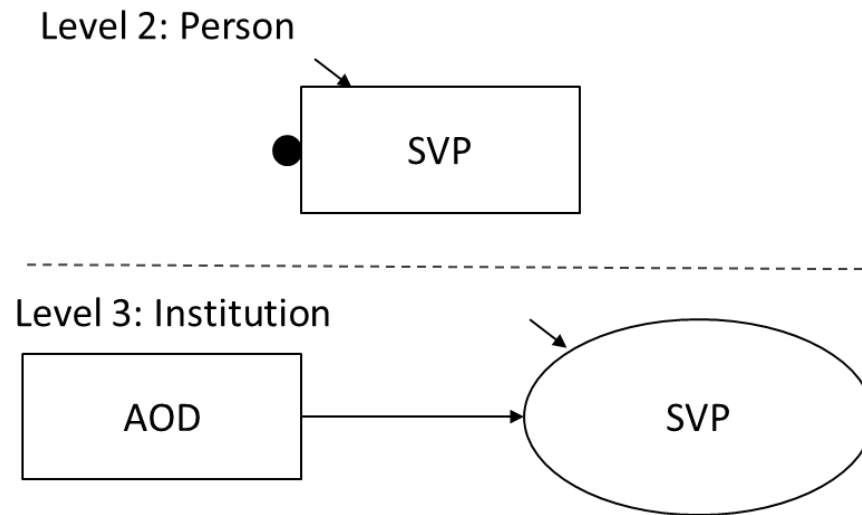
Figure 2.5 Exploratory Initial Random Intercepts Model of the Effect of Institution-Level Perceptions of Drinking Behavior on Person-Level Heavy Episodic Drinking
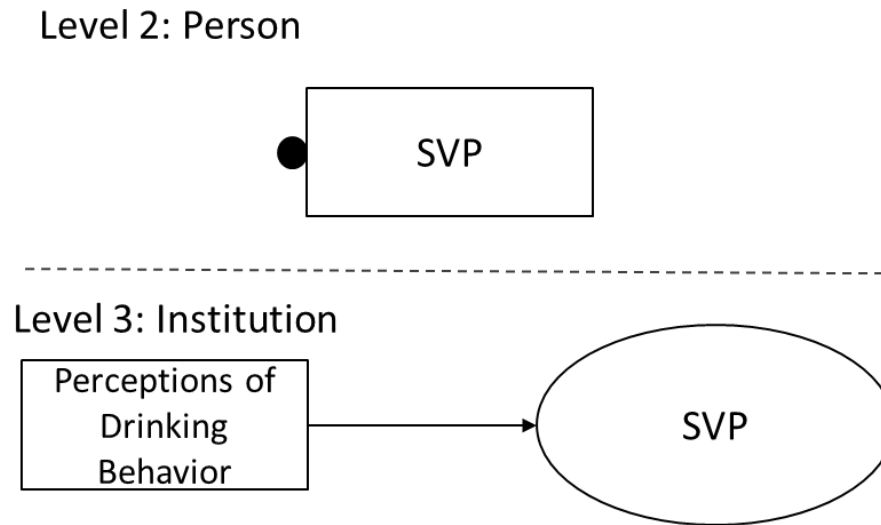
Figure 2.6 Exploratory Initial Random Intercepts Model of the Effect of Institution-Level Perceptions of Drinking Behavior on Person-Level Sexual Violence Perpetration
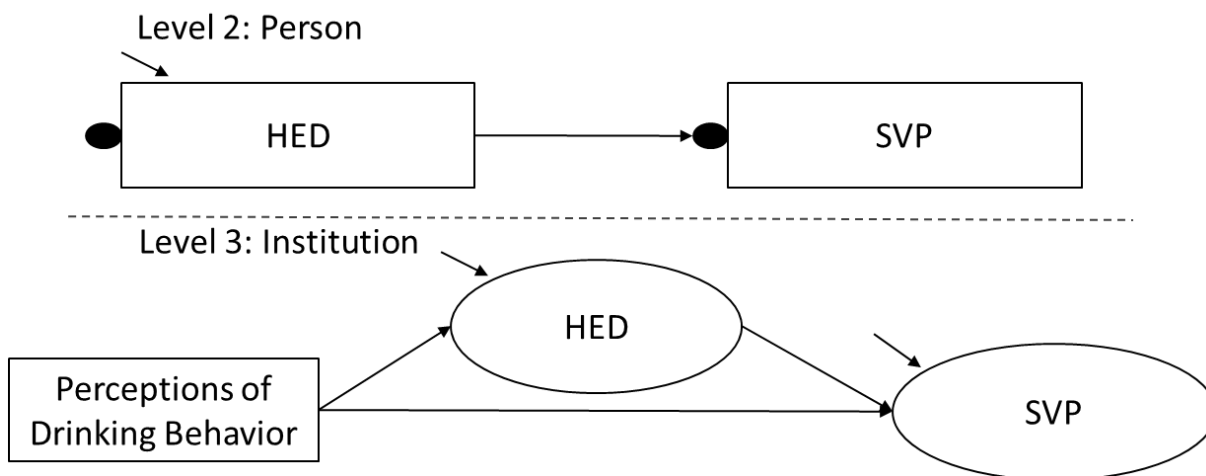
Figure 2.7 Exploratory Multilevel SEM 3-2-2 Mediation Model

3   RESULTS

3.1   Descriptive Statistics

3.1.1   Institution-Level Descriptive Statistics

Raw counts of alcohol outlets by license and business type for each of the specified radii (i.e., half, one, three, and five-mile) are presented in Table 3.1. Per capita availability and proportions for total count, number of on-premise outlets, number of retail outlets, number of bars, and number of liquor-serving outlets for each of the specified radii are presented in Table 3.2. Maps depicting the alcohol outlets within the taxing district for the respective college or university and the size of all buffer zones are included in Appendix A.

Alcohol availability by public vs. private classification is presented in Table 3.3. There were significantly more total outlets, on-premise outlets, bars, and liquor-serving outlets at the five-mile radius near private universities than near public universities. There were no significant differences between the number of total outlets, on-premise outlets, retail outlets, bars, and liquor-serving outlets at the half-, one-, or three-mile radii near public versus private institutions.

Alcohol availability by institution size is presented in Table 3.4. There were significantly more total outlets and liquor-serving outlets within the one- and three-mile radii and on-premise outlets and bars within the half-, one-, three-, and five-mile radii at large institutions. There were no significant differences in the number of total outlets within the half-, three-, and five-mile radii. There were no significant differences in the number of retail outlets within any of the four radii. There were no significant differences in the number of liquor-serving outlets within the five-mile radii.

Alcohol availability by campus environment is presented in Table 3.5. There were significantly more retail outlets within the half- and one- mile radii near campuses located in

suburban areas. There were no significant differences in the number of total outlets, on-premise outlets, bars, or liquor-serving outlets within the half-, one-, three-, and five-mile radii.

Alcohol availability by residence hall alcohol policy – whether students of legal drinking age are allowed to possess alcohol in the residence halls – is presented in Table 3.6. There were significantly more bars near campuses that allow possession of alcohol in residence halls within the one- and three-mile radii. There were no significant differences between the number of total outlets, on-premise outlets, retail outlets, and liquor-serving outlets at the half-, one-, three-, or five-mile radii.

3.1.2   Person-Level Descriptive Statistics

One third of participants reported HED, drinking five or more alcoholic drinks in one sitting, at least once in thirty days during each of the assessment periods, see Table 3.7. On average, participants reported HED approximately one time during their first two years of college. On average, participants perceived that a typical student at their institution drank five drinks the last time they "partied" or "socialized" during their first two years of college.

About 11% of the sample reported perpetrating some form of sexual violence during college; 6.4% reported perpetrating rape, 7.9% attempted rape, 6.3% verbal coercion, 5.8% attempted verbal coercion. On average, participants reported perpetrating one act of sexual violence during waves 3 and 4 and less than one act during wave 2.

3.2   Correlations

Person-level correlations are presented in Table 3.8. Measures of HED, perceptions of drinking behavior, and sexual violence perpetration were significantly correlated across time. HED was marginally correlated with sexual violence perpetration at each wave. However,

perceptions of drinking behavior was significantly correlated with sexual violence perpetration at wave 2 but not at wave 3 or wave 4.

3.3   Hypothesized Models

Three initial random intercepts models were estimated to examine the individual paths of the hypothesized MSEM 3-2-2 mediation model. First, person-level HED was regressed on institution-level alcohol availability within a three-mile radius to examine path A. Alcohol availability did not significantly predict HED using any measure within a three-mile radius (e.g., raw count, per capita, proportion of total), see Table 3.9. Next, person-level SVP was regressed on person-level HED to examine path B. HED significantly predicted SVP, see Figure 3.1. Then, person-level SVP was regressed on alcohol availability within a three-mile radius to examine path C. Alcohol availability did not significantly predict SVP using any measure within a three-mile radius (e.g., raw count, per capita, proportion of total), see Table 3.10. Finally, the hypothesized MSEM 3-2-2 mediation model was estimated to examine whether person-level HED mediated the relationship between institution-level alcohol availability within a three-mile radius and person-level SVP. Alcohol availability did not significantly predict SVP and HED did not mediate the relationship between alcohol availability and SVP. However, HED did significantly predict SVP, see Table 3.11.

3.4   Sensitivity Analyses for A Priori Hypotheses

Given the non-significant findings for path A and path C presented above, sensitivity analyses were conducted using alternate radii. First, person-level HED was regressed on institution-level alcohol availability measured at one-half, one, and five miles (path A). Alcohol availability did not significantly predict HED using any measure within any of the alternate radii (e.g., raw count, per capita, proportion of total), see Table 3.12. Then, person-level SVP was

regressed on institution-level alcohol availability measured at one-half, one, and five miles (path C). Alcohol availability did not significantly predict SVP using any measure within any of the alternate radii (e.g., raw count, per capita, proportion of total), see Table 3.13.

Additional spatial sensitivity analyses were conducted to investigate and account for the presence of spatial autocorrelation. Spatial autocorrelation was present among alcohol availability per capita within a three-mile at the person-level, $I=.08$, $p=.002$. However, there was no spatial autocorrelation among total alcohol availability count within a three-mile radius, $I=.003$, $p=.36$; HED, $I=.001$, $p=.44$; or SVP, $I=.003$, $p=.37$, at the person-level. Two one-level spatial regression models were estimated, using ordinary least squares estimation and a k-nearest neighbors weight matrix, to examine whether total alcohol availability count within a three-mile radius predicted HED and SVP, respectively. Total alcohol availability count within a three-mile radius did significantly predict HED, $R^2 =.01$, $F=7.77$, $p=.01$, $B=-.001$, $p=.01$. However, this effect is negative and very small. Total alcohol availability count within a three-mile radius did not significantly predict SVP, $R^2 =.00$, $F=.003$, $p=.95$, $B=-.00$, $p=.95$. Then, two one-level spatial regression models were estimated using ordinary least squares estimation and a k-nearest neighbors weight matrix, to examine whether alcohol availability per capita within a three-mile radius predicted HED and SVP, respectively. Alcohol availability per capita within a three-mile radius did significantly predict HED, $R^2 =.01$, $F=8.92$, $p=.002$, $B=-.01$, $p=.002$. However, this effect is negative and very small. Alcohol availability per capita within a three-mile radius did not significantly predict SVP, $R^2 =.00$, $F=.06$, $p=.81$, $B=.00$, $p=.81$.

3.5 Exploratory Models

Given these non-significant findings, an exploratory MSEM 3-2-2 mediation model was estimated to examine person-level HED as a potential mediator of the relationship between

perceived drinking behaviors aggregated at the institution-level and person-level SVP. Using a similar approach to the proposed models, three initial random intercept models were estimated to examine the individual paths of the MSEM 3-2-2 mediation model. First, person-level HED was regressed on institution-level perceptions of drinking behavior to examine path A. Institution-level perceptions of drinking behavior significantly predicted person-level HED, see Figure 3.2. Next, person-level SVP was regressed on person-level HED to examine Path B. As presented above, HED significantly predicted SVP, see Figure 3.1. Then, person-level SVP was regressed on institution-level perceptions of drinking behavior to examine Path C. The direct effect of institution-level perceptions of drinking behavior on person-level SVP was non-significant, $B = -.08$, $SE = .18$, $p = .31$, 95CI[-.49,.23]. Finally, the exploratory MSEM 3-2-2 mediation model was estimated. The direct effect of perceptions of drinking behavior aggregated at the institution-level on person-level HED was significant, such that an increase of one standard deviation in perceptions of drinking behavior led to a .83 increase in self-reported HED, see Figure 3.2. The direct effect of person-level HED on SVP was significant, such that a one standard deviation increase in HED led to a .24 increase in SVP. The indirect effect of institution-level perceptions of drinking behavior on SVP through person-level HED was significant, such that an increase of one standard deviation in perceptions of drinking behavior led to a .20 increase in SVP. Perceptions of drinking accounted for 69% of the variance in HED between the institutions; HED accounted for 6% of the variance in SVP between participants; and perceptions of drinking behavior and HED accounted for 59% of the variance in SVP between the institutions.

Level 2: Person
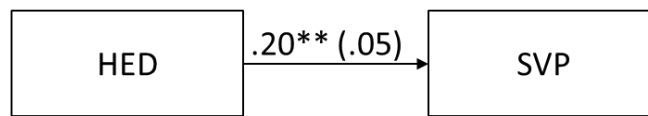
Note: * denotes p < .1, ** denotes p <.05.

Figure 3.1 Initial Random Intercepts Model of the Effect of Person-Level Binge Drinking on Person Level Sexual Violence Perpetration
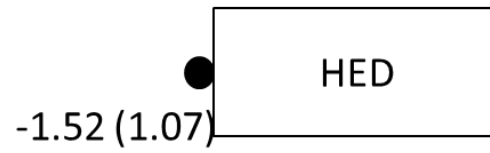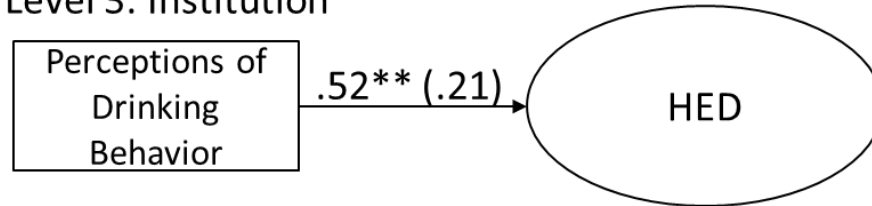
Note: * denotes p < .1, ** denotes p <.05.

Figure 3.2 Exploratory Random Intercepts Model of the Effect of Institution-Level Perceptions of Drinking Behavior on Person-Level HED

Level 2: Person
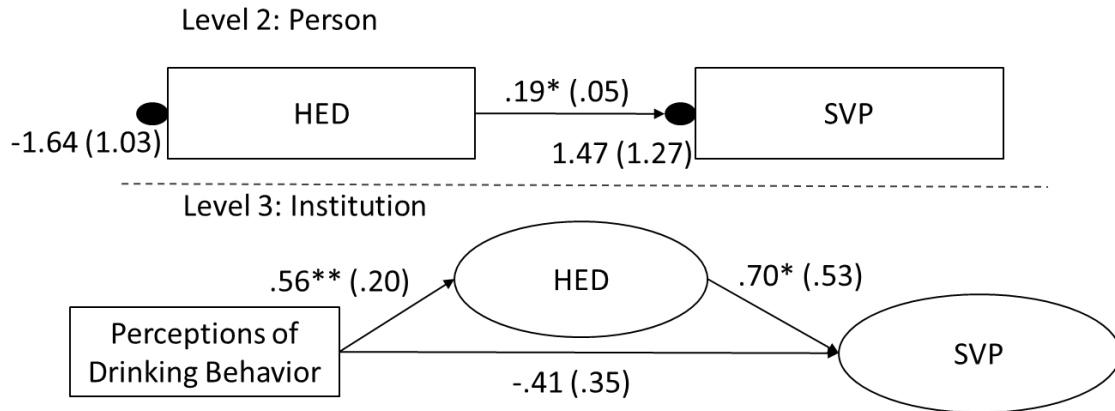
Indirect Effects:
Compositional = .49** (.39), p =.03
Total = .89** (.53), p = .02

*Note: * denotes p < .1, ** denotes p <.05.*
Figure 3.3 Exploratory Multilevel SEM 3-2-2 Mediation Model

Table 3.1 Alcohol Availability by License and Business Type

Buffer Size		*Mean(SD)*	Range
Half Mile	Total Alcohol Outlets	6.13(11.54)	0-56
	Consumption on Premise License	3.53(8.96)	0-43
	Retail License	2.50(3.28)	0-13
	Bars	1.80(4.82)	0-22
	Restaurants	1.57(3.48)	0-14
	Beer, Wine, Liquor Stores	.23(.68)	0-3
	Convenience Stores and Gas Stations	.90(1.16)	0-5
	Grocery and Department Stores	.37(.81)	0-3
	Liquor Serving	3.83(9.26)	0-48
One Mile	Total Alcohol Outlets	25.03(47.31)	0-210
	Consumption on Premise License	14.40(37.30)	0-159
	Retail License	9.70(9.39)	0-36
	Bars	5.77(11.21)	0-45
	Restaurants	6.67(15.42)	0-63
	Beer, Wine, Liquor Stores	1.10(1.58)	0-7
	Convenience Stores and Gas Stations	4.27(4.39)	0-16
	Grocery and Department Stores	1.37(1.85)	0-7
	Liquor Serving	16.13(40.59)	0-177
Three Miles	Total Alcohol Outlets	138.97(192.54)	1-756
	Consumption on Premise License	77.27(143.12)	0-544
	Retail License	54.47(45.51)	1-183
	Bars	31.27(49.41)	0-193
	Restaurants	40.20(68.74)	0-268
	Beer, Wine, Liquor Stores	7.47(7.81)	0-27
	Convenience Stores and Gas Stations	26.67(20.78)	0-73
	Grocery and Department Stores	8.03(7.17)	0-31
	Liquor Serving	86.07(152.25)	0-580
Five Miles	Total Alcohol Outlets	260.43(340.86)	1-1095
	Consumption on Premise License	146.37(237.60)	0-733
	Retail License	105.77(96.22)	1-322
	Bars	63.20(90.41)	0-293
	Restaurants	76.30(118.47)	0-368
	Beer, Wine, Liquor Stores	13.93(15.48)	0-48
	Convenience Stores and Gas Stations	47.40(42.62)	1-143
	Grocery and Department Stores	14.30(12.25)	0-42
	Liquor Serving	163.30(256.28)	0-794

Table 3.2 Alcohol Availability Per Capita and Proportions

Buffer Size		*Mean(SD)*	Range
Half Mile	Total Outlets Per 1,000 Students	.90(1.15)	0-4
	On-Premise Outlets Per 1,000 Students	.30(.53)	0-2.10
	Retail Outlets Per 1,000 Students	.60(.87)	0-3.25
	Bars Per 1,000 Students	.17(.29)	0-1.08
	Liquor-Serving Outlets Per 1,000 Students	.37(.56)	0-2.10
	Proportion of On-Premise Outlets to Total	.21(.28)	0-.93
	Proportion of Retail Outlets to Total	.42(.42)	0-1.33
	Proportion of Bars to Total	.15(.25)	0-1
	Proportion of Liquor-Serving Outlets to Toal	.25(.30)	0-.89
One Mile	Total Outlets Per 1,000 Students	3.75(4.17)	0-15
	On-Premise Outlets Per 1,000 Students	1.39(2.32)	0-10.63
	Retail Outlets Per 1,000 Students	2.26(2.71)	0-11.78
	Bars Per 1,000 Students	.81(1.06)	0-3.42
	Liquor-Serving Outlets Per 1,000 Students	1.69(2.52)	0-11.31
	Proportion of On-Premise Outlets to Total	.29(.28)	0-.84
	Proportion of Retail Outlets to Total	.60(.34)	0-1
	Proportion of Bars to Total	.18(.17)	0-.75
	Proportion of Liquor-Serving Outlets to Toal	.34(.27)	0-.84
Three Miles	Total Outlets Per 1,000 Students	30.13(42.38)	.82-202
	On Premise Outlets Per 1,000 Students	15.55(28.97)	0-133.73
	Retail Outlets Per 1,000 Students	13.61(13.56)	.77-60.16
	Bars Per 1,000 Students	6.06(8.61)	0-38.41
	Liquor-Serving Outlets Per 1,000 Students	17.89(31.97)	0-147.62
	Proportion of On Premise Outlets to Total	.38(.20)	0-.80
	Proportion of Retail Outlets to Total	.60(.22)	.11-1
	Proportion of Bars to Total	.18(.12)	0-.52
	Proportion of Liquor-Serving Outlets to Toal	.45(.20)	0-.89
Five Miles	Total Outlets Per 1,000 Students	65.37(108.25)	.82-448.87
	On-Premise Outlets Per 1,000 Students	36.27(73.78)	0-291.53
	Retail Outlets Per 1,000 Students	26.98(32.38)	.82-139.75
	Bars Per 1,000 Students	15.99(29.10)	0-113.33
	Liquor-Serving Outlets Per 1,000 Students	40.62(80.11)	0-318.83
	Proportion of On-Premise Outlets to Total	.38(.19)	0-.72
	Proportion of Retail Outlets to Total	.60(.20)	.24-1
	Proportion of Bars to Total	.20(.10)	0-.46
	Proportion of Liquor-Serving Outlets to Toal	.44(.19)	0-.78

Table 3.3 Alcohol Availability by Public vs. Private Classification

			Mean (SD)	Range	*t*
Half Mile	Total Outlets	Public	7.86(13.08)	0-56	-1.38
		Private	1.38(1.69)	0-4	
	On-Premise	Public	4.73(10.26)	0-43	-1.22
	Outlets	Private	.25(.46)	0-1	
	Retail Outlets	Public	3.05(3.62)	0-13	-1.55
		Private	1(1.31)	0-3	
	Bars	Public	2.36(5.54)	0-22	-1.07
		Private	.25(.46)	0-1	
	Liquor-Serving	Public	5.05(11.04)	0-48	-1.15
	Outlets	Private	.5(.76)	0-2	
One Mile	Total Outlets	Public	30.86(54.01)	0-210	-1.24
		Private	9(10.89)	0-27	
	On-Premise	Public	18.82(42.88)	0-159	-1.08
	Outlets	Private	2.25(4.20)	0-12	
	Retail Outlets	Public	10.82(9.97)	0-36	1.09
		Private	6.63(7.27)	0-18	
	Bars	Public	7.36(12.72)	0-45	-1.31
		Private	1.38(2.13)	0-6	
	Liquor-Serving	Public	20.82(46.71)	0-177	-1.05
	Outlets	Private	3.25(4.86)	0-13	
Three Mile	Total Outlets	Public	126.23(205.58)	15-756	.59
		Private	174(157.73)	1-437	
	On-Premise	Public	67.5(154.37)	1-544	.61
	Outlets	Private	104.13(110.69)	0-289	
	Retail Outlets	Public	55.09(45.92)	9-183	.47
		Private	64(46.78)	1-130	
	Bars	Public	38.36(53.25)	0-193	.53
		Private	39.25(38.84)	0-104	
	Liquor-Serving	Public	75.18(163.54)	3-580	.64
	Outlets	Private	116(120.02)	0-319	
Five Mile	Total Outlets	Public	195.32(297.69)	21-1095	1.80*
		Private	439.5(406.83)	1-970	
	On-Premise	Public	99.45(203.76)	1-733	1.87*
	Outlets	Private	275.38(288.78)	0-648	
	Retail Outlets	Public	90.59(89.06)	13-322	1.46
		Private	147.5(108.85)	1-302	
	Bars	Public	46.32(79.79)	0-293	1.76*
		Private	109.63(106.800	0-272	
	Liquor-Serving	Public	112.82(220.20)	3-794	1.86*
	Outlets	Private	302.13(310.80)	0-690	

*Note: * denotes p < .1, ** denotes p <.05.*

Table 3.4 Alcohol Availability by Institution Size

Radius		Total Outlets		On-Premise Outlets		Retail Outlets		Bars		Liquor-Serving Outlets	
		Mean(SD)	F	Mean(SD)	F	Mean(SD)	F	Mean(SD)	F	Mean(SD)	F
Half	Small	1.38(1.69)	2.48	.13(.35)	3.76**	1.38(1.69)	.68	.13(.35)	4.70**	.25(.46)	3.45**
Mile	Medium	5.13(6.64)		1.93(3.13)		3.07(3.83)		.67(.90)		2.20(3.14)	
	Large	13.71(20.91)		10.86(16.75)		2.57(3.46)		6.14(9.01)		11.43(18.26)	
One	Small	8.38(12.02)	4.29**	2.38(4.27)	5.04**	5.88(8.32)	1.34	2(2.67)	6.99**	3(4.87)	4.81**
Mile	Medium	14.73(10.48)		4.67(4.37)		9.87(6.81)		2.33(1.88)		5.87(5.21)	
	Large	66.14(88.24)		49(69.51)		13.71(14.10)		17.43(19.58)		53.14(76.04)	
Three	Small	98.75(138.57)	3.40**	53.13(96.64)	3.82**	42.25(39.41)	2.19	19.13(16.10)	6.65**	59.88(106.24)	3.54**
Mile	Medium	88.67(81.63)		34.60(55.11)		51.87(28.72)		14.20(16.10)		46.67(61.59)	
	Large	292.71(324.30)		196.29(243.25)		86.86(69.87)		81.71(80.52)		209(258.39)	
Five	Small	214.38(322.33)	2.15	124(220.20)	2.68*	83.13(92.16)	1.11	53.50(81.50)	3.26*	136(239.87)	2.50
Mile	Medium	180.67(216.80)		79.47(140.57)		96.33(76.820)		35.80(50.08)		94.87(154.73)	
	Large	484(503.62)		315.29(353.62)		151.86(132.99)		133(135.98)		341.14(380.60)	

Note: * denotes $p < .1$, ** denotes $p < .05$. df = 2,24.

Table 3.5 Alcohol Availability by Campus Environment

Radius		Total Count		On-Premise Outlets		Retail Outlets		Bars		Liquor-Serving Outlets	
		Mean(SD)	F	Mean(SD)	F	Mean(SD)	F	Mean(SD)	F	Mean (SD)	F
Half Mile	Urban	9.39(15.67)	.97	6.46(12.84)	.76	2.62(2.73)	2.98**	3.69 (6.96)	.90	7 (13.86)	.73
	Suburban	.71(1.89)		.43(1.13)		.29(.76)		.14(.38)		.43(1.13)	
	Mid-size City	1.67(1.53)		---		1.67(1.53)		.33(.58)		.33(.58)	
	Town	10.75(10.75)		4.5(5.45)		6.50(5.69)		1(1.41)		4.50(5.45)	
	Rural	3(3.46)		.33(.58)		2.67(2.89)		0(0)		.67(1.16)	
One Mile	Urban	44.85(66.79)	1.14	29.08(54.02)	.89	13.69(9.86)	.34**	11(15.64)	1.34	32.38(58.61)	.93
	Suburban	4.17(7.34)		2.29(4.79)		2.43(2.82)		1(2.24)		2.29(4.79)	
	Mid-size City	7(1)		1.67(2.89)		5.33(2.82)		2(1)		2(8.30)	
	Town	23.75(17.48)		7(6.68)		16.50(11.48)		3.25(2.75)		8.75(8.30)	
	Rural	6.33(7.57)		1.67(2.89)		4.67(4.73)		1.33(2.31)		2(3.46)	
Three Mile	Urban	232.31(260.96)	1.50	144.69(196.44)	1.38	78.77(57.56)	1.61	53.54(64.53)	1.33	159.69(208.21)	1.47
	Suburban	81.71(83.30)		38.57(61.91)		42.43(24.60)		19.71(37.36)		42.14(61.86)	
	Mid-size City	94(47.66)		32.33(11.85)		60.67(35.81)		22.33(153)		40.67(8.81)	
	Town	49.50(16.05)		14(6.98)		35(9.63)		7.50(4.20)		16.50(8.81)	
	Rural	32.33(35.57)		4.67(7.23)		27(27.62)		2.33(3.21)		7.67(10.79)	
Five Mile	Urban	401.54(419.96	1.28	242.77(293.39)	1.22	144.54(113.80)	1.37	99(105.79)	1.27	269(316.60)	1.25
	Suburban	239(326.15)		137.57(235.85)		93.86(84.99)		63.43(101.50)		150.14(250.87)	
	Mid-size City	169.33(114.05)		56(32.92)		111.67(81.71)		35.33(15.31)		71.67(49.66)	
	Town	55(20.31)		14.75(7.63)		39.75(13.12)		8.25(4.99)		17.75(10.21)	
	Rural	64(89.15)		15(25.12)		47.67(67.99)		8.67(14.15)		21.67(34.96)	

Note: * denotes p < .1, ** denotes p <.05. df = 5,24.

Table 3.6 Alcohol Availability by Residence Hall Alcohol Policy

			Mean(SD)	Range	*t*
Half Mile	Total Outlets	Allows	8.93(15.22)	0-56	1.28
		Does Not	3.57(5.35)	0-20	
	On-Premise	Allows	6.13(12.18)	0-43	1.61
	Outlets	Does Not	1(1.88)	0-7	
	Retail Outlets	Allows	2.67(3.13)	0-10	.13
		Does Not	2.50(3.59)	0-13	
	Bars	Allows	3.27(6.57)	0-22	1.71
		Does Not	.38(.50)	0-1	
	Liquor-Serving	Allows	6.53(13.15)	0-48	1.55
	Outlets	Does Not	1.21(1.89)	0-7	
One Mile	Total Outlets	Allows	39.60(64.02)	0-210	1.75
		Does Not	10.29(9.45)	0-27	
	On-Premise	Allows	25.67(50.96)	0-159	1.72
	Outlets	Does Not	3.21(3.68)	0-12	
	Retail Outlets	Allows	12.20(11.38)	0-36	1.55
		Does Not	6.93(6.46)	0-18	
	Bars	Allows	9.60(14.99)	0-45	1.94*
		Does Not	2(2.08)	0-6	
	Liquor-Serving	Allows	28.33(55.49)	0-177	1.70
	Outlets	Does Not	3.93(4.05)	0-13	
Three Mile	Total Outlets	Allows	175.67(242.44)	15-756	1.33
		Does Not	84.43(105.59)	1-437	
	On-Premise	Allows	106.93(181.65)	6-544	1.42
	Outlets	Does Not	34.71(73.79)	0-289	
	Retail Outlets	Allows	63.20(55.48)	7-183	.924
		Does Not	47.86(31.43)	1-130	
	Bars	Allows	44.93(63.96)	0-193	1.76*
		Does Not	14.29(20.82)	0-83	
	Liquor-Serving	Allows	116(192.21)	6-580	1.37
	Outlets	Does Not	41.79(80.81)	0-319	
Five Mile	Total Outlets	Allows	301.33(383.69)	21-1095	1.07
		Does Not	173.86(251.15)	1-970	
	On-Premise	Allows	180.87(271.64)	7-733	1.21
	Outlets	Does Not	80.36(166.41)	0-630	
	Retail Outlets	Allows	110.93(104.46)	13-322	.65
		Does Not	88.64(80.89)	1-302	
	Bars	Allows	79(106.34)	0-293	1.27
		Does Not	38(63.67)	0-232	
	Liquor-Serving	Allows	199.07(291.25)	9-794	1.19
	Outlets	Does Not	92.93(181.30)	0-689	

*Note: * denotes p < .1, ** denotes p <.05.*

Table 3.7 Person-Level Descriptive Statistics

	Mean(SD)	Range	Rate
W2 HED	1.20(1.95)	0-8	31.8%
W2 Perceived Drinking Behavior	5.05(4.14)	0-43	69.9%
W2 Sexual Violence Perpetration	.25(1.80)	0-30	3.8%
W3 HED	1.16(1.89)	0-8	32.4%
W3 Perceived Drinking Behavior	4.97(4.39)	0-75	69.1%
W3 Sexual Violence Perpetration	1.28(8.01)	0-105	5.9%
W4 HED	1.31(1.99)	0-8	34.1%
W4 Perceived Drinking Behavior	4.95(5.41)	0-75	64.8%
W4 Sexual Violence Perpetration	1.12(7.28)	0-105	5.3%

Table 3.8 Person-Level Correlation Matrix

	2	3	4	5	6	7	8	9
1. W2 HED	.39**	.15**	.61**	.22**	.13**	.62**	.16**	.10**
2. W2 Perceived Drinking Behavior		.12**	.26**	.28**	-.03	.33**	.28**	.08**
3. W2 Sexual Violence Perpetration			.70**	-.04	.28**	.05	-.02	.27**
4. W3 HED				.36**	.11**	.66**	.22**	.08**
5. W3 Perceived Drinking Behavior					-.001	.33**	.20**	-.02
6. W3 Sexual Violence Perpetration						.08**	-.01	.31**
7. W4 HED							.35**	.09**
8. W4 Perceived Drinking Behavior								.02
9. W4 Sexual Violence Perpetration								

*Note: * denotes p < .1, ** denotes p <.05.*

Table 3.9 Initial Random Intercepts Model of the Effect of Institution-Level Alcohol Availability on Person-Level Heavy Episodic Drinking

Model	1		2		3		4		5		6	
Radius	Intercept	Total Count	Intercept	Total Per 1,000 Students	Intercept	Prop. of On-Premise to Total	Intercept	Prop. of Retail to Total	Intercept	Prop. of Bars to Total	Intercept	Prop. of Liquor-Serving to Total
Three Mile	1.27**	-.001	1.22**	-.01	1.01**	.21	1.23**	-.23	1.08**	.56	1.07**	.06

*Note: * denotes $p < .1$, ** denotes $p < .05$. Outcome is HED. Prop is proportion.*

Table 3.10 Initial Random Intercepts Model of the Effect of Institution-Level Alcohol Availability on Person-Level Sexual Violence Perpetration

Model	1		2		3		4		5		6	
Radius	Intercept	Total Count	Intercept	Total Per 1,000 Students	Intercept	Prop. of On-Premise to Total	Intercept	Prop. of Retail to Total	Intercept	Prop. of Bars to Total	Intercept	Prop. of Liquor-Serving to Total
Three Mile	2.70**	.00	2.76**	.003	2.68**	-.001	2.66**	-.06	2.72**	.14	2.65**	-.09

Note: * denotes $p < .1$, ** denotes $p < .05$. Outcome is SVP. Prop is proportion.

Table 3.11 Proposed Multilevel SEM 3-2-2 Mediation Model

Model		Estimate	Posterior SD	p	95% CI
1	Person-Level				
	SVP on HED	.20**	.06	.00	.09,.32
	Institution-Level				
	HED on Three Mile Total Outlets	-.001	.001	.18	-.002,.001
	SVP on HED	.27	.25	.13	-.20,.76
	SVP on Three Mile Total Count	.00	.00	.34	-.001,.001
	SVP (Intercept)	3.10**	.44	.00	2.35,4.05
	Binge (Intercept)	1.27**	.14	.00	.98,1.55
	Indirect Effect				
	Compositional	.00	.00	.19	-.001,.00
	Total	.47**	.25	.03	-.01,.98
2	Person-Level				
	SVP on HED	.20**	.06	.00	.1,.32
	Institution-Level				
	HED on Three Mile Total Per Capita	-.01	.004	.08	-.01,.002
	SVP on HED	.29	.25	.11	-.19,.78
	SVP on Three Mile Total Per 1,000 Students	.01	.004	.12	-.003,.01
	SVP (Intercept)	3.19**	.44	.00	2.40,4.14
	Binge (Intercept)	1.31**	.14	.00	1.03,1.59
	Indirect Effect				
	Compositional	-.002	.002	.10	-.01,.001
	Total	.49**	.25	.02	.01,1.002

*Note: * denotes p < .1, ** denotes p <.05.*

Table 3.12 Sensitivity Analyses for Path A

Model	1		2		3		4		5		6	
Radius	Intercept	Total Count	Intercept	Total Per 1,000 Students	Intercept	Prop. of On-Premise to Total	Intercept	Prop. of Retail to Total	Intercept	Prop. of Bars to Total	Intercept	Prop. of Liquor-Serving to Total
Half Mile	1.10**	.00	1.14**	-.05	.99**	.40	1.20**	-.28	1.06**	.22	1.03**	.25
One Mile	1.14**	-.002	1.20**	-.03	1.02**	.25	1.27**	-.31	1.06**	.23	1.05**	.12
Five Mile	1.14**	.00	1.14	-.001	.98**	.31	1.25**	-.26	.98**	.62	1.04**	.12

*Note: * denotes $p < .1$, ** denotes $p < .05$. Outcome is HED. Prop is proportion.*

Table 3.13 Sensitivity Analyses for Path C

Model	1		2		3		4		5		6	
Radius	Intercept	Total Count	Intercept	Total Per 1,000 Students	Intercept	Prop. of On-Premise to Total	Intercept	Prop. of Retail to Total	Intercept	Prop. of Bars to Total	Intercept	Prop. of Liquor-Serving to Total
Half Mile	.267**	-.001	2.74**	.05	2.64**	-.18	2.80**	.30	2.62**	-.48	2.63**	-.23
One Mile	2.68**	.00	2.73**	.01	2.61**	-.24	2.78**	.16	2.68**	-.13	2.60**	-.25
Five Mile	2.73**	.00	2.74**	.001	2.17**	.07	2.61**	-.15	2.66**	-.17	2.68**	-.03

*Note: * denotes p < .1, ** denotes p <.05. Outcome is SVP. Prop is proportion.*

4   DISCUSSION

Combining publicly-available alcohol license data and self-report data from a longitudinal cohort study of college men provided a unique opportunity to examine the relationships between alcohol availability, heavy episodic drinking, and sexual violence perpetration. As expected, alcohol availability varied across the thirty colleges in the sample based on whether the institutions were public or private, the size of the institutions, their campus environment, and whether students of legal drinking age can possess alcohol in residence halls. However, these differences were relatively inconsistent. There were more total outlets, on-premise outlets, bars, and liquor-serving outlets near private schools, but only at the five-mile radius. The number of bars near campuses varied according to the institution size, with more bars near larger institutions, and residence hall alcohol policy, with more bars near institutions that allow alcohol. On the other hand, the number of total outlets, on-premise outlets, and liquor-serving outlets only seemed to vary according to institution size, with more outlets located near larger campuses. Campus environment, whether institutions were located in urban, rural, or suburban areas, did not seem to be related to alcohol availability, except for campuses located in suburban areas where there were more retail outlets at the one- and three-mile radii.

Contrary to my hypotheses and findings from previous research, institution-level alcohol availability within a three-mile radius did not predict college men's heavy episodic drinking nor sexual violence perpetration. However, college men's heavy episodic drinking did significantly predict sexual violence perpetration. In the final hypothesized 3-2-2 MSEM mediation model, institution-level alcohol availability within a three-mile radius did not predict college men's heavy episodic drinking, which in turn did not mediate the relationship between alcohol availability within a three-mile radius and person-level sexual violence perpetration.

Given these non-significant findings, an exploratory model was estimated to examine an additional component of college alcohol culture, perceptions of the typical student's drinking behavior. Research suggests that college alcohol culture, which refers to traditions, beliefs, expectations, and practices related to drinking alcohol, on college campuses is a complex phenomenon (Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism, 2002; Rabow & Duncan-Schill, 1995). Alcohol culture includes perceptions of drinking norms, social expectations, temporal patterns, and celebratory rituals. Norms related to drinking behavior are associated with self-reported drinking (Neighbors et al., 2007; Perkins 2005). Perceptions of drinking behavior aggregated at the institution-level significantly predicted college men's self-reported heavy episodic drinking but did not significantly predict college men's sexual violence perpetration. Overall across institutions and participants, college men's reported heavy episodic drinking did significantly predict sexual violence perpetration. College men's heavy episodic drinking did mediate the relationship between perceptions of other's drinking behavior and college men's perpetration of sexual violence.

4.1   Hypothesized Models

The link between alcohol availability and individuals' drinking has been well-established in the literature in both college and community samples (e.g., Campbell et al., 2009; Kypri et al., 2008; Popova et al., 2009). However, the findings of this study did not follow this well-established relationship. Despite using various methods for measuring alcohol availability (i.e., raw counts, per capita counts, and proportions of total count), alcohol availability at the institution-level did not significantly predict self-reported heavy episodic drinking among college men. These findings are surprising and signal a need for further research on the link between alcohol availability and drinking behavior on college campuses. Nevertheless, it is too early to

conclude that there is no link between alcohol availability and heavy episodic drinking, as there are several potential explanations for these findings that deserve consideration.

One potential explanation is related to the dynamic nature of communities which can make it difficult to accurately assess the impact of alcohol availability. Communities and alcohol outlets are not static (Gruenewald, 2008). Outlets experience changes in culture, type of customer, and staff and management. All of which could influence the impact that an outlet has on a community. Gruenewald's (2007) social ecological theory highlights stratification of outlets – concentration of high-risk drinkers into specific outlets – as an important driving force for the link between alcohol availability and crime. Perhaps, few alcohol outlets near a campus with a culture supportive of heavy episodic drinking and sexual violence perpetration is enough to create a hotspot where negative behaviors are reinforced. Thus, increased alcohol availability, through a high number of alcohol outlets, may not directly contribute to increases in heavy episodic drinking nor perpetration of sexual violence.

Another potential explanation is related to the age of the sample. This study assessed the drinking behaviors of college men over their first two years of college, as such many of the participants may not have been of legal age to purchase and consume alcohol. Underage students are more likely to drink at off-campus and fraternity parties than of-age peers, who drink at off-campus bars (Harford, Wechsler & Seibring, 2002). Underage students also obtain alcohol from of-age peers (Wechsler, Kuo, Lee, & Dowdall, 2000; Wechsler, Lee, Nelson, & Kuo, 2002b). Therefore, the effect of alcohol availability, measured via the number of alcohol outlets, on this sample may have been limited. Assessing alcohol availability in multiple ways (e.g., license type, business type) might account for the age of the sample, but it is possible that alcohol availability near campuses has a different effect on students depending on their age.

Finally, this study measured alcohol availability using measures of alcohol outlet density (i.e., raw counts of alcohol outlets, counts per capita, and proportions of different types of outlets to the total number of outlets). Although these methods of assessing alcohol availability are common in the literature, there is additional information about outlets that could be helpful. Perceptions of availability on and near campuses may matter more than actual availability. Perceptions of a more permissive alcohol culture was related to heavy drinking among college students in a national sample (Perkins & Weschler, 1996). In a Canadian sample, perceptions of campus norms about drinking was a stronger predictor of drinking behavior than actual campus drinking behavior (Perkins, 2005). Additionally, information about the culture and practices of specific alcohol outlets (e.g., serving underage patrons, bar specials, large volume purchase limitations) could be helpful to understand alcohol culture on individual campuses. Information about drink specials and pricing could provide important context about levels of consumption at specific bars (Kuo et al., 2003; Weitzman et al., 2003). Research suggests that higher alcohol prices are associated with less intoxication, suggesting that bars with more drink specials and lower prices may have more intoxicated patrons (O'Mara et al., 2009). "All-You-Can-Drink" specials are also associated with higher intoxication and college students appear to plan around drink specials (Thombs et al., 2009). Assessing these additional components of availability and alcohol culture, including perceptions of alcohol availability and drinking, on college campuses represents an important next step and may help to clarify the findings of this study.

4.2 Exploratory Models

Additional, post-hoc model results suggest that perceptions of the typical student's drinking behavior aggregated at the institution-level may have an impact on college men's drinking behavior and perpetration of sexual violence. Participant's self-reported HED mediated

the relationship between perceptions of the typical student's drinking behavior aggregated at the college-level and SVP, such that participants at institutions with higher levels of perceived drinking reported more HED and SVP. This finding is significant due to the use of social norms campaigns as prevention strategies for high-risk drinking and SVP. Social norms campaigns that challenge norms about drinking can be successful and ultimately reduce alcohol consumption (DeJong et al., 2006; Haines & Spear, 1996; Mattern & Neighbors 2004). Thus, if social norms campaigns can change perceptions of drinking and drinking behaviors, it is possible that these programs could also reduce sexual violence perpetration. It is important to note, that the effectiveness of alcohol-related social norms campaigns may depend on additional community factors, such as alcohol availability (DeJong et al., 2009; Scribner et al., 2011). Interestingly, two of the few successful prevention programs for sexual violence identified in recent reviews involve social norms campaigns (Coker et al., 2017; DeGue et al., 2014). This demonstrates the urgent need for more research that investigates the potential impact of social norms campaigns that target both drinking and sexual violence perpetration.

Additionally, this study highlights the importance of assessing norms and perceptions about drinking alongside assessments of drinking behaviors, especially among college populations. The clear link between perceived norms and drinking behaviors suggests that norms may influence patterns of high-risk drinking and may help to explain when and why college students engage in high-risk drinking. For example, perceptions of celebratory drinking practices may be important predictors of engaging in celebratory drinking (e.g., 21 shots on 21st birthday; Neighbors, Oster-Aaland, Bergstrom, & Lewis, 2006). Although few students may participate in these high-risk drinking events, misperceptions – both about how many peers participate and how much peers drink – are associated with more drinking. Understanding how and why

drinking norms and perceptions impact college students' high-risk drinking should continue to be an important focus for researchers.

4.3   Limitations

There are a few important limitations to consider regarding this study. First, the sample of institutions was relatively small and the relatively small sample sizes at a few of the institutions greatly limits the ability to generalize to these institutions. Although there was adequate power to detect effects, a larger sample of institutions with more participants at each institution would have provided additional power and variability. It is very likely that some of the institutional samples were not representative of the institution from which they were collected.

Second, this study defined alcohol availability using measures of alcohol outlet density. Although alcohol outlet density is often used as a proxy for availability, it does not completely capture whether or not alcohol is readily available to all populations in a given community. College students are a unique population in which to assess availability as many students obtain alcohol and drink while underage. In this population, there are specific components of availability of alcohol that are not captured using alcohol outlet density. For example, enforcement of minimum legal drinking age laws at alcohol outlets may vary from outlet to outlet. Some outlets may "card" more stringently while others are less strict, making alcohol more accessible to underage students (Koenings, Olfert, Kattelmann, & Nitzke, 2013). Additionally, laws regarding drink specials and volume sales in certain jurisdictions may impact availability. In college towns, it is common for bars to have drink specials around certain events (e.g., football games, drinking holidays) and some jurisdictions require event registration when making large volume purchases (e.g., kegs; Neal & Fromme, 2007; Thombs et al., 2009; Weschler et al., 2002b). These components of availability are impossible to capture when

examining alcohol outlet density and may be especially important when examining alcohol availability in a college population.

Third, this study incorporated spatial data but did not account for spatial autocorrelation in the multilevel models. Given that participants were nested within institutions, multilevel structural equation modeling was a more appropriate analysis strategy as it accounts for nested data and allows for the calculation of between cluster indirect effects (Lachowicz et al., 2015). Additionally, the focus of the current study was alcohol availability near colleges and universities and not the spatial relationship between outlets and participants (Chaix, Merlo, Subramanian, Lynch, & Chauvin 2005). Spatial sensitivity analyses were conducted to examine spatial autocorrelation and estimate the effect of alcohol availability on HED and SVP using spatial regression. However, alcohol availability did not predict HED or SVP in the expected direction.

4.4   Future Directions

Future research should examine a broader picture of the potential impact of college alcohol culture on heavy episodic drinking and sexual violence perpetration. This study attempted to examine alcohol availability as a potential institution-level target for prevention; however, there are other components of college alcohol culture that could be prevention targets. Perceptions of alcohol availability may provide a better measure of availability, as students may perceive that alcohol is relatively easy to obtain regardless of how many alcohol outlets are near campus. Additionally, future research should examine the culture and practices of specific alcohol outlets and investigate whether outlets near college campuses are supportive of heavy episodic drinking and sexual violence perpetration. Qualitative research using participant observation or focus groups could provide unique insight into the culture of outlets near college

campuses and examining pricing and volume sales could help determine whether specific alcohol outlets promote heavy episodic drinking. Finally, future research should investigate the potential for alcohol-related social norms campaigns to prevent other negative behaviors, including sexual violence perpetration. The findings from this study suggest that perceptions of a typical student's drinking behavior are related to heavy episodic drinking and sexual violence perpetration. If social norms campaigns can change perceptions about drinking norms and reduce consumption, this may lead to a reduction in sexual violence perpetration.

4.5 Conclusion

Given the well-established relationship between alcohol availability and crime in campus and community samples, this study investigated whether alcohol availability near colleges and universities was a community-level risk factor for heavy episodic drinking and sexual violence perpetration. Unfortunately, the findings from this study do not follow this well-established relationship. Alcohol availability, measured by alcohol outlet density, did not predict heavy episodic drinking or sexual violence perpetration using any measure of availability within any of the specified distances. Although these findings are surprising, alcohol availability is more complex than alcohol outlet density and there are a number of other factors that may be important to understand alcohol availability, especially near college campuses. The alcohol culture on college campuses varies widely due to differences in alcohol control policies, enforcement of legal drinking age laws, and culture and practices of specific alcohol outlets. Therefore, additional research is needed to further unpack alcohol availability and alcohol culture on college campuses. One important next step may be to investigate the role of perceptions of drinking norms as there is evidence to suggest that changing these norms may lead to reductions in alcohol consumption. The findings from the post-hoc exploratory model

suggest that changing norms related to drinking may be a way to both reduce heavy episodic drinking and prevent sexual violence perpetration. Perceptions of drinking behavior, aggregated at the institution-level, significantly predicted heavy episodic drinking, which mediated the relationship between perceptions of drinking behavior and sexual violence perpetration. Combining these findings with evidence of successful social norms campaigns related to drinking provides some hope for identifying potential community-level risk factors for sexual violence perpetration. However, additional research is needed to determine whether alcohol-related social norms campaigns can be effective at preventing other negative behaviors. Although the findings of this study are somewhat surprising and raise more questions about the effects of alcohol availability near college campuses, the exploratory findings provide some hope that there may be effective community-level prevention strategies for sexual violence on college campuses.

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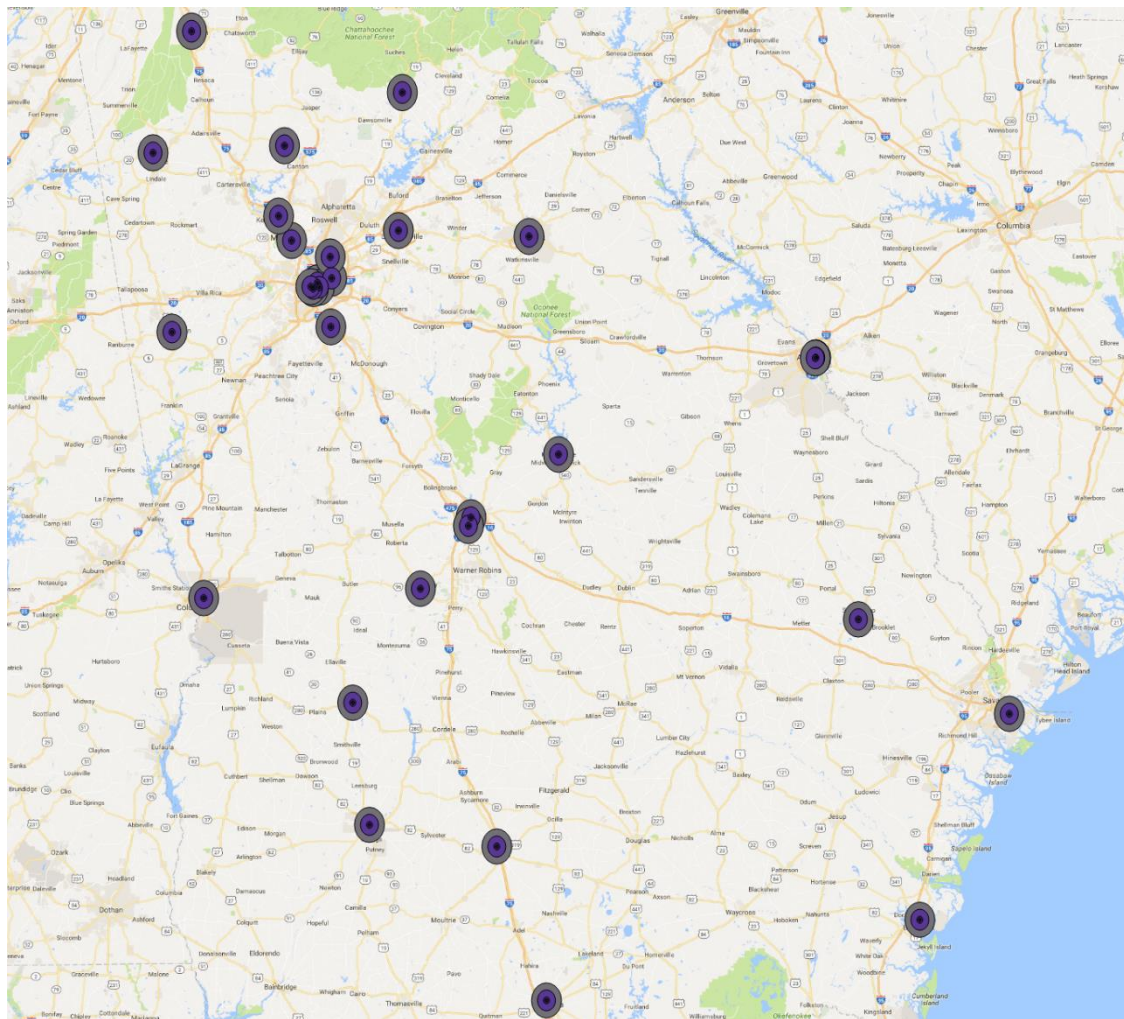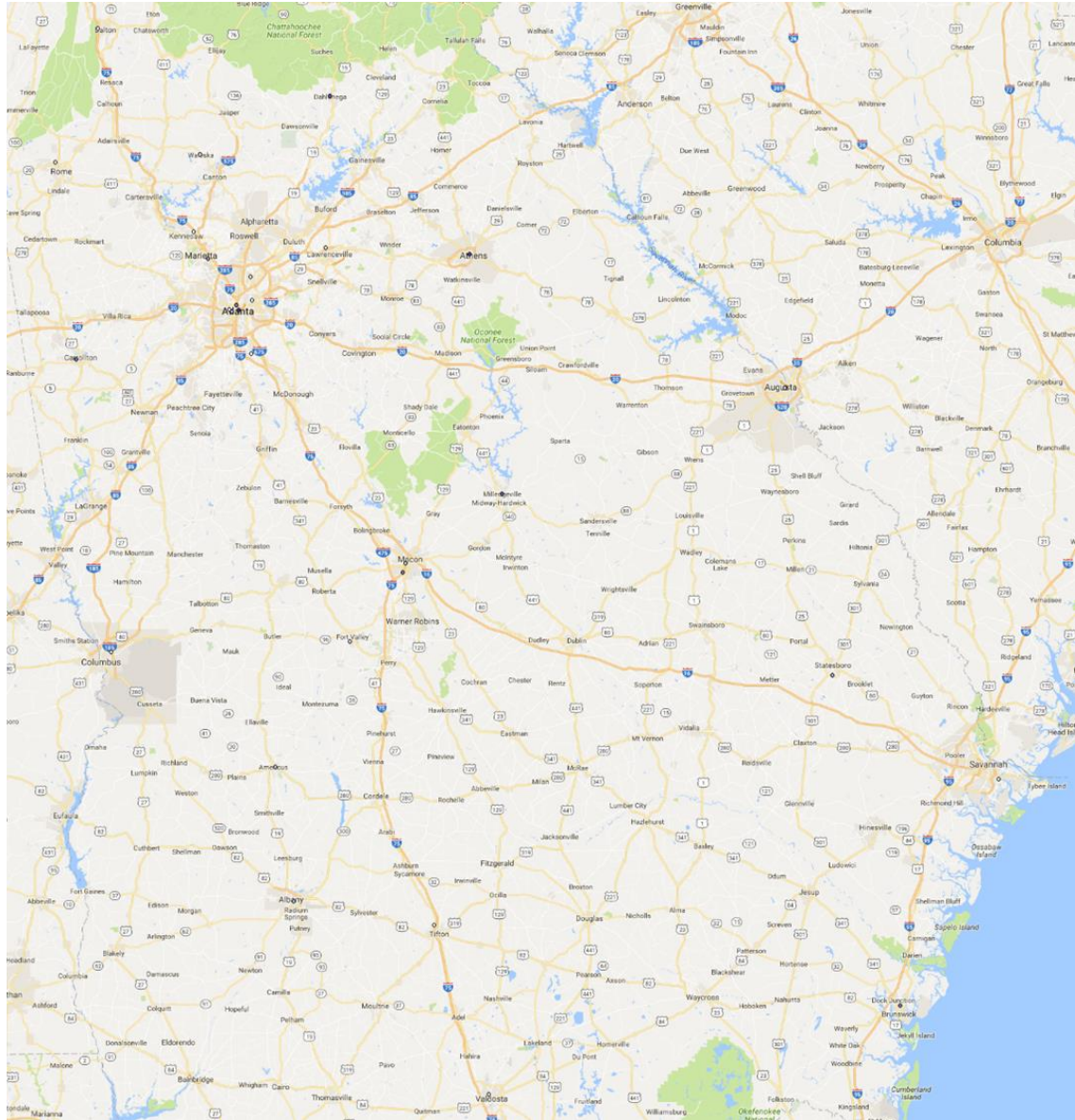
APPENDICES

Appendix A

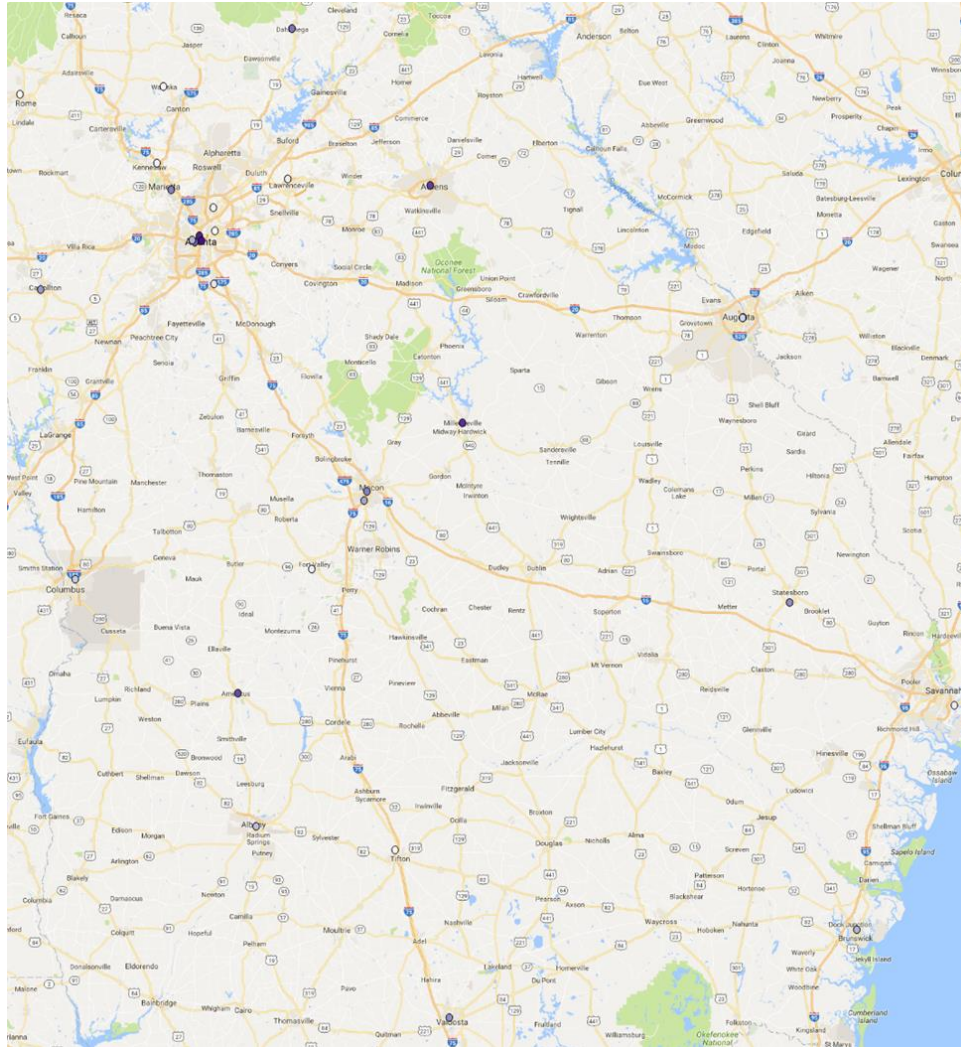### *Appendix A.1 Map Depicting All Alcohol Outlets within Taxing Districts*
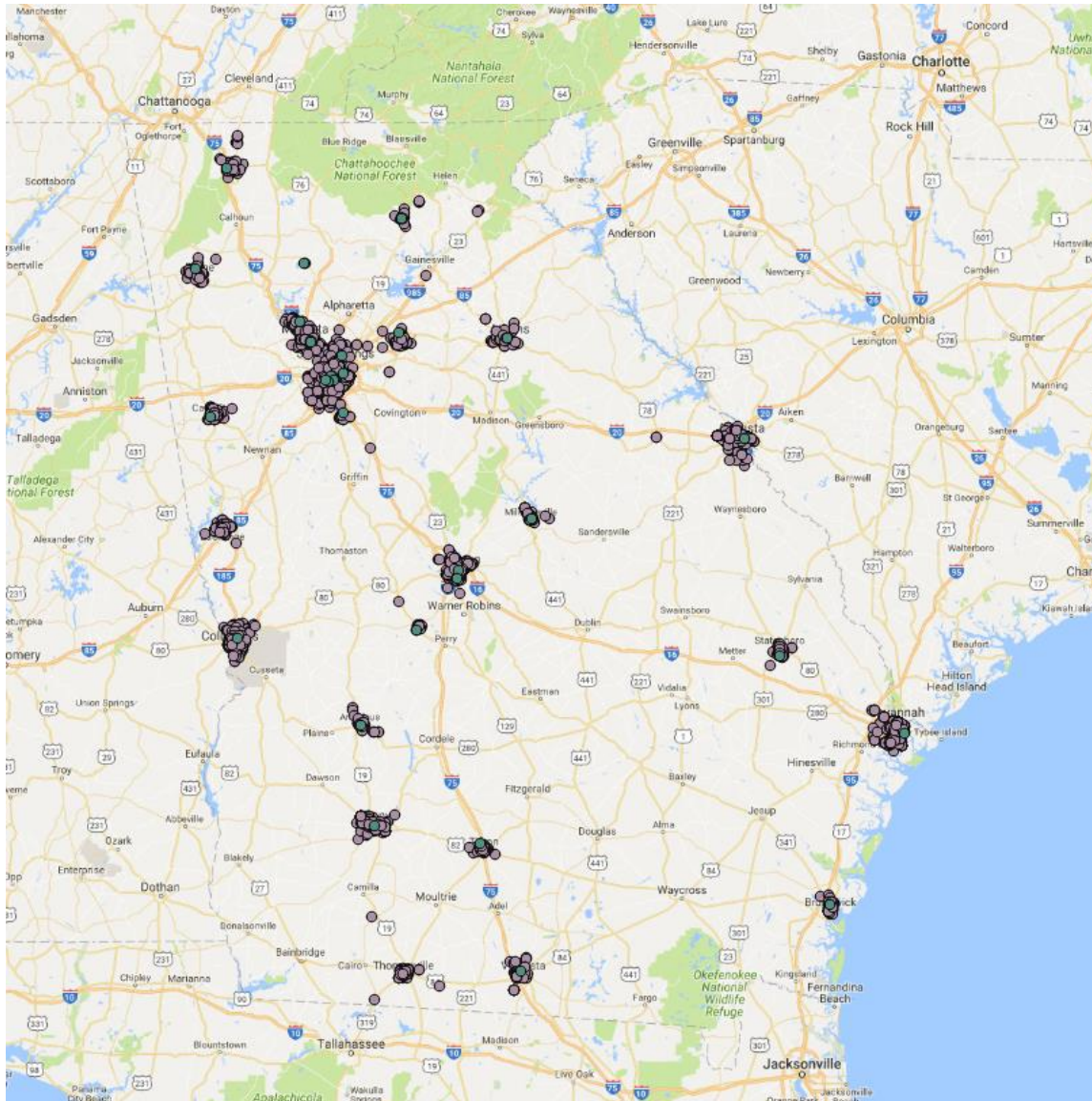
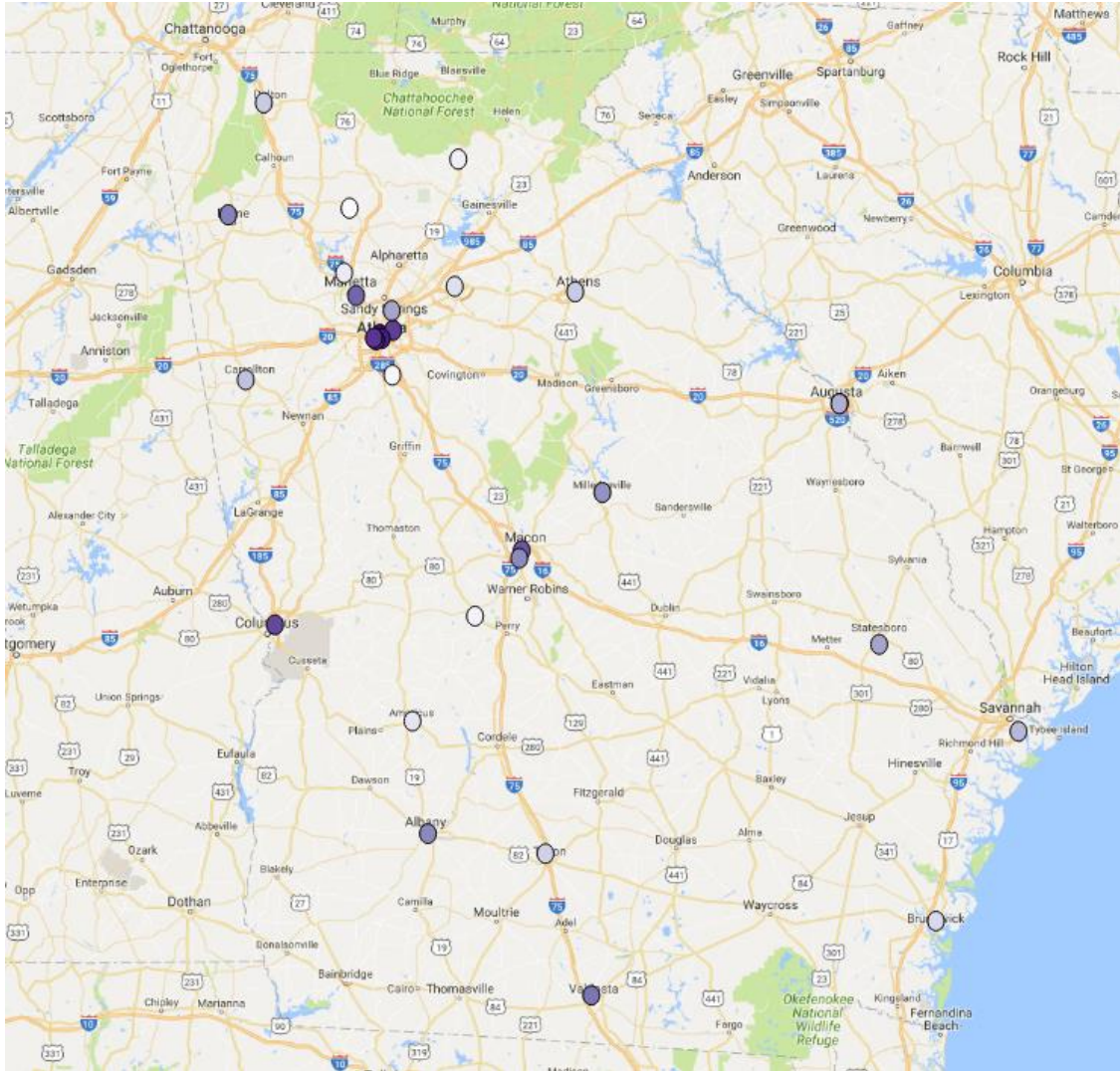*Appendix A.2 Map Depicting All Buffer Zones*

Appendix A.3 Map Depicting Half-Mile Buffer Color-Coded

Appendix A.4 Map Depicting One-Mile Buffer Color-Coded

Appendix A.5 Map Depicting Three-Mile Buffer Color-Coded

Appendix A.6 Map Depicting Five-Mile Buffer Color-Coded