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Social Influences on College Student Use of Tobacco Products, Alcohol, and Marijuana

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Abstract

Objective—This study investigated associations between the use of alternative tobacco products (e.g., cigarettes, little cigars/cigarillos, hookah, e-cigarettes), alcohol, and marijuana among college students and use by their parents, siblings, and friends. A large literature exists for social influences on adolescent substance use, but few studies have focused on college samples.

Participants—3,418 college students from seven universities in the state of Georgia participated in this study.

Methods—Web-based surveys were completed by students (45–60 minutes) during the fall semester, 2014.

Results—Findings largely indicated specificity of associations between college student use and use by social influences for similar tobacco products and other substances. For each tobacco product or substance, the highest associations were for friends' use. Structural equation analyses further supported the specificity of associations and highlighted the relative strength of friends' use on student use.

Conclusion—Similar to findings with adolescents, the use of alternative tobacco products, alcohol, and marijuana by parents, siblings, and friends is associated with higher levels of use among college students, and friends' use was the most potent correlate for this phase of the lifespan.

Keywords

College students; substance use; parental influence; sibling influence; friend influence

There is an extensive literature on social influences (e.g., parents, siblings, friends) of substance use on adolescent substance use, including studies focused on tobacco use

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(Kandel, Griesler, & Hu, 2015; Mays et al., 2014), alcohol use (Ary, Tildesley, Hops, & Andrews, 1993; McGue, Sharma, & Benson, 1996), and other substance use (Fagan & Najman, 2005; Needle et al., 1986; Whiteman, Jensen, & Maggs, 2013; Windle, 2000). Collectively, these studies have generally demonstrated significant associations between use by the social agent (e.g., friends) and use by the target adolescent. For example, findings by Whiteman et al. (2013) indicated that older sibling and friends' substance use was significantly associated with target adolescent use after controlling for a range of other variables including parental substance use, family structure, and parental knowledge (of child's behaviors and activities). Interestingly, this study further suggested that there were shared friends among the target adolescent and his/her older sibling and that these shared peer networks interacted with sibling use to predict higher target adolescent alcohol use. Windle (2000) also found significant associations between parental, sibling, and friends' alcohol use and adolescent alcohol use. However, in a more comprehensive structural equations model, sibling and friends' use remained significantly associated with target adolescent use, while parental alcohol use was no longer significant.

Alternative theoretical models and mechanisms, such as social learning theory and the offspring modeling of parental behavior, may account for the social influence associations with adolescent substance use (Ary et al., 1993; Barnes, Farrell, & Cairns, 1986). They suggest that children and adolescents mimic or model the behaviors that they observe among powerful others in their environment. Peer selection and socialization theory is also important in understanding processes related to peer influence (Burk, van der Vorst, Kerr, & Stattin, 2012; Wills & Cleary, 1999). According to this notion, adolescents select into and socialize with peer group members who share similar interests and activities, including substance use practices. Older sibling influences are often viewed within a socialization framework, as they are viewed as agents (e.g., role models) within the proximal environments of target adolescents, as well as agents who may provide easier access to substance use products (Needle et al., 1986; Whiteman et al., 2013).

Most social influence studies of substance use have examined associations during the important developmental period of adolescence, often with concurrent social influence assessments, though some studies have used social influence scores from the elementary school years to predict adolescent substance use (Bricker et al., 2006). However, social influence research typically has not been extended to include the young adulthood years, including college student samples. Rather, some studies have focused on friend influences or friend networks of substance use in young adulthood (Andrews, Tildesley, Hops, & Li, 2002; Dishion & Owen, 2002) or marital partner influences (Leonard & Homish, 2008), but typically have not included parental or sibling influences. The current study sought to address voids in the literature in three ways. First, a relatively large college student sample was used to expand the age range of the social influence literature beyond adolescence. Second, the study included parental, sibling, and friends' substance use in relation to college student substance use; thus, we extended the potential range of social influences beyond friends. Binary items were used to measure parental and sibling substance use, whereas up to five friends were used to measure substance use among peers. Third, we included not only traditional measures of cigarette, alcohol, and marijuana use, but also, because of their increasing prevalence of use especially adolescent and young adult populations (Amrock &

Weitzman, 2015; Lee, Hebert, Nonnemaker, & Kim, 2015; Soneji, Sargent, & Tanski, 2016), measures were used related to alternative tobacco product use (i.e., little cigars/cigarillos, hookah, and e-cigarettes). Recent research has indicated an acceleration in the use of alternative tobacco products, especially by young adults (Amrock & Weitzman, 2015; Gilreath et al., 2016). To our knowledge, this study will be the first to investigate social influences on alternative tobacco products among young adults.

This study investigated two research questions. The first pertained to associations between student use of each alternative tobacco product, alcohol, and marijuana in relation to parent, sibling, and friends' use. This enabled the determination of the significance and magnitude of the bivariate associations for each social influence (i.e., parent, sibling, friends) and target student for each tobacco product and substance (i.e., alcohol and marijuana). The second research question used a multivariate, structural equation model (SEM) approach to determine the combined contributions of parent, sibling, and friends' tobacco, alcohol, and marijuana use on college student use. The SEM included testing a specificity hypothesis that suggested that college student use of each substance could be predicted only by parent, sibling, and friends' use of the same specific substance (e.g., student hookah use predicted only by parent, sibling, and friends' hookah use).

The SEM used in this study to evaluate associations between social influences (parental, siblings, friends) and target college student substance use focused on six substances: cigarettes, little cigars/cigarillos, hookah, e-cigarettes, alcohol, and marijuana. The target student reported on the use of these six substances for himself/herself, parents, siblings, and friends. A standard multivariate regression model could have been specified to evaluate *all* associations between each of the substances used by the target student and each of the substances used by each of the family/friend member, though it would have required the estimation and interpretation of 108 regression coefficients. This specification could have been justified on the basis that substance use often co-occurs and may reflect a more general social tendency rather than a specific substance tendency. However, a more parsimonious model was specified to evaluate a “specificity hypothesis” for the nature of these multivariate associations. The specificity hypothesis proposed that target adolescent substance use would be significantly predicted only by a “like” substance for social influences. Hence, targeted student cigarette use was specified to be predicted only by parent, sibling, and friend cigarette use (but not by parental, sibling, or friend use of any other substance). The specificity model suggests that college students do discriminate among exposures to different substances across social influences. These alternative models of general versus specific social influences across substance have not been tested. Using an SEM specification, the number of regression (structural) coefficients to an estimated was reduced from 108 regression coefficients to 18.

A strength of the SEM approach used in this study facilitated a comparison of these alternative representations. If the more parsimonious specificity model did not provide a “good fit” to the data, this would suggest that modifications are required that incorporate parameters that are not substance-specific. Goodness of model fit refers to the adequacy of a proposed model to reproduce the observed variance–covariance matrix of data (Bentler, 1990). A model that fits well based on model fit statistics does well in terms of accounting

for the observed data; a poorly fitting model indicates that the specified model must be modified (respecified) to account for the observed data. Hence, if the specificity model accounts well for the data (as indicated by the goodness-of-fit statistics), the plausibility of this model is supported; hence, the hypothesized specificity model can be rejected if it does not adequately account for the observed data.

Methods

Participants

Project DECOY (Documenting Experiences with Cigarettes and Other Tobacco in Youth) is a two-year, six-wave longitudinal cohort study involving 3,418 racially/ethnically diverse young adults attending seven Georgia colleges/universities. More detailed information on sampling and recruitment are provided elsewhere (Berg et al., 2016) and are briefly summarized here. Contact information (e.g., email addresses) was obtained from the registrar's office from each college/university for students meeting eligibility criteria (i.e., ages 18–25 and able to speak English) and the study was promoted on campuses via flyers and school websites.

Three thousand randomly selected 18–25 year olds were selected from one private and two public universities (total of 9,000 potential subjects). Each of the remainder of the schools had 18–25 year old student populations of less than 3,000; thus, the entire student population of that age range at each of those schools was included in recruitment. Response rates ranged from 15.4% to 27.6% at the technical colleges; 12.0% and 19.2% at the public colleges/universities; 18.8% and 59.4% at the private universities; and 23.1% at the historically black university. Our overall response rate of 22.9% ($N = 3574/15,607$), albeit low, was over a very short time frame (24 hours at the private schools to seven days at the technical colleges) and met our sampling quota targets (Berg et al., 2016). At Wave 1, the time-point used in this article, 156 students did not confirm their participation in the study via email and were excluded from the study. Our recruitment approach was designed to enroll participants who were engaged in email and were potentially more likely to be retained in the subsequent waves of the larger, multi-wave longitudinal project. Less than 1% of the sample had any missing data for the variables used in this study and their missing data were estimated via robust maximum likelihood estimation.

Measures

A four-month window was used for each of our survey items related to participant's substance use so as to capture use patterns across the full two-years of the six-wave longitudinal study. This time frame was used to capture information between each assessment to provide a more continuous measure of use across time. Four-month windows for substance use have been used in other studies to capture a broader window of use (Donohue, Holland, Lopez, Urgelles, & Allen, 2014; Foxcraft et al., 2014; Halkitis, Palamar, & Mukherjee, 2007). Analyses conducted in this article with four-month vs. 30-day windows yielded highly similar findings. Pearson correlations between the four-month window and a 30-day window were 0.89, 0.67, 0.57, 0.81, 0.83, and 0.89, respectively, for use of cigarettes, little cigars/cigarillos, hookah, e-cigarettes, alcohol, and marijuana use.

The prevalence of the four-month data was somewhat higher than for the 30-day data, as they appear to capture participants who did not use substances in the past 30-days but did so in the past four-months.

Tobacco products use

Cigarette use was assessed by the survey item “In the past 4 months, on how many days have you used cigarettes?” with answer choices ranging from 0 to 120. Analogous stems were used for little cigars/cigarillos, hookah, and e-cigarettes. Because of the non-normality of the item distributions, a log transformation was applied to each of the items.

Alcohol use

Alcohol use was assessed by the survey item “In the past 4 months, on how many days have you used alcohol?” with answer choices with scores ranging from 0 to 120. A log transformation was applied to this item.

Marijuana use

Marijuana use was assessed by the survey item “In the past 4 months, on how many days have you used marijuana?” with answer choices ranging from 0 to 120. A log transformation was applied to this item.

Social influence substance use variables

Social influence substance use variables were assessed via a series of survey items about the nonuse-use (scored 0 and 1, respectively) of each of the tobacco products, alcohol, and marijuana use items referenced above with regard to parents, to siblings, and to each of five closest friends. Hence, scores for each substance ranged from 0 to 1 for parental and sibling use, respectively, and 0 to 5 for friends' use. These differences in the range of response options for parents and siblings versus number friends were guided by: (a) the notion that exposure to parents and friends' substance use may be limited, especially if college students are not living at home or are spending limited time in the home context even if they are living at home; and (b) exposure to friends' substance use is likely to be higher because of altered living circumstances (e.g., living on campus or with friends or romantic partners) and a substantially higher percentage of time spent with friends than parents or sibs during this phase of lifespan (Windle et al., 2008). Note that 334 (9.6%) of participants reported no siblings. Rather than deleting these participants from the analyses and losing their data on parent and friends' exposures, we assigned a “0” score for sibling exposure for these 334 participants. Subsequent sensitivity analyses conducted with the exclusion of these 334 participants relative to their inclusion with the “0” score yielded no significant differences in the statistical models used in this study.

Sociodemographic variables

Sociodemographic variables included as covariates were age, gender, ethnicity, and race. Ethnicity was scored as “0” equals non-Hispanic and “1” equals Hispanic. Two dummy variables were created for race: White/Non-White and Black/non-Black (sample size was limited to form other race groups via dummy variable coding).

Procedure

The data collection procedure involved Web-based surveys completed by students (45–60 minutes) during the fall semester, 2014. As part of the recruitment protocol, students were informed that this was a longitudinal study that would involve six different occasions (waves) of measurement spaced at four-month intervals. We employed a graduated compensation schedule (\$30 for the first two assessments, \$40 for the second two, \$50 for the final two), with an additional \$100 incentive for participating in all assessments. Payment was made in the form of gift cards that were sent electronically (via email) to participants within a week of completing the online survey. Project DECOY was approved by the Emory University and ICF International Institutional Review Boards as well as those of the participating colleges.

Data analysis

To address our first research question about the associations between student use of each alternative tobacco product, alcohol, and marijuana, and parent, sibling, and friends' use, bivariate analyses were conducted and odds ratios were derived. This facilitated an evaluation of the significance and magnitude of the bivariate associations for each social influence (i.e., parent, sibling, friends) and target student for each tobacco product and substance (i.e., alcohol and marijuana). For these analyses, the college student tobacco and substance use scores were dichotomized to enable the computation of odds ratios. To address our second research question, a structural equation model (SEM) was specified to evaluate the combined contributions of parent, sibling, and friends' tobacco, alcohol, and marijuana use on college student use. For these analyses, the college student tobacco and substance use scores were treated as continuous so as not to lose variation in these outcome variables. A specificity model was initially tested to evaluate if college student use of each substance could be predicted only by parent, sibling, and friends' use of that specific substance (e.g., college student cigarette use would be uniquely predicted by parental, sibling, and friends' cigarette use, and not parent, sibling, or friends' use of other alternative tobacco products or other substance use). The SEM approach enabled us to directly test the specificity hypothesis via goodness of model fit statistics (e.g., Comparative Fit Index) and to reject this hypothesis if it did a poor job of reproducing the observed data. The SEM approach also enabled modification of the model if it did not fit well to increase overall model fit. For the SEMs, covariances among exogenous variables were freely estimated in the model, as were residual correlations among the dependent variables. In addition, the SEM included a complex modeling specification to account for the clustering of students within schools and maximum likelihood robust estimation, thereby decreasing potential sampling bias and increasing the precision of parameter estimates.

Results

Preliminary analysis

Comparisons of last 30-day use of alternative tobacco products, alcohol, and marijuana were made for our sample and the college sample data collected in the Monitoring the Future Studies (MtFS; Johnston, O'Malley, Bachman, Schulenberg, & Miech, 2015). The prevalence comparisons were highly similar for most tobacco products (e.g., cigarettes for

our sample was 13.3%, MtFS was 12.9%), alcohol (63.5% for our sample, 63.1% for MtFS), and marijuana (19.7% for our sample, 21% for MtFS). It was more difficult to make comparisons for our measure of cigars and cigarillos (both flavored and regular) and the measures reported in the MtFS because they reported separate prevalence rates for large cigars (8.4%), flavored little cigars (9.8%), and regular little cigars (8.6%) but not a combined single measure of use of any of these products. Our 30-day prevalence across cigar/cigarillos was 11.3%.

Primary analysis

The bivariate associations between college student alternative tobacco use and substance use by social influences are presented in Table 1.

The bivariate associations were statistically significant ($p < 0.001$) for all comparisons, suggesting that alternative tobacco use and substance use by parents, siblings, and friends were each associated with college student use. With the exception of marijuana use, the odds ratios for each substance in relation to parent and sibling use was about 2.0, or a doubling of the odds of college student use if either parents or siblings used the substance. The odds ratio for friends' use of alternative tobacco products or other substances was substantially higher (6.0–9.0), indicating a six-to-nine-fold increase in the odds of college student use if friends' used the substance. The odds ratios for marijuana use by college students was somewhat higher for parent and sibling use (over 3.0), and substantially higher for friends' use (over 21.0).

Our next step was to specify and test our model related to the specificity hypothesis. Because this model contains a large number of predictors that could be highly correlated and contribute to collinearity in estimating parameters in the larger model, Table 2 provides bivariate correlations among the predictors. Almost all of the correlations provided in Table 2 are in the low-to-moderate range and do not raise “red flags” about collinear relationships among the predictors.

The initial SEM evaluating the specificity hypothesis indicated that the model failed to provide an adequate fit for the observed data [χ^2 with 90 df = 382.93, $p < 0.001$, CFI = 0.903, RMSEA = 0.028 (0.024–0.031), SRMR = 0.018]. Guided by the modification indices from the SEM, a revised model was specified that included freeing two additional paths—friends' marijuana use predicted both college student little cigar/cigarillo use and alcohol use. The fit of the revised model was excellent [χ^2 with 88 df = 211.12, $p < 0.001$, CFI = 0.950, RMSEA = 0.020 (0.017–0.023), SRMR = 0.015] and the χ^2 difference test with 2 df was 117.80, $p < 0.001$, further indicating that the revised model provided a significant improvement of model fit. The revised model is presented in Figure 1. To facilitate ease of representation, only statistically significant parameter estimates are displayed. The findings portrayed in Figure 1 indicate, for instance, that college student cigarette use was significantly predicted by parent, sibling, and friends' use of cigarettes. All three social influences were also statistically significant with regard to predicting college student marijuana use. By contrast, e-cigarette use was significantly predicted only by friends' e-cigarette use, and use of little cigars/cigarillos was significantly predicted only by friends' use of little cigars/cigarillos. Hookah and alcohol use were predicted by social influences

stemming from sibling and friends' use but not parental use. The magnitude, or strength, of predictive relationships are provided by the estimated R^2 values provided above each of the substance use boxes in Figure 1. Substance use by social influences used in the specified model accounted for 5.2–21.6% of variance in college student use. Of substantive importance, the largest and most consistent predictor of college student use was friends' use that predicted all six college student substance use variables.

Also not presented in Figure 1 to simplify the representation were findings related to the four covariates of age, sex, ethnicity, and race. Age was not significantly associated with any of the six substances (i.e., the four tobacco use products alcohol and marijuana use). Male gender was significantly associated with somewhat higher use of hookah, e-cigarettes, and alcohol. Non-Hispanic ethnicity was significantly associated with a slightly lower use of little cigars/cigarillos and marijuana use. Black race was associated with lower levels of alcohol use and White race was associated with lower levels of little cigars/cigarillos use.

Ancillary analysis

Because of differences in the response options for parents and siblings as social influences (binary scores of 0 and 1 for each) relative to the larger range of response options for friends (0–5), it is possible that our findings were largely influenced by these scale differences in response options. To evaluate this possibly, we recoded friends to a score of “0” or “1” and then specified and tested the revised model reported above. The model fit statistics indicated adequate model fit [χ^2 with 88 df = 284.76, $p < 0.001$, CFI = 0.904, RMSEA = 0.025 (0.022–0.029), SRMR = 0.015]. The pattern of significant and non-significant parameter estimates was virtually identical to those reported in Figure 1, but the magnitude of the friends' predictor variables decreased in magnitude by about 20%. Nevertheless, in all equations the magnitude of the parameter estimates (regression-like coefficient) for friends' use remained 2–3 times as large as those of parent or sibling use. Hence, friend use remained the most prominent predictor of college student use across substances.

We also specified a saturated model in which we freely estimated all possible (cross-path) predictors for each of the outcome variables. The resulting saturated model has zero degrees of freedom and hence cannot be evaluated via model fit statistics; however, examining the overall R -square values for the six equations for the saturated model and the specificity hypothesis model indicated an increase of approximately 1% of additional variance accounted for in the saturated model. Hence, by including an additional 100 predictors in the specified model, approximately 1% of additional variance was accounted for in the outcomes. Hence, very little is achieved statistically or substantively by adding all of these parameter estimates but the cost is an exploratory model that is not guided by theory, a significant loss in of parsimony (i.e., a model requiring only 20 predictors instead of 120), and virtually no additional substantive interpretation of the findings.

Discussion

Our findings regarding social influences (i.e., parents, siblings, and friends) on college student tobacco product, alcohol and marijuana use were similar in many respects to prior findings reported during adolescence (Fagan & Najman, 2005; Kandel et al., 2015; Mays et

al., 2014). That is, there were significant bivariate associations between use by each of the social influences and use by college students, with the most potent associations for friends' use. This association for friends' use, relative to parent and sibling use, is likely stronger for this college sample relative to earlier phases in the lifespan due to greater personal autonomy, altered living circumstances, a larger socialization network to select into, and easier, often legal, access to more products (Petersen, 1988; Windle & Zucker, 2010). Parental and even sibling influences likely play a stronger role during earlier phases of development (e.g., preadolescence) when there is less personal autonomy, typical residence is in the parental home, a more restricted peer socialization network, and more difficult (and illegal) access to substance use products (Steinberg, 1990; Windle et al., 2008).

A valuable addition to the literature of these findings is that these significant associations were indicated not only for traditional substances (cigarettes, alcohol, and marijuana) but also for alternative tobacco use products that are on the increase including little cigars/cigarillos, hookah, and e-cigarettes. This suggests that some of the same theories and proposed mechanisms (e.g., role modeling, peer selection, and socialization) that have been proposed for more traditional substance use products may also function for these alternative tobacco products whose use is on the rise, especially among young adults (Amrock & Weitzman, 2015; Gilreath et al., 2016). This is especially important considering that today's college students are tomorrow's parents and likely will be modeling the use of these alternative tobacco products and other substances for their children. Recently, the Food and Drug Administration finalized a rule extending their regulatory authority to cover all tobacco products, including vaporizers, vape pens, hookah pens, electronic cigarettes (E-Cigarettes), e-pipes, and all other Electronic Nicotine Delivery Systems. However, the actual implementation and enforcement of these rules as they apply to specific domains (e.g., commercial advertising and marketing), in addition to ongoing social influences, may impact the use of these products among young adults (Amrock & Weitzman, 2015; Gilreath et al., 2016).

The SEM provided valuable insight into the specificity of relationships for the associations between social influences and college student use. To a large extent, the specificity model accounted for the observed data reported in this study, though two additional parameters needed to be estimated to better account for the data. Still only 20 structural (regression) coefficients needed to be estimated rather than 108 for a full (or saturated) model and thus the specificity model was substantially more parsimonious. The use of cigarettes and marijuana by all three social influences was significantly associated with student cigarette and marijuana use, respectively, thereby suggesting that cigarette and marijuana use within the larger social network of family members and friends may continue to exert a significant influence on college student cigarette and marijuana use. Although the strength of the relationships for sibling-to-student use, relative to friends-to-student use, was not as large, sibling associations remained significant for four of the six student use variables: cigarette use, hookah use, alcohol use, and marijuana use. Hence, sibling use remains a fairly prominent correlate of tobacco and other substance use among students during the college years. Parent associations with use among students was limited in the SEM to cigarette and marijuana use. As noted previously, part of this may be attributable to different influences on substance use across age/cohort groups, but another source may be that the prevalence of use

for some of the alternative tobacco products (e.g., hookah, e-cigarettes) currently are relatively low among this age/cohort of parents; however, the prevalence rate may not be as low among future parents. Finally, with regard to the two freely estimated parameters in the revised SEM, both related to friends' use of one product being significantly associated with use of another substance (e.g., friends' marijuana use on students alcohol use). These associations are likely due to patterns of polytobacco and other substance use among friendship groups where selection and socialization effects may operate to foster multiple substance use patterns (Andrews et al., 2002; Lee, Hebert, Nonnemaker, & Kim, 2014).

This study had several limitations that merit discussion. First, the sample was restricted to college students attending educational settings in the State of Georgia. The external validity (generalizability) of findings to students in college settings in other states or countries cannot be assumed. Second, the response rate for the sample was also only 22%, thereby potentially impacting the representativeness of the sample. Third, the study relied on student self-reports for all variables, and thus mono-method bias may have inflated some of the reported associations. Fourth, parental, sibling, and friend substance use was measured using a binary response format of perception of use-nonuse rather than amount used or how many parents used. This binary format may have restricted meaningful variation in substance exposure but obtaining "amount used" can create reliability issues for a variety of reasons (e.g., student not living at home to observe daily use patterns) and extensive family and friend self-assessments was beyond the scope of this study. Fifth, the age and sex of siblings were not measured in this study and these variables may be influential in evaluating sibling influences (Needle et al., 1986; Whiteman et al., 2013). Sixth, the findings in this study were based on cross-sectional data and hence prospective data that would facilitate the statistical modeling of plausible causal relations among variables was not possible. Related to this issue, alternative models (e.g., a bidirectional effects model) could not be tested to determine the strength and direction of influences between college students and social agents (e.g., tobacco use by college students may have been a stronger influence on friend or sibling tobacco use than vice-versa).

Despite these limitations, the findings do provide data supportive of the continuing role of social influences on college student alternative tobacco and other substance use. While the parental associations were of lower magnitude, they remained significant for cigarette and marijuana use, and sibling associations were significant for four of the six substances. Friends' use clearly demonstrated the most potent associations with college student use. Furthermore, as reported by Whiteman et al. (2013) for adolescents, there may be synergistic effects across friend and sibling networks that exacerbate use patterns for college students. At a general level (e.g., universal prevention programs), these findings may be used to inform college intervention programs on tobacco product or other substance onset or cessation that may focus on, or include a component related to, friendship networks and sibling influences. They may be used also to help guide campus anti-use campaigns against alternative tobacco products and influence educational interventions to reduce polytobacco and polydrug use (Gilreath et al., 2016). More specifically, the findings may be used to guide peer (and sibling) refusal skills programs to reduce the potential influence of these social agents on college students' tobacco use. More friend (social) network types of intervention programs may also be of value in attempting to reduce rates of student nicotine use. Finally,

students identified as multi- or polytobacco users may be identified for more intensive and extensive interventions that include components related to perceived risk for nicotine dependence and the social skills necessary to minimize the ongoing influences of parent, sibling, and friend influences on maintaining and escalating the use of tobacco products and other substances.

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Figure 1. Structural equations model of parent, sibling, and friend tobacco and other substance use associations with college student use ($N = 3,418$). Figure provides standardized parameter estimates. LCC = little cigars and cigarillos.

Table 1

Bivariate associations of college student tobacco, alcohol, and marijuana use and use by parents, siblings, and friends ($N = 3,418$).

	% of population	χ^2 statistic	df	O.R. (C.I.)
Cigarette use (Student)	15.7	—	—	—
Parental	23.2	32.67 ^c	1	1.78 (1.46–2.17)
Sibling	19.3	40.18 ^c	1	1.94 (1.58–2.38)
Friends	39.7	429.21 ^c	1	8.09 (6.49–10.09)
Cigar use (Student)	21.2			
Parental	6.4	27.53 ^c	1	2.14 (1.60–2.86)
Sibling	7.3	32.59 ^c	1	2.18 (1.66–2.86)
Friends	29.2	469.56 ^c	1	6.30 (5.27–7.53)
Hookah use (Student)	21.5			
Parental	1.0	16.50 ^c	1	3.71 (1.88–7.30)
Sibling	5.6	40.20 ^c	1	2.56 (1.90–3.46)
Friends	36.2	571.11 ^c	1	7.89 (6.57–9.47)
E-cigarette use (Student)	16.4			
Parental	4.9	28.01 ^c	1	2.42 (1.73–3.40)
Sibling	5.2	31.26 ^c	1	2.47 (1.78–3.43)
Friends	22.2	623.88 ^c	1	9.63 (7.91–11.74)
Alcohol use (Student)	67.5			
Parental	54.3	121.25 ^c	1	2.22 (1.93–2.58)
Sibling	45.6	120.69 ^c	1	2.28 (1.96–2.64)
Friends	86.9	481.04 ^c	1	9.75 (7.73–12.30)
Marijuana use (Student)	19.7			
Parental	6.4	75.84 ^c	1	3.28 (2.48–4.34)
Sibling	18.2	173.96 ^c	1	3.41 (2.82–4.12)
Friends	51.1	620.26 ^c	1	21.38 (15.61–29.29)

^c $p < 0.001$.

Bivariate associations of parent, sibling, and friend alternative tobacco product, alcohol, and marijuana use ($N = 3,418$).

Table 2

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. P-Cigs	1.0																	
2.S-Cigs	.22	1.0																
3. F-Cigs	.19	.17	1.0															
4. P-Cigars	.15	.05	.04	1.0														
5. S-Cigars	.07	.31	.04	.18	1.0													
6. F-Cigars	-.01	.04	.29	.13	.15	1.0												
7. P-Hookah	.09	.01	.04	.14	.05	.06	1.0											
8. S-Hookah	.05	.26	.05	.07	.37	.06	.09	1.0										
9. F-Hookah	.04	.02	.25	.04	.10	.36	.07	.17	1.0									
10. P-Ecigs	.30	.09	.09	.13	.05	.01	.17	.05	.01	1.0								
11. S-Ecigs	.09	.33	.08	.05	.16	.03	.03	.24	.07	.14	1.0							
12. F-Ecigs	.04	.07	.36	.03	.04	.26	.07	.06	.26	.09	.16	1.0						
13. P-Alc	.11	.06	.07	.14	.06	.06	.04	.07	.04	.09	.05	.03	1.0					
14. S-Alc	.01	.34	.06	.06	.22	.06	.01	.22	.06	.02	.18	.01	.33	1.0				
15.F-Alc	.01	.04	.27	.04	.04	.22	.04	.08	.33	.01	.04	.19	.22	.21	1.0			
16. P-Marij	.29	.13	.09	.17	.13	.05	.14	.07	.05	.15	.04	.02	.14	.06	.05	1.0		
17. S-Marij	.08	.42	.11	.08	.31	.07	.04	.28	.09	.06	.18	.05	.13	.39	.14	.21	1.0	
18. F-Marij	.01	.05	.29	.05	.05	.30	.06	.06	.41	.01	.05	.20	.08	.10	.45	.18	.24	1.0

Note. P = Parent; S = Sibling; F = Friends; Cigs = Cigarettes; Ecigs = E-cigarettes; Alc = Alcohol; Marij = Marijuana.