The Nature, Determinants, and Consequences of the School-Level Tobacco-Alcohol Use Association

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ABSTRACT

It is widely recognized that stage of the life course and school health environments are key determinants of trajectories of health behaviors, yet investigations rarely combine these approaches. Furthermore, the strong relationship between different health behaviors is acknowledged but rarely studied jointly. Our investigation identifies a key feature of the school health environment, the school-specific association of tobacco and alcohol use, and investigates its influence on patterns of alcohol and tobacco co-use through young adulthood. We find that this feature is strongly associated with long-term patterns of tobacco and alcohol co-use, even when key individual demographic and school compositional and structural characteristics are controlled. We conclude that this is a widely variable and key feature of the social environment that influences long-term health behavioral trajectories.

INTRODUCTION

Early adulthood is widely understood as a period in which young people's behaviors change dramatically to incorporate less healthy patterns. Yet typical investigations of this phenomenon treat individual behaviors as though they were independent of one another and of earlier social contexts in the young adults' lives. In contrast, a life course approach emphasizes that outcomes are frequently interdependent and heavily influenced by social contexts during critical periods of development. As a result, although we know much about health behaviors in adolescence, we know relatively little about how these patterns change across stages of the life course and even less about how contextual influences in earlier life shape these transitions (Frech 2012; Lau et al. 1990; Resnick et al. 1997; Telama et al. 1997).

Tobacco and alcohol use are two of the most frequently-studied behaviors in all of social science, and much is known about how social context influences patterns of these behaviors independently. Yet relatively little is known about how social environments shape these behaviors jointly. This is important to redress because, while moderate alcohol use has few negative health effects in itself, the joint health effects of tobacco *and* alcohol use are substantially greater than tobacco use alone (Castellsague et al. 1999; Kalman et al. 2010). To partially redress this omission in the literature, we hypothesize that the school-specific association between tobacco and alcohol use is an important indicator of the school's health behavioral environment. This is likely for two reasons. First, this may be an indication of the presence of common environmental influences on tobacco and alcohol use among select members of the population which may have persistent effects in the future, consequently influencing this subgroup's health prospects. Second, this may also indicate the degree to which one behavior is a 'gateway' for the other. Even if adolescents do not smoke or drink while they attend this school, this linkage may remain and influence their odds of adopting both behaviors when they adopt one in the future.

Although previous research has investigated over-time variability in the tobacco-alcohol use association (Daw et al. 2012), no prior research has investigated its cross-sectional variability, demographic predictors, and long-term behavioral consequences. Because schools are largely anchored in neighborhoods and neighborhoods vary widely in patterns of health behavioral practices, it is likely that they vary widely in

this association as well. Finally, given that adolescence is a critical period in the formation of health behaviors, it is likely that this feature of the school health behavioral environment has long-lasting influences on behaviors and health.

BACKGROUND

Tobacco Use, Alcohol Use, and Health

Although tobacco and alcohol use are frequently discussed together under the common banner of 'health behaviors,' they have very different consequences for adolescents' future health prospects. While moderate alcohol use itself has little effect on health trajectories, and may even yield health benefits, tobacco use is one of the least healthy behaviors one can engage in. Indeed, smoking causes more preventable deaths than any other cause, accounting for 21% and 17% of male and female deaths in 2004 in the United States, respectively (Fenelon and Preston 2012).

While these facts are well known, less appreciated is that the effects of tobacco and alcohol use on health outcomes and mortality are interactive, such that non-smokers' moderate alcohol use is inconsequential but the alcohol use of smokers amplifies the health consequences of their tobacco use (Castellsague et al. 1999; Kalman et al. 2010). In short, drinking alcohol *is* bad for one's health if one also smokes cigarettes. This contested fact (Mukamal 2006) highlights the need to examine tobacco and alcohol use jointly, examining the rates at which members of the population engage in both behaviors, potentially negatively influencing their future health. Somewhat surprisingly, very little research has done so. Because health behaviors adopted in young adulthood are likely to continue later in life (Frech 2012; Lau et al. 1990; Telama et al. 1997), studying patterns of co-use longitudinally during adolescence and young adulthood is an important place to begin to address this omission.

The Transition to Adulthood and the Social Epidemiology of Tobacco and Alcohol Use

The transition from adolescence to young adulthood is a crucial turning point in the determination of trajectories of health behaviors. As many young adults leave their parents' homes and enter the work force, college, or the military, the transition to adulthood is marked by a steep decline is proportions of such persons eating right, getting enough sleep, and avoiding tobacco and heavy alcohol use (Frech 2012).

However, life course research on health behaviors suggests that the influence of earlier home, school, and neighborhood environments do not end when young people reach legal adulthood (Crosnoe 2004; Crosnoe and Elder 2002; Elder et al. 2003; Frech 2012). Instead, it is likely that these key environments in adolescence continue to shape young people's behavior, and therefore their health, well into adulthood.

This suggests that understanding the social epidemiology of alcohol and tobacco use in adolescence will help us understand patterns of co-use in young adulthood, as well. Although tobacco and alcohol co-use has received scant attention, much is known about the social epidemiology of these behaviors individually. Crucially for present purposes, a great deal of prior research has investigated contextual influences on tobacco and alcohol use, leaving no doubt that both behaviors cluster appreciably within schools and neighborhoods far above what one would expect under randomness (Aveyard et al. 2004; Ennett et al. 1997; Galea et al. 2007; Karriker-Jaffe 2011; Maes and Lievens 2003; O'Malley et al. 2006; Reboussin et al. 2010; Snedker et al. 2009). This clustering suggests that some combination of contagion and compositional effects on tobacco use which are associated with the school environment and substance use patterns (Ennett et al. 1997). Explanations of this phenomenon typically focus on the neighborhood or school racial and socioeconomic composition, disorder, and other key characteristics of the social environment (Ennett et al. 1997; Galea et al. 2007; O'Malley et al. 2006; Reboussin et al. 2010). Theoretically, it is often assumed that these environmental characteristics will influence tobacco and alcohol use similarly. However, the evidence on this is considerably mixed (Karriker-Jaffe 2011) – often, for instance, socioeconomic effects on alcohol use are found to be positive while those on tobacco use are found to be absent or negative (Galea et al. 2007)(Galea et al. 2007). Other studies find positive associations of SES with both (Chuang et al. 2005; Crum et al. 1996; Ennett et al. 1997), or opposite effects by age (O'Malley et al. 2006).

Hypothesized Environmental Influences on Tobacco and Alcohol Co-Use (TAAC)

We argue that studies of contextual influences on tobacco and alcohol use could benefit greatly from studying their co-use. Doing so is important for understanding population health because of the non-additive effects of these behaviors. Furthermore, because of the mixed relationship between area-level socioeconomic

characteristics, disorder, and these health behaviors, we do not feel that these are the most important environmental characteristic to examine.

Instead, we investigate the predictive power of the school-specific association of tobacco and alcohol use on patterns of tobacco and alcohol co-use (or TAAC), for two reasons. First, much research investigates whether these behaviors act as a 'gateway drug' for one another (Torabi et al. 1993), so contextual variation in this association may indicate that this process occurs more in some schools than others. In this case, adolescents who would only take up alcohol use in other schools may also take up cigarette smoking at a school with a high association between these two behaviors. Second, it may be that this measure of variability in the association of tobacco and alcohol use does not reflect variation in the gateway effect, but rather the effects of selective influences on the tobacco and alcohol use of a subset of that school's student body. For instance, if a school is socioeconomically and/or racially integrated and students from different groups are more or less likely to engage in tobacco and alcohol use due to aspects of their environmental circumstances not common to the entire school, the association of tobacco and alcohol use at this school would also be high. In contrast, schools with students subject to relatively similar environments would be expected to have low associations of tobacco and alcohol use if this is so.

These are reasons to expect that the school-specific tobacco-alcohol association (SSTAA) will be associated with TAAC in adolescence. However, because of the life course dependency of health behaviors, we also predict that SSTAA will predict life course patterns of TAAC at older ages, as well. If these hypotheses are supported, this suggests that the TAAC will be geographically and socially concentrated among populations with high associations of these behaviors, as will the long-term consequences thereof.

DATA, MEASURES, AND ANALYSIS

Data

Data for this study comes from the National Longitudinal Study of Adolescent Health (Add Health), a nationally representative dataset on secondary school attendees in 132 schools in 1994. There are currently five waves of Add Health data – the in-school survey, and four waves of in-home interviews with a subset of the attendees of those schools. The in-school survey offers far less depth than the in-home surveys, but has

the benefit of surveying everyone at each of these schools on a moderate range of behavioral, attitudinal, and other social measures. Crucially, the in-school survey asked students to report their cigarette smoking and alcohol drinking behaviors, resulting in data on the health behaviors of more than 90,000 students in 132 schools with which to measure the school-specific association of tobacco and alcohol use. Furthermore, the longitudinal follow ups of a subset (more than 15,000 in waves 3 and 4) of these students permits study of the long-term influences of this association on TAAC.

Measures

School-specific tobacco and alcohol use association (SSTAA). SSTAA is measured using an original measure inspired by chi-square tests (Daw et al. 2012). The idea is that the proportion of students who engage in TAAC is influenced by the marginal proportions who engage in tobacco and alcohol use in the absence of an association. For instance, if half the students at a school engage in alcohol and tobacco use, even without an association one would expect that one-fourth of those students would use both alcohol and tobacco. Just as chi-square statistics are calculated by comparing the observations in each cell of a cross-tabulation to the count expected if the two variables were independent, we derive our measure of the school-specific association of tobacco and alcohol use as the excess proportion of students who engage in TAAC above that expected based on the marginal distributions of tobacco and alcohol use.[1] More formally, this 'excess proportion' measure is calculated as

$$P_{ej} = p_{cj} - p_{sj}p_{dj}$$

where P_{ej} is the excess proportion of students at school j who engage in TAAC than expected under independence, p_{cj} is the proportion of students at school j who engage in TAAC, p_{sj} is the proportion engaging in tobacco use, and p_{dj} is the proportion engaging in alcohol use at school j. This measure is separately calculated for any and heavy use of tobacco and alcohol, as is described presently.

[1] Although we could have measured this association using polychoric or polyserial correlations, we prefer this measure because it has the added virtue of capturing the scale of the health behavioral consequences of this association. While a polychoric correlation of 0.5 tells you that there is a positive relationship between tobacco and alcohol use at a school, an excess proportion measure of 0.2 informs you that 20% of the student body engages in TAAC who would not do so if there were no association between tobacco and alcohol use.

In-School tobacco and alcohol use measures. The SSTAA is calculated using in-school measures of tobacco and alcohol use. Although these measures are less refined than those available in the in-home survey, they have the virtue of measuring the tobacco and alcohol use of all students at each school. The in-school tobacco use measure is based on student responses to the question, "During the past twelve months, how often did you smoke cigarettes?" Responses were measured ordinally on a 0-6 scale, indicating "never," "once or twice," "once a month or less," "2 or 3 days a month," "once or twice a week," "3 to 5 days a week," and "nearly everyday" in order. Any tobacco use is indicated by a 1-6 value; heavy tobacco use is indicated by a value of 6 – i.e., the respondent smokes cigarettes nearly every day.

The in-school alcohol use measure is based on student responses to the question, "During the past twelve months, how often did you drink beer, wine, or liquor?" Response categories are identical to those of the tobacco use measure just described. Any alcohol use is indicated by a 1-6 value; heavy alcohol use is indicated by values of 4 or higher – i.e., the respondent drinks alcohol at least once a week. Any co-use of alcohol and tobacco is then measured as reports that the respondent has engaged in both behaviors; heavy co-use indicates that the respondent smoked cigarettes nearly everyday and drank alcohol at least once a week over the prior 12 months.

In-home tobacco and alcohol use measures. In waves 1-4, more detailed measures were available. We employ measures that combine information on the frequency and intensity of tobacco and alcohol use over the prior 30 days and 12 months respectively to obtain an estimate of the total cigarettes and alcoholic beverages consumed over that period. Tobacco use frequency is measured using responses to the question, "During the past 30 days, on how many days did you smoke cigarettes?" Tobacco use intensity was measured by the response to the question, "During the past 30 days, on the days you smoked, how many cigarettes did you smoke each day?" Multiplying these responses together yields the estimated number of cigarettes smoked over the last 30 days.

Alcohol use frequency is measured more coarsely, using ordinal responses to the question, "During the past 12 months, on how many days did you drink alcohol?" Responses were reverse coded so that they ranged 0-6, respectively indicating "never," "1 or 2 days," "once a month or less," "2 or 3 days a month," "1

or 2 days a week," "3 to 5 days a week," and "every day or almost every day." Alcohol use intensity was then measured using responses to the question, "Think of all the times you have had a drink during the past 12 months. How many drinks did you usually have each time? (A 'drink' is a glass of wine, a can of beer, a wine cooler, a shot glass of liquor, or a mixed drink.)" Legitimate skips were recoded to 0. An interval-level measure of the estimated number of alcoholic drinks consumed over the past 12 months is then derived by multiplying these values together.

School-level measures. To assess what sorts of schools have high excess proportions of tobacco and alcohol co-users, we constructed a number of school-level measures. The racial index of qualitative variation (IQV) is a measure of racial diversity at the school (Frankfort-Nachmias and Leon-Guerrero 2009), where race was measured in five categories – non-hispanic white, non-hispanic black, hispanic. Native American or Asian American, or other. Another measure of school racial composition used in this analysis is the proportion of students at that school who were non-white.

Mean parental education at the school is calculated by assigning midpoint years of education values to the following student responses concerning their parents' highest educational attainment: "eighth grade or less" (4), "more than eighth grade, but did not graduate from high school" (10), "high school graduate" (12), "completed a GED" (12), "went to a business, trade, or vocational school after high school" (14), "went to college but did not graduate" (14), "graduated from college or a university" (16), "professional training beyond a four-year college" (20), "(he/she) went to school, but I don't know what level" (missing), "(he/she) never went to school" (0), "I don't know if (he/she) ever went to school" (missing). If the student reported both their mother's and father's educational attainment, the highest recoded value of the two was used.

Four school social network measures were employed as well. The in-school survey gave respondents the opportunity to nominate their five best male and five best female friends at the school. Mean popularity measures the average number of times a student at the school was nominated as a friend by others at that school. Mean centrality is the average Bonacich centrality of a respondent at the school. Network sex and race segregation is constructed by Add Health using the formula of the chi-square statistic of the expected and observed number of cross-trait ties (Freeman 1978).

Finally, four measures of student attitudes, behaviors, and health are employed. The Mean Bad Outlook Index is the school average value of the sum of student pessimistic predictions of the odds that they will live to age 35, be killed by 21, get HIV or AIDS, graduate from college, and obtain a middle class income by age 30. Each set of responses ranged from 0 to 8 (representing "no chance" to "it will happen"), and values were recoded so that predictions of higher likelihoods of bad outcomes were given higher values. These were then summed together for each student and this summed value was averaged across the student body.

The mean school effort measure is the school average of students' ordinal responses to the question, "In general, how hard do you try to do your school work well?" Responses were recoded so that values 1-4 indicate "I never try at all," "I don't try very hard," "I try hard enough, but not as hard as I could," and "I try very hard to do my best." The mean self-rated health measure is the school average of students' ordinal responses to the question, "In general, how is your health?" with responses recoded 1-5 to indicate "poor," "fair," "good," "very good," and "excellent" respectively. Finally, the mean school feelings index attempts to capture positive feelings about the school they attend. Student responses to four questions measured on a 5-ponit Likert scale (recoded so that higher values indicate stronger agreement) were summed together: "I feel close to people at this school"; "I feel like I am part of this school"; "I am happy to be at this school"; and "The teachers at this school treat students fairly." These values were summed together across items and averaged across respondents at the same school.

Analysis

The analysis proceeds in a number of steps. First, we describe the distribution of the school-level measure of the association of tobacco and alcohol use, overall and covarying with the school-level measures described above. Second, we spend the majority of the analysis describing the long-term patterns of co-use associated with higher or lower levels of this measure across young adolescence and young adulthood. To do this, we combine the four waves of in-home data we have to construct a sort of artificial cohort of persons, taking advantage of the fact that the four waves of the Add Health study were time to provide portraits of the health patterns of persons aged 13-32.

To illustrate this, we provide counts of (rounded) age values across the four waves of the Add Health in-home sample. As can be seen, reasonably large counts of observations for every age between 13 and 32 can be obtained from this data. Furthermore, concerns that age patterns may be driven by wave effects are allayed by the substantial overlap in ages between waves II and III and III and IV. We recode ages 11 and 12 to 13, and ages 33-35 as 32, to ensure that all cells of the age vector are well-populated.

Using these data, we predict TAAC as a function of discrete age interacted with the school-level tobacco and alcohol use association from the respondent's secondary school using logistic regression. Statistical inferences are made using the sandwich standard error estimator (Rogers 1993) to account for the non-independence of observations. Age patterns of TAAC are then portrayed by tracing predicted probabilities of TAAC by age separately for five values of the SSTAA, at the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles of these values (defined across schools, not students). We present the results of three nested models: (a) logistic regressions predicting TAAC solely as an interactive function of discrete age and SSTAA; (b) logistic regression models adding controls for gender, race, and parental education to (a); and (c) logistic regression models identical to (b) except that the SSTAA measure has had the effects of a set of school-level covariates regressed out. In preliminary analyses (not shown), we found that the racial IQV, mean parental education, proportion non-white, mean popularity, mean centrality, sex segregation, race segregation, mean bad outlook index, mean school effort, mean self-rated health, and mean school feelings index were potential confounders of the SSTAA-TAAC relationship because they were statistically significantly related to both, separately analyzed. To adjust for this while nonetheless preserving the statistical power of our analysis, we regressed SSTAA on these school-level characteristics and captured the residuals of this model ($SSTAA_r$). We employ $SSTAA_r$ in the third regression model as an implicit control for the school-level influence of these characteristics.

RESULTS

The Distribution of SSTAA

Figures 1A and 1B describe the cross-school distribution of the excess proportion of TAAC above that predicted from the marginal distributions of tobacco and alcohol use. Values are multiplied by 10. Both

graphs show substantial cross-school variation in this trait. The distribution of the excess proportion of ever TAAC is approximately bell-shaped and symmetric, with a mean, median, and mode of 8-9 (Figure 1A). The minimum and maximum values are 0.62 and 16.0. The distribution of the same for heavy co-use (Figure 1B) is characterized by lower values. The mean and median are approximately 2.4, and the minimum and maximum values are -0.16 and 8.3 respectively. In sum, there is substantial cross-school variation in both of these characteristics.

Figures 2A and 2B show the scatterplots (along with a line of best fit and the correlation) of the excess proportion of TAAC and a variety of other school characteristics of interest. These graphs show that the SSTAA is strongly related to a variety of school characteristics. The ever co-use SSTAA (Figure 2A) shows evidence of substantial negative associations with race IQV, the proportion of non-white students, mean school effort, and mean self-rated health. It shows positive relationships with mean parental education, mean popularity, mean centrality, mean bad outlook index, and mean school feelings index. Similarly, the heavy co-use SSTAA (Figure 2B) shows evidence of substantial negative associations with race IQV, proportion non-white, sex segregation, mean school effort, and mean self-rated health. This characteristic shows positive associations with mean popularity, race segregation, mean bad outlook index, and the mean school feelings index. Because all of these characteristics are also related to TAAC probabilities, ever co-use and heavy co-use SSTAA values were multiply regressed on these characteristics. The residuals were then computed for each of these measures and the resultant measure was used to examine age patterns of TAAC net of school characteristics.

Age Patterns of TAAC

Figures 3A, 3B, and 3C provide age patterns of TAAC, stratified by SSTAA (3A and 3B) or SSTAAr (3C) values, and with (3B and 3C) and without (3A) demographic controls. The unconditional results (Figure 3A) show that the ever co-use SSTAA measure is a major predictor of TAAC throughout adolescence and young adulthood, beginning around age 17 and with persistent effects up to age 32. These differences are especially pronounced between ages 18-20 and 22-25, as those who attended 90th percentile SSTAA schools

have probabilities of TAAC substantially and statistically significantly higher than those who attended lower percentile SSTAA schools.

Figure 3B shows these same patterns controlling for demographic characteristics. Demographic characteristics explain much of the initial association between SSTAA and TAAC patterns by age. However, statistically significant differences are still observed at ages 19, 20, and and 23-25.

Figure 3C shows these same patterns, still controlling for demographic characteristics, but employing $SSTAA_r$, thereby controlling for the set of potential school-level confounders we identified for this relationship. Employing this measure but still controlling for individual demographic characteristics, the association of the $SSTAA_r$ and age-specific TAAC is stronger than that with SSTAA, suggesting that the collective effect of these confounders is to suppress the SSTAA effect. When these effects are adjusted out, statistically significant differences in the predicted probability of TAAC is observed between ages 17 and 19 and 22 and 25, net of individual demographic characteristics. This suggests that the effects of the school health behavioral environment on TAAC persist into the mid-20s.

Figures 4A, 4B, and 4C examine the same patterns for heavy co-use. Figure 4A examines these patterns unconditionally, and shows that there is a very large effect of the heavy co-use SSTAA on future patterns of heavy TAAC. Indeed, at many ages the predicted probability of TAAC for those who attended 90^{th} percentile schools is double that for those who attended 10^{th} percentile schools. Thus the association of the school health behavioral environment and life course patterns of TAAC appears to be substantially stronger for heavy co-use than for any co-use.

Figure 4B depicts these same patterns controlling for individual demographic characteristics. Much of the association is preserved, especially for the 17-19 and 22-25 age ranges. However, the magnitude of this association is somewhat decreased.

Finally, Figure 4C examines these age patterns while employing $SSTAA_r$, rather than SSTAA, as the key measure of the school tobacco-alcohol association. These results show that the association of the school health behavioral environment is robust to controls for the set of potential school-level confounders that we identified and regressed out of SSTAA to produce $SSTAA_r$. As with the results that only control for

individual demographic characteristics in Figure 4B, these results show that ages late in high school and in the post-college years are the key age ranges in which this association is observed. During the intervening years (19-21), identically high probabilities of heavy co-use are observed for persons from all school backgrounds.

CONCLUSION

Contexts matter. While this is not a novel claim in the sociology of health disparities, in this paper we have identified a powerful feature of the social environment which structures patterns of tobacco and alcohol co-use through young adulthood. We show that the school-specific tobacco-alcohol use association varies substantially across schools, is related to a number of school compositional and structural characteristics, and is associated with the probability of tobacco and alcohol co-use through the mid-20s even when controlling for individual demographic and key school characteristics. Although we cannot rule out the possibility of other confounders, the strong theoretical motivation for this measure lends these results additional credibility. Finally, our analysis emphasizes the importance of considering joint patterns of health behaviors across the life course, because frequently constellations of poor health behaviors may exert greater influence on long-term health prospects than their individual effects would suggest, as is the case with tobacco and alcohol use.

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Table 1: Rounded Age Distribution by Wave, Analytical Sample

	Wave				
Age	1	2	3	4	Total
11	1	0	0	0	1
12	58	0	0	0	58
13	1,490	80	0	0	1,570
14	2,471	1,381	0	0	3,852
15	3,177	2,106	0	0	5,283
16	3,885	2,649	0	0	6,534
17	4,082	3,190	0	0	7,272
18	3,870	3,182	18	0	7,070
19	1,457	1,647	654	0	3,758
20	162	423	1,787	0	2,372
21	42	43	2,187	0	2,272
22	0	7	2,707	0	2,714
23	0	0	2,897	0	2,897
24	0	0	2,806	4	2,810
25	0	0	1,789	129	1,918
26	0	0	249	1,360	1,609
27	0	0	34	2,006	2,040
28	0	0	12	2,516	2,528
29	0	0	0	3,026	3,026
30	0	0	0	2,963	2,963
31	0	0	0	2,718	2,718
32	0	0	0	847	847
33	0	0	0	88	88
34	0	0	0	15	15
35	0	0	0	1	1
	20,695	14,708	15,140	15,673	66,216

NOTE: 66,216 is the count of person*wave observations in the Add Health in-home data.

Table 2: Multinomial Logit Coefficients of SSTAA Predicting Tobacco and Alcohol Co-Use vs. Neither, Tobacco Only, or Alcohol Only

	SSTAA x Age			+ Demographic Controls			Using $SSTAA_r$		
Any Use	Vs. None	Vs. Smoke	Vs. Drink	Vs. None	Vs. Smoke	Vs. Drink	Vs. None	Vs. Smoke	Vs. Drink
None	--	0.949*	0.940*	--	0.986	0.974*	--	0.999	0.956*
Smoke Only	1.054*	--	0.991	1.014	--	0.988	1.001	--	0.957*
Drink Only	1.064*	1.009	--	1.027*	1.012	--	1.046*	1.045*	--
Co-Use	1.109*	1.052*	1.043*	1.030*	1.016	1.004	1.082*	1.081*	1.034*
	SSTAA x Age			**+ Demographic Controls**			**Using $SSTAA_r$**		
Heavy Use	Vs. None	Vs. Smoke	Vs. Drink	Vs. None	Vs. Smoke	Vs. Drink	Vs. None	Vs. Smoke	Vs. Drink
None	--	0.857*	0.827*	--	0.938*	0.910*	--	1.005	0.902*
Smoke Only	1.167*	--	0.965*	1.066*	--	0.970	0.995	--	0.897*
Drink Only	1.209*	1.037*	--	1.099*	1.031	--	1.108*	1.114*	--
Co-Use	1.404*	1.203*	1.161*	1.201*	1.127*	1.092*	1.263*	1.270*	1.140*

NOTE: Only SSTAA and $SSTAA_r$ coefficients are shown for simplicity. Demographic controls include gender, race, and parental education. $SSTAA_r$ is the SSTAA residual from a school-level regression on racial IQV, mean parental education, proportion non-white, mean popularity, mean centrality, sex segregation, race segregation, mean bad outlook index, mean school effort, mean self-rated health, and mean school feelings index. See text for details.

Table 3: Multinomial Logit Coefficients of SSTAA Predicting Continued Alcohol and Tobacco Co-Use vs. Never Co-Use and Quitting Co-Use

	No Controls		+ Demographic Controls		Using $SSTAA_r$	
Any Use	Vs. Never	Vs. Quit	Vs. Never	Vs. Quit	Vs. Never	Vs. Quit
Never	--	0.943*	--	0.982	--	0.941*
Quit	1.061*	--	1.018	--	1.062*	--
Ongoing	1.067*	1.006	1.006	0.988	1.035	0.974
	No Controls		**+ Demographic Controls**		**Using $SSTAA_r$**	
Heavy Use	Vs. Never	Vs. Quit	Vs. Never	Vs. Quit	Vs. Never	Vs. Quit
Never	--	0.830*	--	0.901*	--	0.802*
Quit	1.205*	--	1.110*	--	1.248*	--
Ongoing	1.129*	0.936	1.092*	0.984	1.098	0.880

NOTE: Only SSTAA and $SSTAA_r$ coefficients are shown for simplicity. Demographic controls include gender, race, and parental education. $SSTAA_r$ is the SSTAA residual from a school-level regression on racial IQV, mean parental education, proportion non-white, mean popularity, mean centrality, sex segregation, race segregation, mean bad outlook index, mean school effort, mean self-rated health, and mean school feelings index. See text for details.

Figure 1A: Distribution of School Excess Proportion of Any Tobacco and Alcohol Co-Use

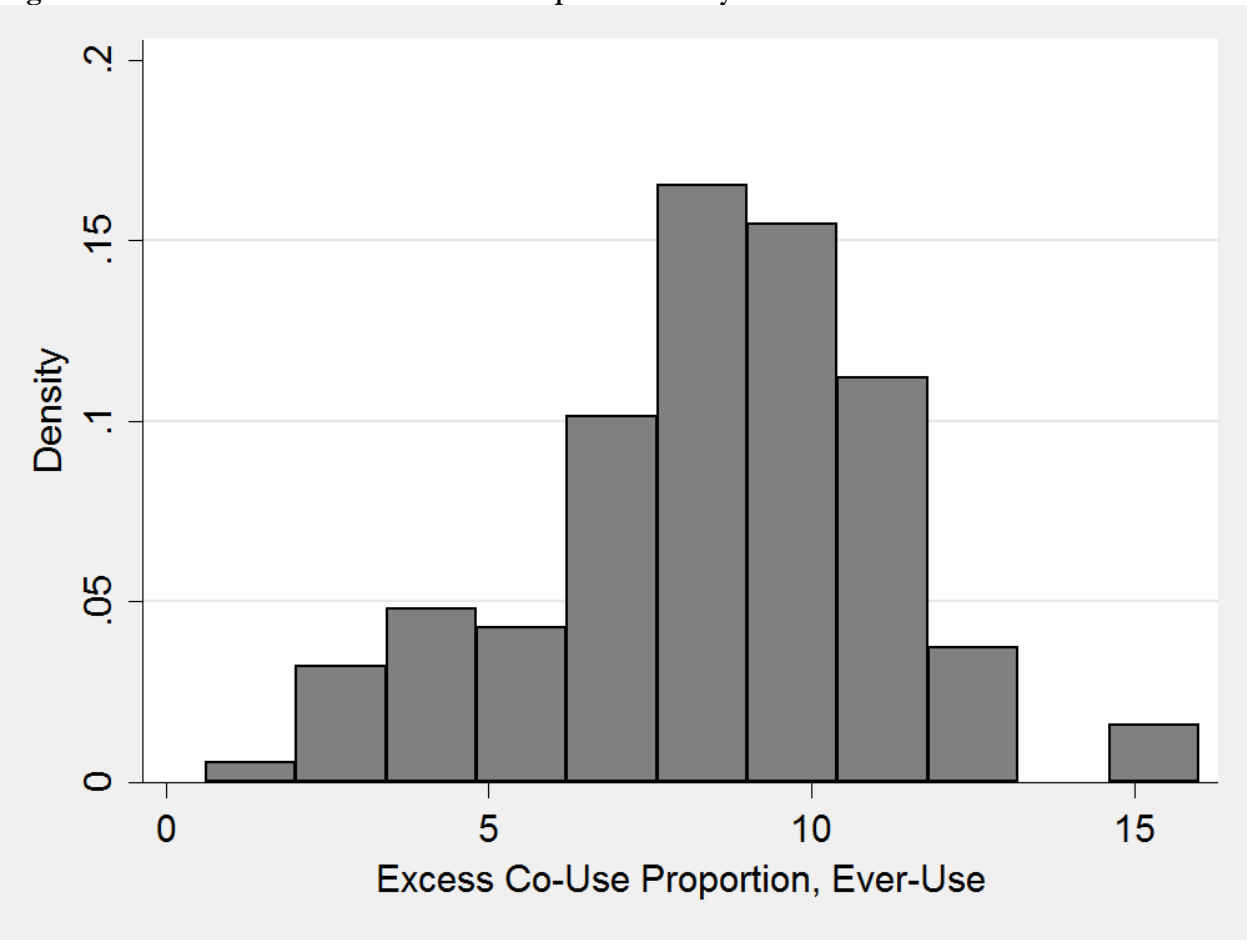


Figure 1B: Distribution of School Excess Proportion of Heavy Tobacco and Alcohol Co-Use

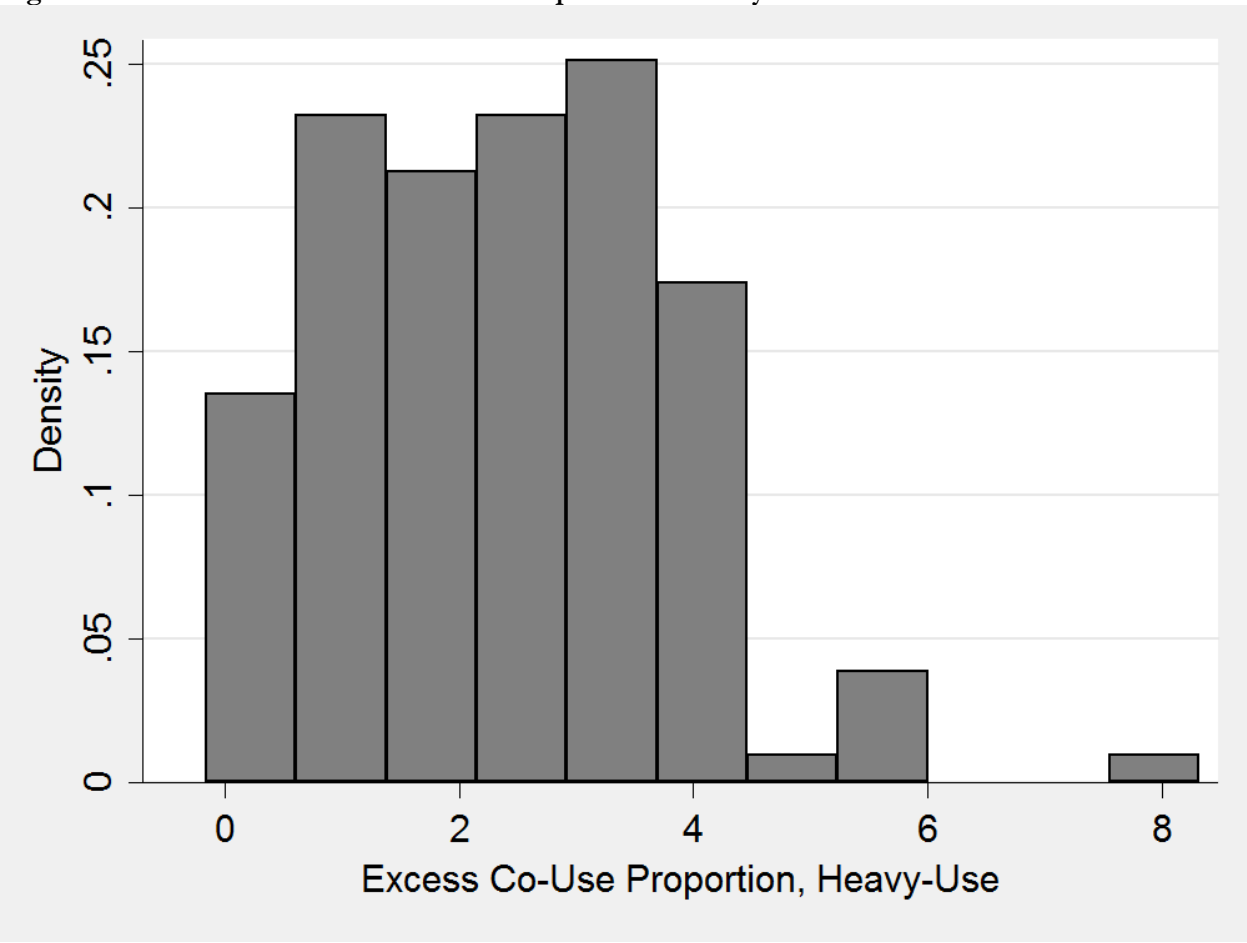
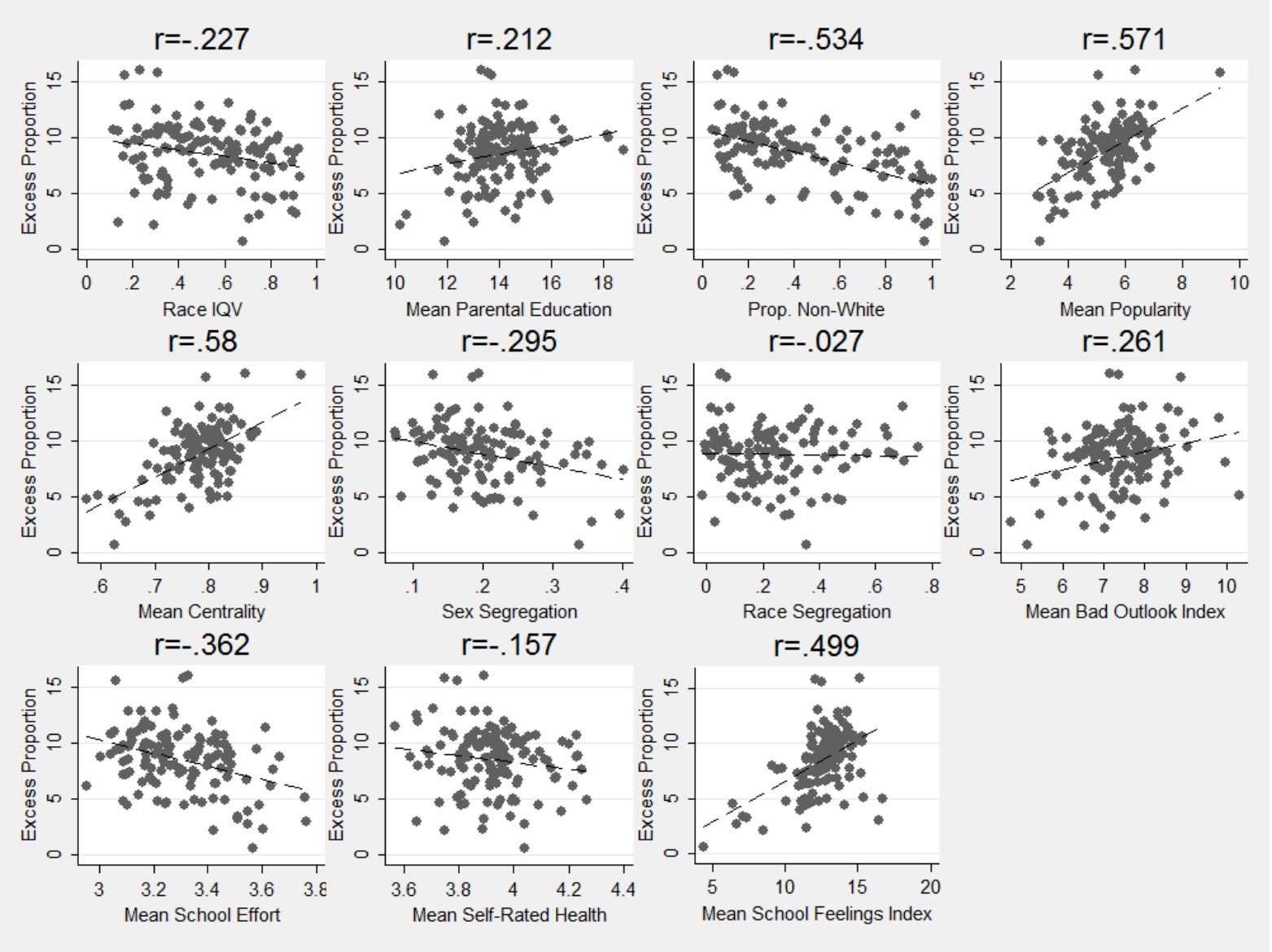
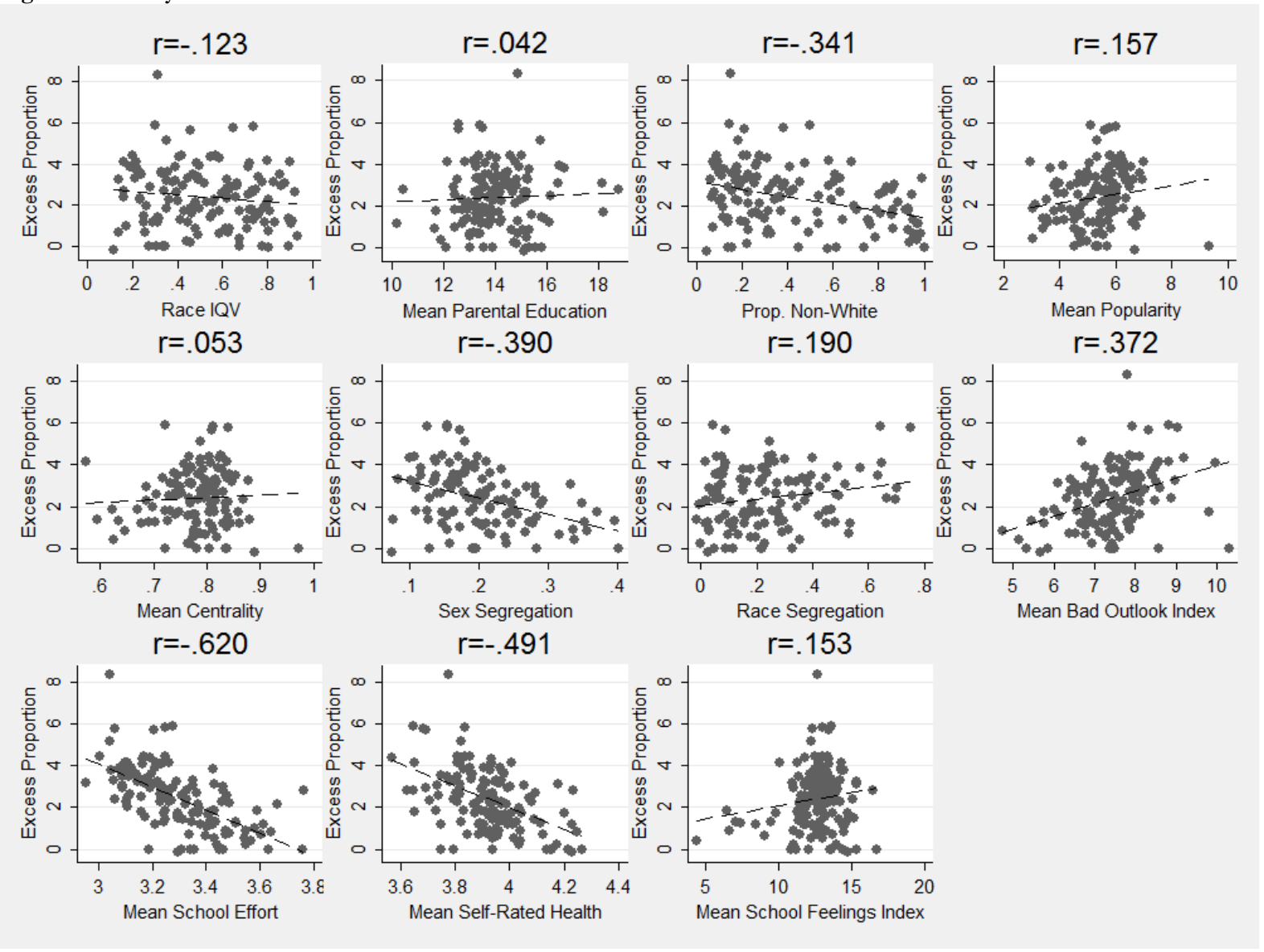


Figure 2A: Any SSTAA vs. School Characteristics



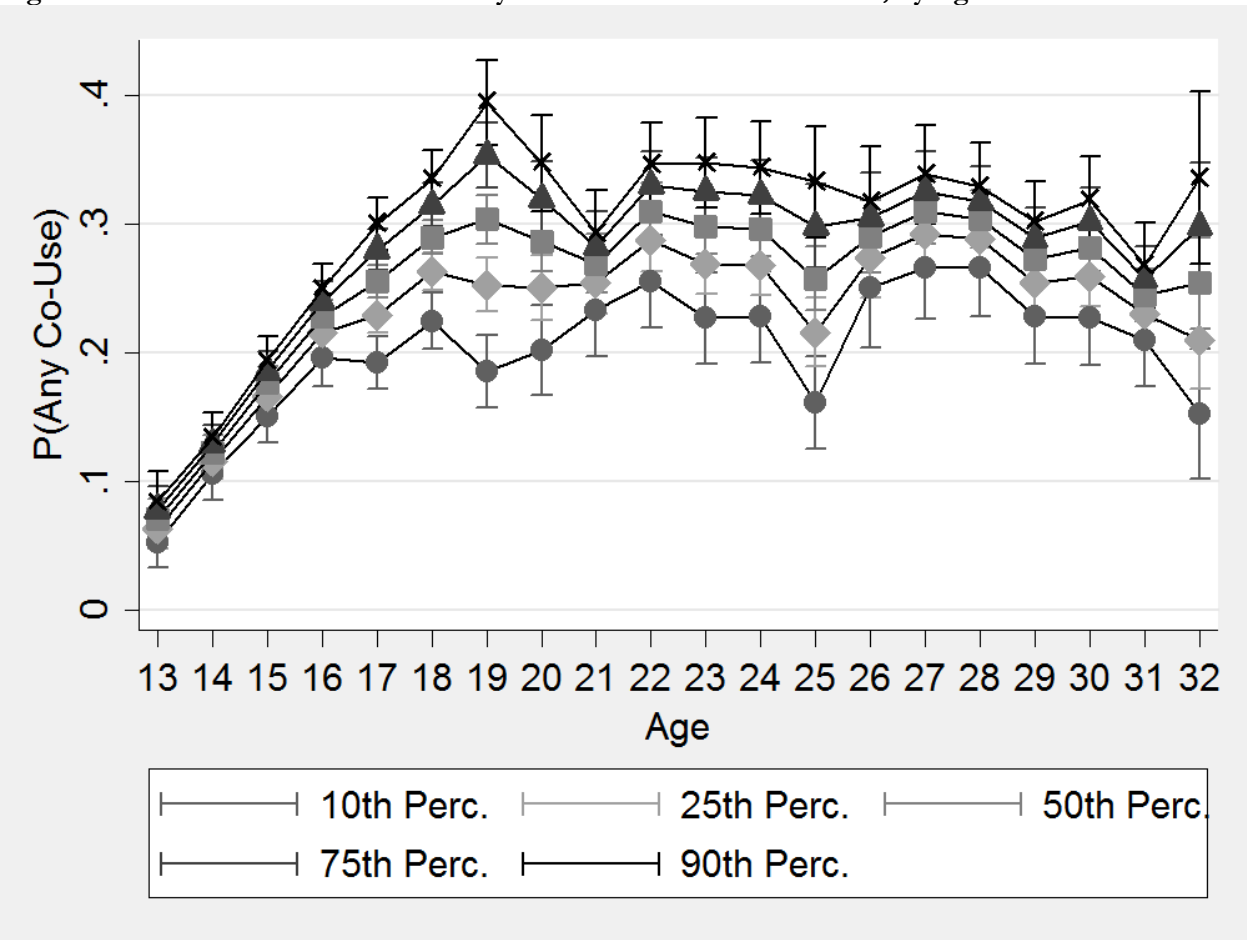
NOTE: Titles of each-subgraph are the school-level correlation of the two characteristics.

Figure 2B: Heavy SSTAA vs. School Characteristics



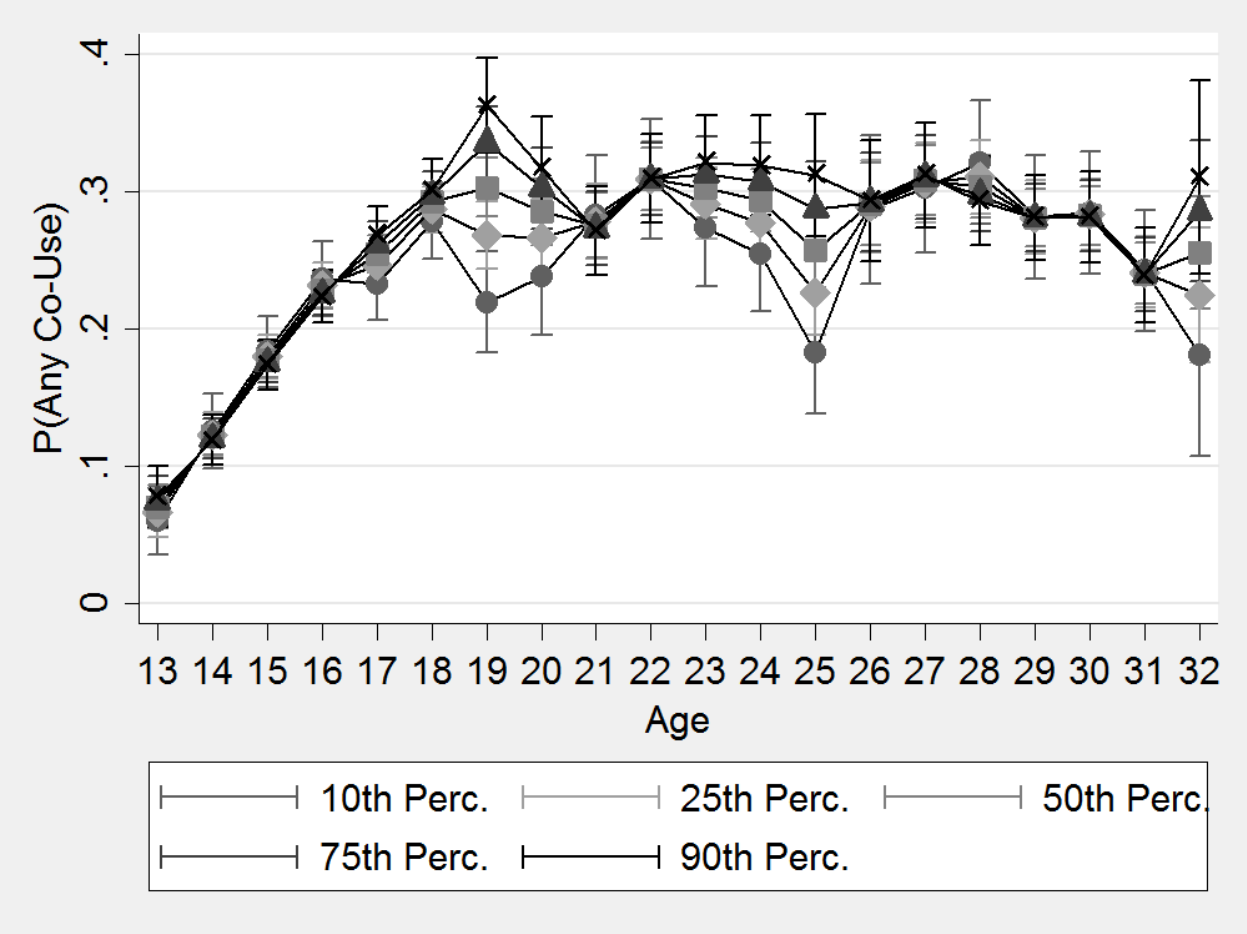
NOTE: Titles of each-subgraph are the school-level correlation of the two characteristics.

Figure 3A: Predicted Probabilities of Any Tobacco and Alcohol Co-Use, by Age and SSTAA



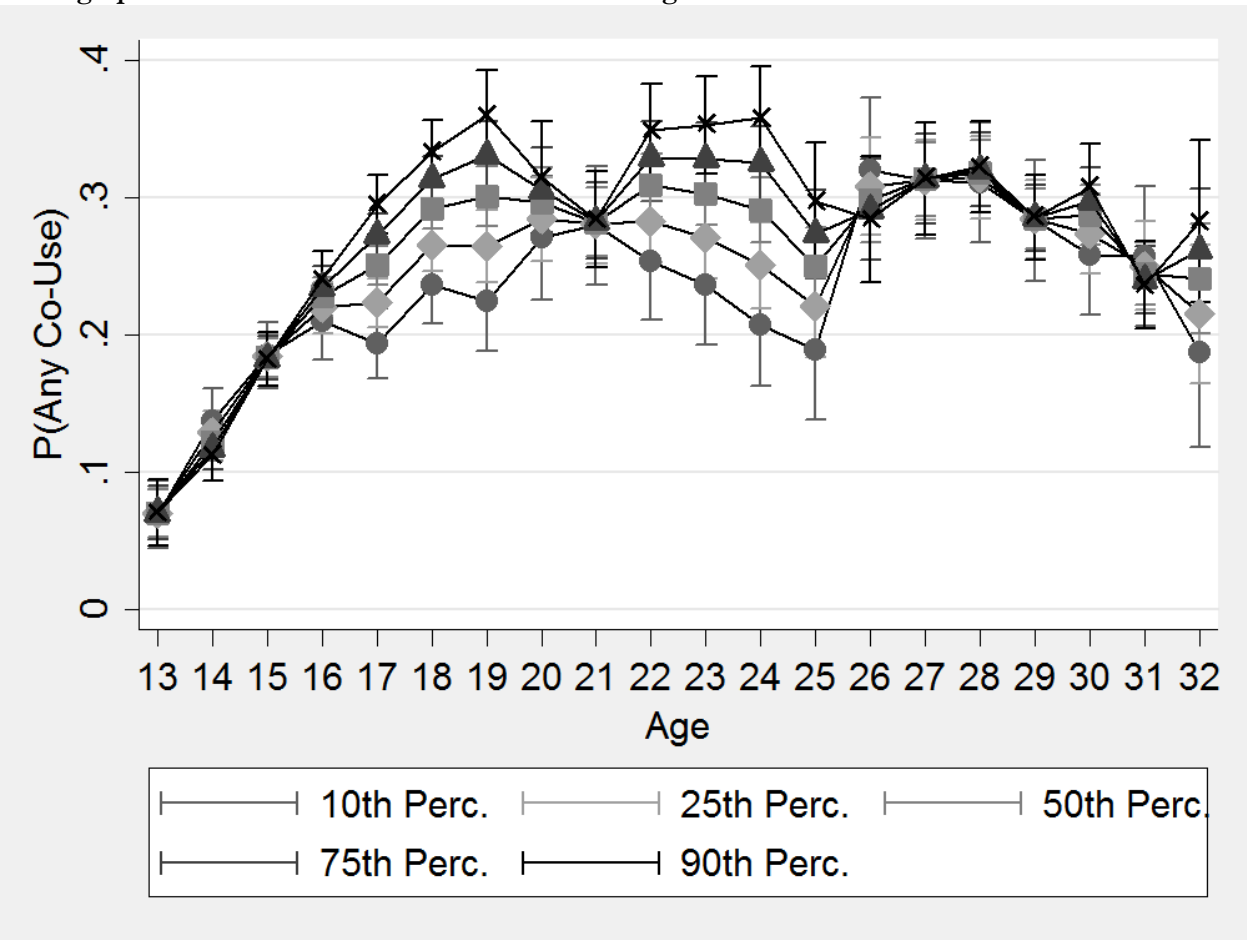
NOTE: This figure depicts patterns of tobacco and alcohol co-use without any demographic or school controls, stratified by age and any SSTAA (see text for details).

Figure 3B: Predicted Probabilities of Any Tobacco and Alcohol Co-Use, by Age and SSTAA, with Demographic Controls



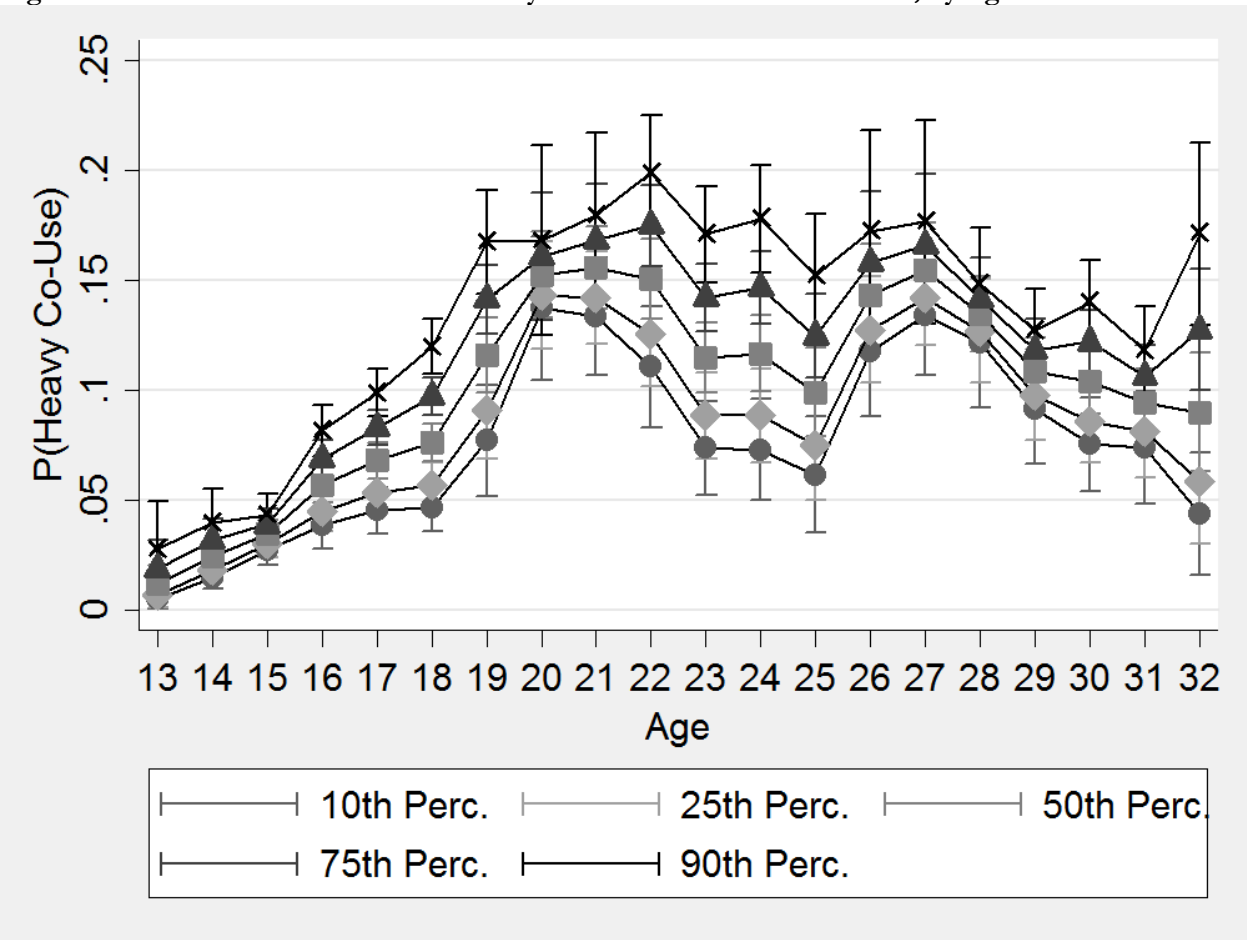
NOTE: This figure depicts patterns of tobacco and alcohol co-use with controls for individual demographic characteristics but no adjustment for school characteristics, stratified by age and any SSTAA (see text for details).

Figure 3C: Predicted Probabilities of Any Tobacco and Alcohol Co-Use, by Age and SSTAA$_r$, with Demographic Controls and School Characteristics Regressed Out



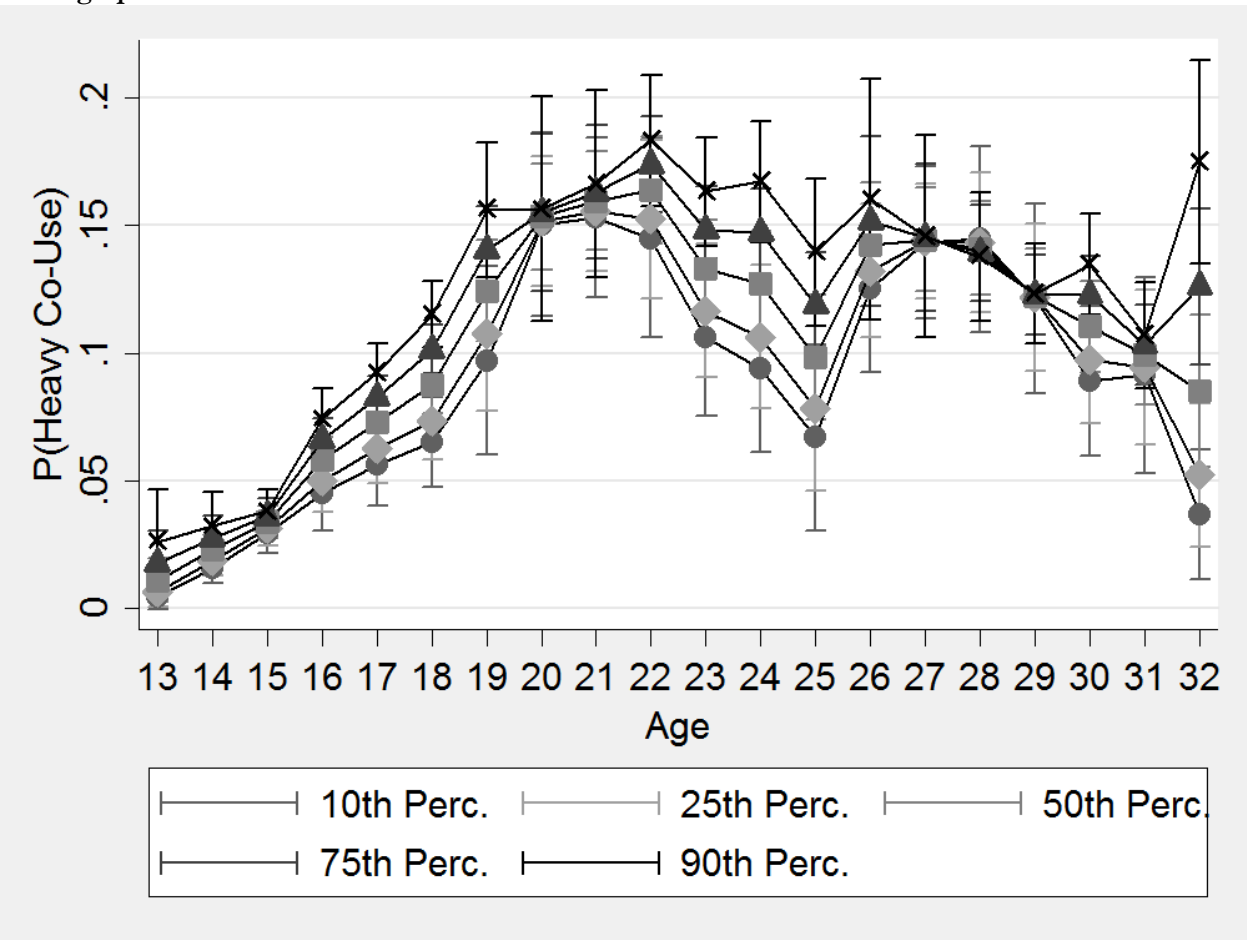
NOTE: This figure depicts patterns of tobacco and alcohol co-use with controls for individual demographic characteristics and with school-level confounders regressed out of SSTAA, stratified by age and any SSTAA$_r$ (see text for details).

Figure 4A: Predicted Probabilities of Heavy Tobacco and Alcohol Co-Use, by Age and SSTAA



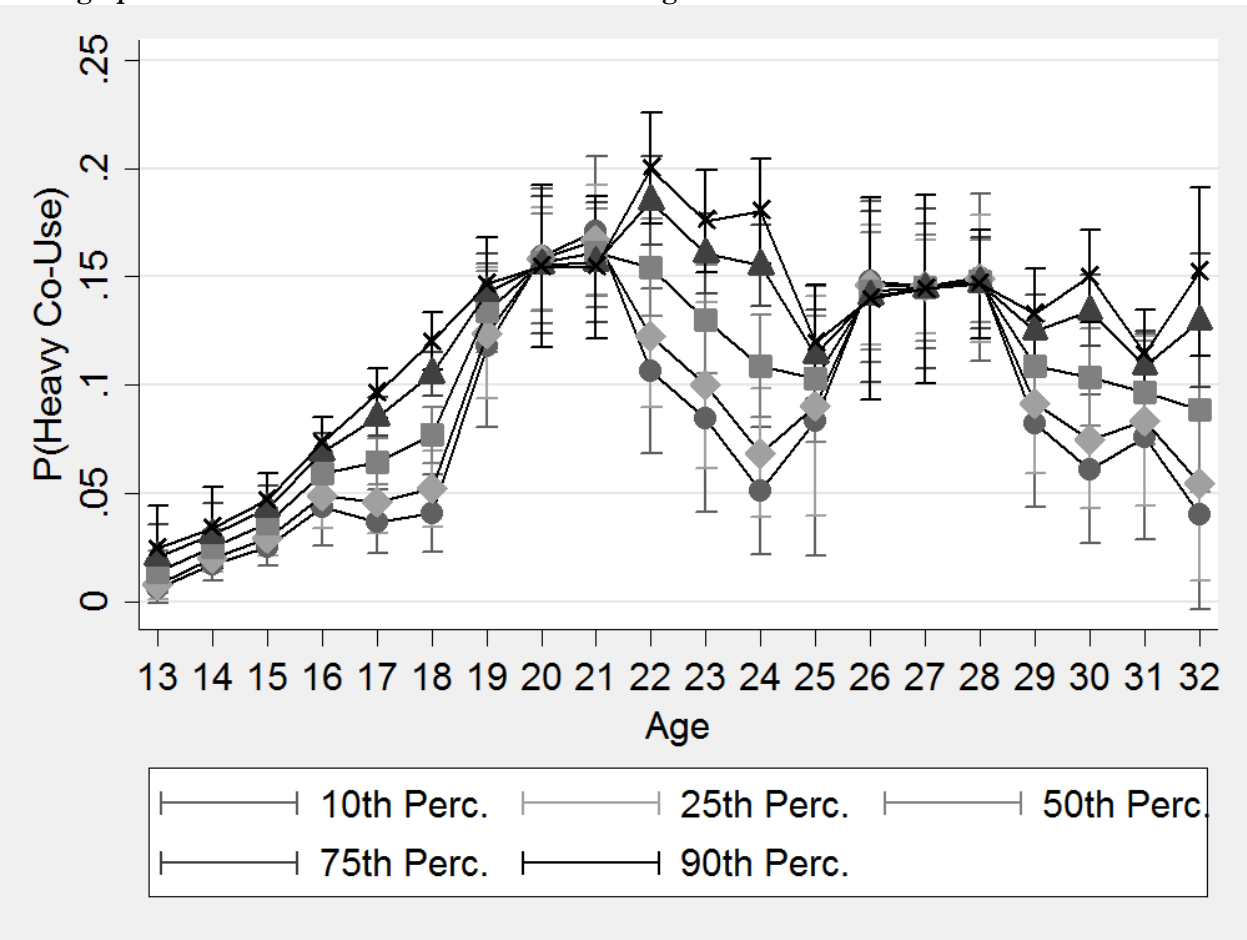
NOTE: This figure depicts patterns of heavy tobacco and alcohol co-use without any demographic or school controls, stratified by age and heavy SSTAA (see text for details).

Figure 4B: Predicted Probabilities of Heavy Tobacco and Alcohol Co-Use, by Age and SSTAA, with Demographic Controls



NOTE: This figure depicts patterns of heavy tobacco and alcohol co-use with controls for individual demographic characteristics but no adjustment for school characteristics, stratified by age and heavy SSTAA (see text for details).

Figure 4C: Predicted Probabilities of Any Tobacco and Alcohol Co-Use, by Age and SSTAA$_r$, with Demographic Controls and School Characteristics Regressed Out



NOTE: This figure depicts patterns of tobacco and alcohol co-use with controls for individual demographic characteristics and with school-level confounders regressed out of SSTAA, stratified by age and any SSTAA$_r$ (see text for details).