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Signature:

Eugene Christopher Wong

Date

Nicotine Dependence and Motives for Tobacco Use: Nuances Among Alternative Tobacco and
Polytobacco Users

By

Eugene Christopher Wong
MPH

Behavioral Sciences and Health Education

Carla J. Berg, PhD
Committee Chair

Regine Haardörfer, PhD
Committee Member

Michael Windle, PhD
Committee Member

Colleen McBride, PhD
Department Chair

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Polytobacco Users

By

Eugene Christopher Wong

Bachelor of Science in Public Health
The University of North Carolina at Chapel Hill
2014

Thesis Committee Chair: Carla J. Berg, PhD

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Abstract

Nicotine Dependence and Motives for Tobacco Use: Nuances Among Alternative Tobacco and Polytabacco Users

By Eugene Christopher Wong

Background: The growing trend of alternative tobacco product (ATP) and polytabacco use in young adults is concerning. We explored the extent to which the use of ATP in cigarette smokers increases nicotine dependence. We also examined the motives for polytabacco use and motives for the individual use of ATP.

Methods: A mixed-methods longitudinal study was started in the Fall of 2014 using online surveys distributed to 18-25 year-old students of 7 college campuses; analyses focused on data among past 4-month tobacco users from wave 2 (administered in Spring 2015). Variables of interest included: sociodemographics, tobacco use (cigarettes, little cigars/cigarillos, smokeless tobacco, hookah, e-cigarettes), nicotine dependence per an adapted Hooked on Nicotine Checklist, and tobacco use motives per an adapted Tobacco Use Motives Scale (yielding subscales of social, self-enhancement, boredom, and affect regulation).

Results: Of 2,969 participants (retention rate 86.9%), 22.9% smoked cigarettes in the past 4 months (25.9% used one ATP, 13.9% used ≥ 3). The mean age of this subset was 20.5, 45.1% were male, and 24.0% Black. Regression found that, among smokers, past 30-day consumption levels of cigarettes ($B=0.14$; $p<.001$), smokeless tobacco ($B=0.55$; $p=.006$), and e-cigarettes ($B=0.32$; $p=.004$) were associated with higher nicotine dependence. Boredom was associated with polytabacco use versus cigarette only use ($OR=1.19$; $p=.007$). Age, female sex, and Black race also significantly predicted polytabacco use (age, $OR=.79$, $p<.001$; female, $OR=0.39$, $p<.001$; Black, $OR=3.79$, $p=.002$). Regression models among single ATP users indicated differences in use motives that predicted past 30-day consumption levels (little cigars/cigarillos: affect regulation, $B=0.02$, $p=.035$; smokeless tobacco: social, $B=-0.05$, $p=.003$, self-enhancement, $B=0.05$, $p=0.017$, boredom, $B=0.07$, $p=.007$; hookah: social, $B=0.04$, $p=.002$, self-enhancement, $B=-0.05$, $p=.004$, boredom, $B=0.05$, $p=.033$, affect regulation, $B=-0.03$, $p=.001$).

Conclusions: The current research examined the impact of ATP in addition to cigarette use on nicotine dependence as well as differences in tobacco use motives among college student ATP and polytabacco users. Most notably, we found that ATP use does contribute to dependence and that the motives for tobacco use differed between tobacco products, when controlling for age, sex, and race/ethnicity. Findings from this study reveal initial differences in the contextual use of ATP.

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INTRODUCTION

“Changing face” of Tobacco Use

Tobacco use is one of the leading causes of mortality and morbidity in the United States (1, 2). The deleterious health consequences from smoking cigarettes were first documented as early as the 1940s (3). Despite the scientific evidence that has been collected since, tobacco use remains the leading preventable cause of death in the country (2). In the past decade, significant public health efforts have led to the decline in cigarette consumption by 32.8% (4).

Unfortunately, the attenuation in the consumption of traditional cigarettes in the past decade has been accompanied by the alarming rise in consumption of alternative tobacco products (ATPs) in the young adult population (5-10). The use of ATP (i.e., cigarillos, little cigars, smokeless tobacco, e-cigarettes, and hookah) among young adults is increasing due to reasons such as widespread misunderstanding of safety, attractive smell and test, and social appeal (11-16).

Nearly all cigarette use in the United States starts during adolescence with experimentation, often leading to nicotine dependence (17). Research has shown that most adolescents who continue smoking into young adulthood become regular users (2, 17). Young adults are now the highest risk group for using ATP (6). With the experimentation tendencies of this population, the need for research assessing the potential harms and methods to control the use of these ATPs in the young adult population is great.

Alternative Tobacco Products

The tobacco in little cigars and cigarillos (LCCs) is wrapped in leaf tobacco or any substance that contains tobacco, as opposed to a cigarette that is defined as a roll of tobacco wrapped in a substance that does not contain tobacco. Little cigars (similar in size to cigarettes with a filter) and cigarillos (short narrow cigars without a filter) look similar to cigarettes are

becoming more appealing to young adults because of the variety of flavors available. From 2000 to 2011, the consumption of loose tobacco and cigars increased from 3.4% to 10.4% (4).

Previous studies have shown that cigar use increases with age (5, 17). There is also a lack of literature investigating the contextual uses of cigars and a need to better understand young adult cigar preferences.

Smokeless tobacco encompasses a large variety of products that are generally chewed, sucked, or simply placed in the oral cavity. A large market of smokeless tobacco products exists in the world. Smokeless tobacco products are sold in a variety of flavors and are appealing to young adult populations (1). Use of smokeless tobacco products has been steadily increasing since 2000 among adult male populations from almost 4.5% to 6.0% in 2010. Smokeless tobacco product use in young adults can be as high as 17.2% (5).

Electronic cigarettes, more commonly referred to as e-cigarettes or “e-cigs”, recently emerged in an explosive fashion in the United States market (17, 18). E-cigarettes are considered ATP because they can be used in places where smoking is banned as many older smoke-free policies do not prohibit the use of e-cigarettes. This gap that e-cigarettes fill has become an increasingly concerning health issue (9, 19, 20). The prevalence of e-cigarette use has risen dramatically among young adults. A study showed that from 2011-2012, ever e-cigarette use more than doubled from 4.7% to 10% in young adults (1, 5).

Hookah use in the United States has increased dramatically over the past two decades (21, 22). Due to the use of water to vaporize the flavored tobacco mix, hookah smoking has been widely misunderstood to be non-addictive and to have little to no health harms (23, 24). However, hookah smoke contains significant concentrations of toxicants that present a serious inhalation hazard and can cause heart and lung disease (25). Furthermore, since hookah contains

nicotine, regular hookah users experience symptoms associated with nicotine dependence (26). Prolonged use of hookah can increase an individual's risk of nicotine addiction. A study revealed that the past year use prevalence of hookah in young adults was as high as 20% in 2012 (1, 5).

Multiple Tobacco Product Use

The recent increase in ATP use has increased the occurrence and concern of multiple tobacco product or polytobacco usage (2, 27). Roughly 15-30% of young adult smokers currently use more than one tobacco product (10, 28). However, among ATP users, multiple tobacco product use increases alarmingly to 40-50% (8, 29). Because different tobacco products have potentially different levels of nicotine, multiple tobacco product usage may be associated with increased risks of nicotine dependence (2, 30-32). There is currently a dearth of research on how ATP use contributes to nicotine dependence. ATPs have very different characteristics from each other. These differences may also result in varying extents to which they lead to nicotine dependence. Due to the rise in multiple tobacco usage, the extent to which this increases nicotine dependence in traditional cigarette smokers also needs to be understood. To evaluate the potential effects of multiple tobacco use in this new era of tobacco products, it is crucial to understand how the use of emerging ATPs increases nicotine dependence among cigarette smokers.

Motives to Use Tobacco

Motives to use tobacco measures have been studied to create interventions and cessation programs for smokers (33, 34). Historically, however, these motives for use have only been examined in traditional cigarette smokers (33-39). With the emerging trend in ATP use, these measures need to be examined within the specific contexts of these distinct products. ATP companies realize the unique user profiles of their products and tailor marketing strategies (14,

40). Given the tobacco companies' inclination to sell their different products in unique ways, the various ATPs are likely to have differing smoker typologies (29, 34).

Specific Aims

In light of the gap in research surrounding ATPs, this study will:

1. Examine the extent to which use of various ATPs is related to nicotine dependence among young adult cigarette smokers;
2. Examine whether motives for tobacco use differentiate cigarette smokers from polytobacco users; and
3. Examine motives for tobacco use among users of various ATPs.

Findings from this study will be timely and address a significant gap in the literature. Moreover, this research will inform efforts to determine appropriate tobacco use prevention and control action.

LITERATURE REVIEW

Tobacco Use Harms in Young Adults

Our understanding of the health consequences of tobacco use has expanded beyond the immediate concerns for young smokers. Examining tobacco use in young adults is now critical in understanding the deeper implications it has across the life course. Active cigarette smoking during adolescence has the potential to slow lung growth and reduce its level of functionality, increasing the risk of developing chronic obstructive pulmonary disease (17). A 15-year longitudinal study of men and women aged 18-30 years who were healthy at enrollment (the CARDIA study) found significant declines in lung function that were associated with the use of cigarettes over 10 years (41). Many other studies have been conducted with similar results showing clinically important reductions of lung function in smokers when compared to non-smokers (17). Low lung growth and reduced functionality increases the propensity for airflow obstruction that can lead to chronic respiratory symptoms or asthma.

Cardiovascular disease is a chronic process with origins in the health behaviors of young adults, and smoking is strongly and causally associated with cardiovascular outcomes (2). In the Pathobiological Determinants of Atherosclerosis in Youth (PDAY) study, tobacco use was positively associated with the prevalence of early lesions of atherosclerosis, the usual cause of cardiovascular disease, in 15- to 19-year olds (42). A case-control study of a PDAY cohort including 50 smokers and 50 non-smokers in the White male young adult (25-34 years old) population found that smokers were twice as likely to have advanced lesions compared to non-smokers (43). There is significant evidence that tobacco use contributes to atherosclerosis in young adults. A report by the Surgeon General reviewed several studies all with consistent results showing that smoking was associated with atherosclerosis at all ages (17).

The topic of nicotine and addiction in tobacco use has been extensively reviewed, most notably in the 1988 Surgeon General's report which confirmed the role of nicotine in causing addiction (2, 17). Evidence reviewed in a 2010 report concluded that nicotine activates multiple biological pathways through which smoking increases risk for disease (44). There is a lack of research providing consistent findings that define the characteristics of nicotine dependence in adolescent to young adult smokers (17). An increasing number of people are being exposed to nicotine through products other than conventional cigarettes (2). This possibility of increasing chronic exposure to nicotine from various products merits additional research. All tobacco products contain toxicants, so the use of any tobacco product poses some degree of health risk. However, there is currently a lack of knowledge as to how these other nicotine containing products, referred to as alternative tobacco products (ATPs), contribute to nicotine dependence.

Alternative Tobacco Products

Cigarette consumption in the past decade has been reduced by 32.8% due to targeted public health efforts (4). The use of the traditional cigarette was diminished by the rise of ATPs. There has been an alarming increase in the consumption of these products in the young adult population (5-10).

Little Cigars and Cigarillos

The consumption of loose tobacco and cigars in the United States increased from 3.4% in 2000 to 10.4% in 2011 (4). In a review of recent nationally representative surveys, the rates of cigar use have remained stable in the adolescent and young adult population (5). The National Youth Tobacco Survey (NYTS) in 2012 observed about 13% current cigar use in high school students, similar to rates reported in 2009 and 2011. Results from the Monitoring the Future study (MTF) demonstrated high past year cigar use rates in college students: 23.6% in 2011,

20.3% in 2012, and 19% in 2013. The National Survey on Drug Use and Health (NSDUH), observed similar results to the NYTS and MTF. Young adults in the NSDUH had rates of 21.7% past year cigar use and 10.7% past month use. The Youth Risk Behavioral Surveillance Survey (YRBSS) similarly reported stable rates of cigar use between 2009 and 2013, with a rate of 12.6% past month use in high school students in 2013. A review of the evidence suggests higher, but stable, rates of cigar use in young adults when compared to high school students. Additional insight into why cigars become more appealing with age is needed.

Smokeless Tobacco

The overall use of smokeless tobacco remains low in the adolescent and young adult population (5). The NYTS did not assess smokeless tobacco rates until 2011. The rates of smokeless tobacco use in 2011 and 2012 have changed very little in high school students, with a past month use rate of 6.4% in 2012. The MTF also demonstrated similar rates of use. The combined rate, between middle and high school students, of past month smokeless tobacco use was 5.7% in 2013. This rate has remained stable in MTF results since 2000. The 2012 NSDUH demonstrated a past year smokeless tobacco use rate of 3.9% in high school students, which was comparable to the rate in 2011. The 2012 NSDUH results also demonstrated higher rates of smokeless tobacco use in young adults. 9.0% of the young adults in the NSDUH reported past year use of smokeless tobacco. The 2013 YRBSS revealed an overall current smokeless tobacco use rate of 8.8% in high school students. Similar to cigar use, smokeless tobacco use rates remain stable but appear to increase with age.

Electronic Cigarettes

Electronic cigarettes, or e-cigarettes, have recently emerged into the tobacco market. The few national studies examining use in adolescents and young adults warrant serious concern and

continued research efforts. Data from the 2011-2014 NYTS show staggering increases in e-cig use in high school students (45). According to the 2014 NYTS, e-cigarettes became the most common currently used tobacco product amongst high school students. Current e-cig use tripled in high school students from 4.5% in 2013 to 13.4% in 2014. Results from the 2014 MTF also demonstrate that e-cigarettes have become the most currently used tobacco product in high school students. In fact, 17.1% of 12th graders in the MTF study reported currently using e-cigarettes. There has been a surge of research into e-cigarettes, but little is still known about how this product contributes to nicotine dependence.

Hookah

Hookah is another alternative tobacco product that has recently emerged as a major player in the market. The NYTS studies from 2011-2014 revealed a significant exponential increase in current hookah use in high school students; 4.1% of high school students in 2011 and 9.4% in 2014 reported hookah use (45). The MTF surveys from 2010-2013 demonstrated much higher rates of hookah use, but with the same trend of increasing rates of use over time in high school students. Specifically, 17.1% of high school students in the 2011 MTF study reported current hookah use, and this statistic jumped to 21.4% of high school students in 2013. Rates of current use in college students remained stable between 26-28% in the same time period.

Multiple Tobacco Product Use

The use of multiple tobacco products, or polytobacco use, is increasing in popularity as new tobacco products emerge, such as e-cigarettes (2, 27). Polytobacco use is particularly concerning since it has been associated with increased physical and psychological health risks. It increases exposure to nicotine and the risk for dependence (12). Polytobacco users have been reported to have a more difficult time quitting the use of tobacco when compared to single

product users (2, 46). Additionally, nicotine dependence treatment programs have historically focused on cigarette smoking cessation, and have yet to be effectively tailored for the new emerging products.

Polytobacco use has been reported to be the highest among college students. In a 2015 study of college students (n=1593), 15% of tobacco ever users reported current polytobacco use (46). However, the rates of polytobacco use increased significantly among ATP users. More than 70% of LCC users reported polytobacco use, and nearly half of the hookah users reported polytobacco use. The same study also revealed that polytobacco users were more likely than single tobacco product users to consume hookah and e-cigarettes. A separate study similarly demonstrated higher rates of polytobacco use among ATP users (29). The prevalence of polytobacco use was only 8.6% among traditional cigarette users, but 50% amongst cigar users. As ATPs become more prominently used in the young adult population, polytobacco use concurrently becomes a more important issue. More research examining motives for polytobacco use is critically needed to address the growing concerns of nicotine addiction and the associated health burdens in the young adult population.

Tobacco Use Motives

Historically, tobacco treatment and cessation programs have focused on traditional cigarettes. As a result of this, and perhaps also a causal factor, research to inform these efforts have focused largely on cigarette use (33-39). Studies investigating tobacco use motives typically examine them within the context of cigarettes. This research has drawn from Cloninger's theory regarding risk for substance use (47, 48). This theory outlines four dispositional constructs: novelty seeking (i.e., preference for novel situations), harm avoidance (i.e., sensitivity to threat cues), task reward dependence or persistence (i.e., sensitivity to rewards

from instrumental achievement), and social reward dependence (i.e., sensitivity to rewards from social relationships). More recent work has examined specific motives related to cigarette smoking, focusing on motives related to social context, self-enhancement, coping with boredom, and affect regulation, all of which have been shown to correlate with cigarette smoking (39).

With regards to cigarette smoking, social norms are believed to be a key motive in the young adult population of western societies (49). Substance use, namely smoking and drinking, are social activities that this population often engage in together. Prior research has revealed that non-daily smokers tend to smoke almost exclusively with friends (50). Self-enhancement motives may also play an important role since those with lower self-esteem are more likely to use tobacco and become nicotine dependent (51). Nicotine may also serve as a coping mechanism in the form of a chemical stress reliever (52). There has also been evidence to suggest that young adults may use cigarettes as a source of stimulation or arousal to counter boredom or negative moods (53). These specific motives (social, self-enhancement, affect regulation, boredom), in relation to cigarette use, have been found to vary between gender and parental education (38, 54). However, there has been no examination of these motives for different tobacco products.

The need to understand the motives to use emerging tobacco products is growing. Several studies have conducted latent class analyses in the young adult population and identified distinct profiles of tobacco product use, including ATPs (7, 55-57). Tobacco companies have also determined the differing psychographic (e.g., values, goals, beliefs) profiles of their consumers by tailoring the content of their advertising to specific products (14, 40). An analysis of advertising content revealed that ads for e-cigarettes focused on harm reduction and the ability to use in areas where smoking is prohibited, while ads on smokeless tobacco focused on

masculinity (14). Based on prior research, the motives to use ATPs are likely to be distinct between products due to the unique patterns of usage.

Theory of Planned Behavior

The Theory of Planned Behavior (TPB) can serve as a theoretical framework for understanding the motivational factors behind the use of cigarettes and ATPs (58). In prior research, TPB has successfully explained and predicted smoking behavior in various populations (59-61). TPB focuses on how attitude, subjective norm, and perceived control of a behavior explain behavioral intention. Attitude encompasses an individual's beliefs about the outcomes of performing the behavior weighted by the individual's evaluations of those outcomes. The instrumental use of tobacco by young adults for social situations, self-enhancement, affect regulation, and boredom are affected by their attitudes towards the use of a specific tobacco product (49-53). Subjective norms are comprised of an individual's perceptions about whether important referent individuals approve or disapprove of the given behavior, otherwise known as normative beliefs. An individual's normative beliefs are weighted by his or her motivation to comply with those referents to determine his or her subjective norms. Smoking serves an important function in many social settings and smoking behavior can be affected by those around us (49, 50). The act of smoking can help individuals feel more connected to other nearby smokers by easing them into socialization and helping them relax. Given how well the constructs of TPB map onto the tobacco use motives, the TPB is a useful framework for understanding why people choose to use cigarettes and specific ATPs.

Research Aims

Given the emergence of ATPs in the market, increased use of ATPs, and polytobacco use, it is critical to understand the extent to which these products are associated with symptoms of addiction and the motives for using the various ATPs. As such, this study will:

1. Examine the extent to which use of various ATPs is related to nicotine dependence among young adult cigarette smokers;
2. Examine whether motives for tobacco use differentiate cigarette smokers from polytobacco users; and
3. Examine motives for tobacco use among users of various ATPs.

Findings from this study will be timely and address a significant gap in the literature. Moreover, this research will inform efforts to determine appropriate tobacco use prevention and control action.

METHODS

Study Design

The current study is a secondary data analysis of a mixed-methods longitudinal study. The parent study is described in detail elsewhere (62). In summary, it employed an explanatory design that obtains longitudinal quantitative data to inform in-depth qualitative assessment of tobacco use behaviors and attitudes. Participants were followed for two years and were individually assessed every four months. Data collection began in the Fall of 2014. The study was approved by the Emory University and ICF International Institutional Review Boards, as well as those of the participating schools.

Participants and Procedures

The sampling frame consisted of seven Georgia college and university campuses. These seven schools were chosen due to their unique and distinctive characteristics. There were two public universities, two private colleges/universities, two technical/community colleges, and a historically Black university. These schools provided a broad range of students from differing sociodemographic backgrounds, representation from urban and rural settings, and settings with unique campus-related factors and differing tobacco control policies. Inclusion criteria for participants were: 1) age 18-25 inclusive and 2) able to read English.

Contact information for students fitting the inclusion criteria were obtained from each school's registrar office. We wanted to select 3000 students from each school but were unable to do so in four of the schools selected. These four schools had an eligible student population of less than 3000, therefore the entire eligible population was selected at these schools. We were able to select 3000 students from one private and two public universities. The overall recruitment process was staggered. Recruitment lasted one week at the technical/community colleges, while recruitment lasted 48-72 hours at the other campuses. Students were sent an email with an initial recruitment letter and a link to a baseline survey. The total response rate of this first email was 22.9% ($n=3574/15,607$). A week after completion of the baseline survey, a confirmation email was sent to reiterate the expectations and incentives of the student's participation. Once confirmed, the student was officially enrolled into the study and sent their first incentive of a \$30 gift card. The confirmation rate was 95.6% ($n=3418/3574$). A graduated compensation schedule was utilized (\$30 for completion of first two surveys, \$40 for second two, \$50 for the last two) and an additional \$100 was offered for completion of all six surveys.

The current analyses examined data from Wave 2 of the study, which was conducted during March/April 2015. The sample size during Wave 2 was 2,969 (86.9% retention rate). The current analyses focused on tobacco use behaviors and motives that were asked to participants who reported any tobacco use in the past 4 months. Of the 2,969 wave 2 participants, 22.9% (n=679) of the sample used tobacco in the past 4 months of completing the survey. (This time frame was used to capture information between each assessment.) When examining the prevalence of use in the past 4 months within specific tobacco products, 14.9% (n=441) of the sample used cigarettes, 11.7% (n=348) used LCCs, 3.9% (n=116) used smokeless tobacco products, 15.8% (n=468) used e-cigarettes, and 12.5% (n=371) used hookah. Of the tobacco users in the sample, 60.2% (n=409) were single product users, 25.9% (n=176) were two product users, and 13.9% (n=94) used 3 or more tobacco products.

Measures

Data for the current analyses were drawn from the baseline survey assessment of sociodemographics and from the Wave 2 assessment of tobacco use, nicotine dependence, and motives for tobacco use. These specific variables are described below.

Sociodemographics. The survey assessed a range of sociodemographic factors as well as some college student specific measures. For the current analyses, age, sex, race, and ethnicity were included.

Tobacco Use. The survey asked, “How many days of the past 4 months did you use: Cigarettes? Flavored little cigars (such as Black and Milds) or cigarillos (such as Swisher Sweets cigarillos)? Chewing tobacco, snuff, or dip (such as Redman, Levi Garrett, Beechnut, Skoal, Skoal Bandits, or Copenhagen)? Snus (such as Camel or Marlboro Snus)? Dissolvable tobacco products (such as Ariva, Stonewall, Camel orbs, Camel sticks, or Camel strips)? Electronic

cigarettes or e-cigarettes (such as Ruyan, Blu, or NJOY)? Tobacco from a hookah or a waterpipe?” Those reporting use within the past 4 months were then asked to report the number of days they used the respective tobacco products in the past 30 days (63). Participants reporting use were asked, “On the days when you do smoke cigarettes, how many do you smoke?” The wording of the question was changed to accommodate the product. For example, the survey asked how many puffs on an e-cigarette was drawn and how many times a smokeless tobacco product was used. In order to calculate a conservative estimate of the level of tobacco use, these two variables (past 30-day use, use per day) were multiplied to compute a past-30 day tobacco use consumption variable.

Hooked on Nicotine Checklist. The Hooked on Nicotine Checklist (HONC) is a 10-item screening tool that assesses the loss of autonomy over tobacco for the participant (64). A tobacco user’s endorsement of any item indicates some loss of autonomy. The verbiage of the HONC was adapted in the current study to be applicable to all types of tobacco and nicotine product use (i.e., not only cigarette smoking). Sample questions include, “Have you ever tried to quit smoking, but couldn’t?” and “Have you ever felt like you really needed to use tobacco or nicotine?” Response options ranged from (1) Yes to (0) No. Summing the answers to individual items creates an overall hooked on nicotine score. The scale ranges from 0-10, with higher scores indicating a higher degree of autonomy lost to nicotine. In previous studies, the Cronbach’s alpha for the scale has ranged from .83-.94. In the current study, the alpha was .94.

The Motives for Smoking Scale. The Motives for Smoking Scale assesses the extent to which each of 15 smoking-related motives is true for the participant (1=not at all true, 5=very true) (38, 39). The measure contains questions about four common motives: social (4 items, e.g., “Smoking helps you fit in with other people”; range 4-20), self-enhancement (4 items, e.g.,

“Smoking makes you feel more self-confident”; range 4-20), boredom relief (2 items, e.g., “Smoking is something to do when you're bored”; range 2-10), and affect regulation (5 items, e.g., “Smoking helps you calm down when you're feeling tense or nervous,” “Smoking cheers you up when you're in a bad mood”; range 5-25). The verbiage of the Motives for Smoking Scale was adapted in the current study to be applicable to all types of tobacco and nicotine product use (i.e., not only cigarette smoking). Higher scores indicate that the motive is more relevant. In the past, Cronbach’s alpha for each motive subscale have ranged from .88 to .93, and the scale has demonstrated strong validity (47, 48). In the current study, Cronbach’s alpha for the total scale, the social subscale, the self-enhancement subscale, the boredom relief subscale, and the affect regulation subscale were .93, .89, .86, .94, and .92, respectively.

Data Analysis

Descriptive analyses were conducted to summarize participant characteristics. Due to the nonnormality of consumption level, a natural log transformation was used to normalize the use consumption variables for LCCs, smokeless tobacco, e-cigarettes, and hookah. No transformation was performed on cigarette consumption due to the normality of its distribution. Correlations were calculated among the following factors: sociodemographics (e.g., age, sex, race/ethnicity), level of tobacco use in the past 30 days across tobacco products (i.e., cigarettes, LCCs, smokeless tobacco, e-cigarettes, hookah), HONC scores, and Motives for Smoking Scale subscale scores. For the first regression model examining the contribution of ATP use above cigarette use to nicotine dependence per the HONC, the sample for analysis was restricted to participants using cigarettes in the past 30 days, who may or may not have used other tobacco products. A binary logistic regression was then conducted to examine motives in relation to polytobacco use versus cigarette only use. The sample for analysis was then restricted to single

product users in the past 30 days to examine motives for smoking per the Motives Scale in relation to level of use of each tobacco product, respectively. Preliminary analyses were conducted using dichotomous outcomes (i.e., use vs. no use in the past 30 days) and continuous outcomes (i.e., number of days used in the past 30 days). Results were similar; thus, the results using continuous outcomes are presented to preserve statistical power. Of note, for each regression, the covariates and correlates of interest were forced into the models. Alpha was set at .05, and all analyses were conducted using SPSS 23.0.

RESULTS

Table 1 highlights the participant characteristics of the sample of 679 participants who reported tobacco use in the past 4 months. The average age was 20.55 (SD=1.86), 54.93% (n=373) were female, and 22.68% (n=154) were non-Hispanic Black. Four participants reported “other gender” and were excluded from analyses. Cigarettes were the most commonly and frequently used tobacco product with nearly half of the sample (48.90%, n=332) reporting use in the past 30 days. The mean number of days that participants smoked cigarettes was 5.82 (SD=10.22) in the past 30 days. Of the sample, 29.16% (n=198) used LCCs, 12.81% (n=87) used smokeless tobacco, 30.04% (n=204) used e-cigarettes, and 36.08% (n=245) smoked hookah in the past 30 days. The median number of days these products were smoked were 2 for LCCs, 15 for smokeless tobacco, 2.5 for e-cigarettes, and 1 for hookah. The mean score for the HONC was 1.93 (SD=3.19). The mean scores for the social and self-enhancement subscales, each with scores ranging from 4-20, were 6.74 (SD=3.37) and 6.11 (SD=3.04), respectively. The mean score for the boredom subscale, with scores ranging from 2-10, was 3.82 (SD=2.28). The mean score for the affect regulation subscale, with scores ranging from 5-25, was 10.08 (SD=5.40).

Table 2 provides a breakdown of the past 30-day polytobacco use patterns by tobacco product. Out of all products, hookah had the highest proportion of single product smokers (n=116, 47.3%). Across products, single product smokers comprised the highest proportion of smokers for hookah and cigarettes (cigarettes, n=140, 42.2%). Cigarettes had the highest rates of concomitant use among tobacco products, with a range of 28.6-52.0% of alternative tobacco smokers also reporting the use of cigarettes. For LCC, smokeless tobacco, and e-cigarette users, concomitant use of cigarettes was the most commonly reported (LCC, n=77, 38.9%; smokeless tobacco, n=36, 41.4%; e-cigarettes, n=106, 52.0%). Concomitant use of smokeless tobacco was the least commonly reported, with a range of 7.8-14.2% of smokers across products also reporting the use of smokeless tobacco.

Bivariate analyses regarding sociodemographic variables, level of tobacco use, HONC scores, and subscale scores were also conducted. Of particular note, Table 3 presents the correlation matrix examining associations between scores on the HONC and the 4 subscales of the smoking motives scale. HONC scores had a statistically significant ($p<.001$) positive linear relationship with scores on each of the subscales (social, $r=0.16$; self-enhancement, $r=0.28$; boredom, $r=0.43$; affect regulation, $r=0.51$). The motive subscale scores also each had a statistically significant ($p<.001$) moderate positive linear relationship with each other.

In addition, the level of past month cigarette consumption was significantly correlated with HONC scores ($r=0.59$, $p<.001$), all four of the subscale scores (social, $r=0.14$, $p<.001$; self-enhancement, $r=0.20$, $p<.001$; boredom, $r=0.30$, $p<.001$; affect regulation, $r=0.40$, $p<.001$), and age ($r=0.14$, $p<0.0001$). The level of cigarette consumption was negatively correlated with the consumption level of hookah ($r=-0.19$, $p<.001$), but positively correlated with the consumption of e-cigarettes ($r=0.10$, $p=.012$). Out of the ATPs, the levels of consumption for smokeless

tobacco ($r=0.25$, $p<.001$), e-cigarettes ($r=0.15$, $p<.001$), and hookah ($r=-0.23$, $p<.001$) were significantly correlated with the HONC scores. LCCs consumption was not significantly correlated with HONC scores or any of the tobacco use motives subscale scores. The level of consumption for smokeless tobacco was significantly associated with all four tobacco use subscale scores (social, $r=0.11$, $p=.004$; self-enhancement, $r=0.28$, $p<.001$; boredom, $r=0.29$, $p<.001$; affect regulation, $r=0.21$, $p<.001$). The level of e-cigarette consumption was also significantly associated with each of the four tobacco use subscale scores (social, $r=0.15$, $p<.001$; self-enhancement, $r=0.09$, $p<.001$; boredom, $r=0.16$, $p<.001$; affect regulation, $r=0.14$, $p<.001$). The level of hookah consumption had a significant, negative association with affect regulation subscale scores ($r=-0.13$, $p=.001$). Age was significantly correlated with the levels of cigarette consumption ($r=0.14$, $p<.001$), LCCs consumption ($r=-0.10$, $p=.013$), e-cigarette consumption ($r=-0.11$, $p=.006$), and hookah consumption ($r=-0.12$, $p=.002$).

Table 4 presents the results of a linear regression model examining cigarette and ATP use in relation to nicotine dependence per HONC scores among the 332 cigarette users (192 of whom used other tobacco products in the past 30 days). Results of the regression model indicated that age and the levels of past month cigarette, smokeless tobacco, and e-cigarette use were significantly associated with HONC scores. Sex and race/ethnicity were not significantly associated with HONC scores. Specifically, for each unit increase in past month cigarette use, HONC scores increased by 0.14 points when controlling for age, sex, race/ethnicity, and the other tobacco products ($B=0.14$; 95% CI=0.12, 0.16; $p<.001$). A one-unit increase in past month smokeless tobacco use increased HONC scores by 0.55 points when controlling for age, sex, race/ethnicity, and the other tobacco products ($B=0.55$; 95% CI=0.16, 0.94; $p=.006$). For each unit increase in past month e-cigarette use, HONC scores increased by 0.32 points when

controlling for age, sex, race/ethnicity, and the other tobacco products ($B=0.32$; 95% CI=0.11, 0.53; $p=0.004$). The levels of past month consumption for LCCs ($B=0.015$, $p=0.939$) and hookah ($B=-0.36$, $p=0.056$) were not significantly associated with the HONC. The total regression model accounted for 44.9% of the variance in HONC scores.

Table 5 presents the results of a logistic regression model examining the tobacco use motives in relation to polytobacco use versus cigarette only use. Results from the model indicated that a one-year increase in age decreased the odds of polytobacco use by 27% ($OR=0.79$; 95% CI=0.70, 0.90; $p<.001$). Female participants were also 61% less likely to be engaged in polytobacco use ($OR=0.39$; 95% CI=0.24, 0.65; $p<.001$). Participants self-reporting to be Black were over 3 times more likely to be engaged in polytobacco use when compared to Whites ($OR=3.79$; 95% CI=1.61, 8.91; $p=.002$). The model also indicated that for each unit increase in boredom subscale scores, the odds of engaging in polytobacco use increased by 19% ($OR=1.19$; 95% CI=1.05, 1.35; $p=.007$). No significant difference was found in the odds of polytobacco use with varying scores in the social ($p=.567$), self-enhancement ($p=0.680$), or affect regulation ($p=0.218$) subscales. The regression model accounted for 18.2% of the variance in the outcome.

Table 6 presents the results of five linear regression models examining tobacco use motives subscale scores in relation to the separate past month use levels of cigarettes and the ATPs. The models predicted the past 30-day consumption levels of single product usage. Therefore, the sub-samples for each model were $n=140$ for cigarettes, $n=65$ for LCCs, $n=29$ for smokeless tobacco, $n=59$ for e-cigarettes, and $n=116$ for hookah. Results of the regression model predicting level of cigarette use suggest that age, sex, being Black, boredom subscale scores, and affect regulation subscale scores were significantly associated with level of use. Social ($p=.172$)

and the self-enhancement ($p=.218$) subscale scores were not significantly associated with cigarette use. Specifically, for each one-year increase in age, the level of past month consumption of cigarettes increased by 0.72 units when controlling for sex, race/ethnicity, and the tobacco use motives subscale scores ($B=0.72$; 95% CI=0.17, 1.27; $p=.011$). On average, females had 4.46 units more of past month cigarette consumption than men when controlling for age, race/ethnicity, and subscale scores ($B=4.46$; 95% CI=2.14, 6.78; $p<.001$). Compared to Whites, Blacks had, on average, 5.55 fewer instances of past month cigarette consumption when controlling for age, sex, and subscale scores ($B=-5.55$; 95% CI=-8.19, -2.90; $p<.001$). For each point increase in boredom subscale scores, past month cigarette consumption levels increased by 0.82, when controlling for age, sex, race/ethnicity, and the other subscale scores ($B=0.82$, 95% CI=0.10, 1.54; $p=.025$). For each point increase in affect regulation subscale scores, the number of past month cigarette consumption instances increased by 0.91, when controlling for age, sex, race/ethnicity, and the other subscale scores ($B=0.91$; 95% CI=0.63, 1.20; $p<.001$). The total regression model accounted for 23.7% of the variance in past month cigarette consumption.

Results of the regression model predicting use of LCCs suggest that age, being Black, and affect regulation subscale scores were significantly associated with levels of past month consumption. Sex ($p=0.401$), social subscale scores ($p=.319$), the self-enhancement subscale score ($p=.703$), and boredom subscale scores ($p=.263$) were not significantly associated with the past month use of LCCs. For each one-year increase in age, the number of past month consumption instances of LCCs decreased by 0.055 units, when controlling for sex, race/ethnicity, and the tobacco use motives subscale scores ($B=-0.055$; 95% CI=-0.088, -0.022; $p=.001$). On average, Blacks had 0.70 more past month consumption instances of LCCs than Whites ($B=0.70$; 95% CI=0.55, 0.86; $p<.001$). Although marginal, but significant, a one-unit

increase in affect regulation subscale scores resulted in an increase of 0.018 instances of past month consumption, when controlling for age, sex, race/ethnicity, and the other subscale scores ($B=0.018$; 95% CI=0.001, 0.035; $p=.035$). The total regression model accounted for 18.6% of the variance in levels of past month consumption of LCCs.

Results of the regression model predicting past month use of smokeless tobacco indicated that sex, being Asian, social subscale scores, the self-enhancement subscale score, and boredom subscale scores were significantly associated with the levels of use. Age ($p=.548$) and the affect regulation subscale score ($p=.651$) were not significantly associated with past month levels of smokeless tobacco consumption. On average, females, when compared to males, had 0.47 fewer past month consumption instances of smokeless tobacco, when controlling for age, race/ethnicity, and the subscale scores ($B=-0.47$; 95% CI=-0.62, -0.31; $p<.001$). When compared to Whites, those self-reporting to be Asian had, on average, 0.41 fewer past month smokeless tobacco consumption instances, when controlling for age, sex, and the subscale scores ($B=-0.41$; 95% CI=-0.71, -0.11; $p=.008$). Changes in the tobacco use motives subscale scores resulted in marginal but significant changes in past month consumption of smokeless tobacco. A one-point increase in social subscale scores decreased past month smokeless tobacco consumption levels by 0.045 instances ($B=-0.045$; 95% CI=-0.074, -0.016; $p=.003$), when controlling for age, sex, race/ethnicity, and the other subscale scores. One-point increases in the self-enhancement and boredom subscale scores increased the level of past month smokeless tobacco consumption by 0.046 ($B=0.046$; 95% CI=0.008, 0.0084; $p=.017$) and 0.065 units ($B=0.065$; 95% CI=0.018, 0.11; $p=.007$), respectively. The total regression model accounted for 18.4% of the variance in past month consumption levels of smokeless tobacco.

Results of the regression model predicting past month consumption levels of e-cigarettes indicated that being Hispanic and being Black were significantly associated with consumption. Age ($p=.129$), sex ($p=.222$), social subscale scores ($p=.234$), the self-enhancement subscale score ($p=.186$), boredom subscale scores ($p=.356$), and affect regulation subscale scores ($p=.685$) were not significantly associated with past month consumption levels of e-cigarettes. On average, non-Hispanic Blacks, when compared to non-Hispanic Whites, had 0.34 fewer instances of consumption of e-cigarettes, when controlling for age, sex, and the subscale scores ($B=-0.34$; 95% CI=-0.59, -0.10; $p=.005$). In the same model, on average, those self-reporting to be Hispanic, when compared to Whites, had 0.69 instances more consumption of e-cigarettes ($B=0.69$; 95% CI=0.10, 1.27; $p=.021$). The total regression model accounted for 5.0% of the variance in the past month consumption levels of e-cigarettes.

Results of the regression model predicting past month consumption levels of hookah indicated that being Black, being Asian, and each subscale of the tobacco use motives scale were significantly associated with levels of consumption. Age ($p=.627$) and sex ($p=.085$) were not significantly associated with the levels of past month hookah consumption. On average, Blacks, when compared to Whites, had 0.31 more past month consumption instances of hookah, when controlling for age, sex, and the subscale scores ($B=0.31$; 95% CI=0.15, 0.48; $p<.001$). In the same model, on average, Asians had 0.62 more consumption instances than Whites ($B=0.62$; 95% CI=0.33, 0.90; $p<.001$). One-point increases in social and boredom subscale scores resulted in 0.043 ($B=0.043$; 95% CI=0.015, 0.070; $p=.002$) and 0.049 ($B=0.049$; 95% CI=0.004, 0.094; $p=.033$) increases in the number of past month hookah consumption instances, respectively. However, one-point increases in the self-enhancement and affect regulation subscale scores resulted in 0.052 ($B=-0.052$; 95% CI=-0.088, -0.017; $p=.004$) and 0.031 ($B=-0.031$; 95% CI=-

0.049, -0.014; $p=.001$) unit decreases in the number of past month hookah consumption instances, respectively. The total regression model accounted for 15.0% of the total variance in past month hookah consumption levels.

DISCUSSION

Findings

The current research examined the impact of ATP in addition to cigarette use on nicotine dependence as well as differences in tobacco use motives among college student ATP and polytobacco users. Most notably, we found that ATP use does contribute to dependence and that the motives for tobacco use differed between tobacco products, when controlling for age, sex, and race/ethnicity. To our knowledge, this is the first study to examine ATP use in relation to nicotine dependence and to compare tobacco use motives across cigarettes, LCCs, smokeless tobacco, e-cigarettes, and hookah, simultaneously.

The use of smokeless tobacco and/or e-cigarettes in addition to conventional cigarettes increased the level of nicotine dependence. This finding might reflect the conclusions of multiple studies that polytobacco use increases the risk of nicotine dependence (12, 28, 30). Similar to our findings, Tomar et al. concluded that the concurrent use of smokeless tobacco and cigarettes increased the risk of nicotine dependence in young adults (28). Given the distribution of past month smokeless tobacco use (mean=1.89; SD=6.34), an increase of 0.55 points on the 10-point HONC measure with each additional day of use is significant. Similarly, with past month e-cigarette use (mean=2.10; SD=5.90), an additional day of use increases HONC scores by 0.32 points. The data suggest that these tobacco products have a varying degree of effect on nicotine dependence. Unsurprisingly, the data also suggest that increasing the consumption level of cigarettes also increases the level of nicotine dependence. Age was the only sociodemographic

variable to have a significant association with HONC scores. This finding may suggest the development of nicotine dependence overtime. With the vast majority of tobacco use initiation starting in adolescence, college student tobacco users may have a long history of use (17).

There are several possible explanations for why the additional use of LCCs and hookah did not contribute to the level of nicotine dependence in cigarette users. Hookah use in college students serves specific social purposes. Use of hookah is typically low, non-daily, and in social settings (65, 66). A previous study examining college hookah smokers reported that 85% (n=58) of the sample had never used hookah alone (66). In the same sample, only 2 participants (2.9%) felt that they were hooked on the use of hookah. The study also concluded that impulsivity was not a significant predictor of hookah use. This may suggest that the planned nature of hookah consumption may have a regulatory effect on nicotine dependence due to hookah use. Unlike the findings from our correlation matrix, a previous study examining LCCs use in cigarette smoking adolescents found that past month LCCs use was strongly associated with the concurrent use of hookah (67). This may suggest that the use of LCCs inhabits similar social experiences as hookah, but much is still unknown about the reasons and context for LCCs use. Interestingly, a qualitative study in male Black marijuana users revealed that LCCs can be modified for marijuana use (68). However, it is unclear the extent to which this phenomenon affects the levels of LCCs use reported in our study, as marijuana use was also asked in a separate section.

The predictors of polytobacco use in our data reflect similar findings of previous studies conducted in college and adult populations (10, 46, 69-70). The prevalence of polytobacco use declines with age and is substantially lower in females. Due to a number of contextual factors, females have historically had lower prevalence rates of tobacco use (2). The same contextual factors would likely directly impact the rates of polytobacco use, as well. The result with age as a

predictor of polytobacco use is interesting. Since the data also revealed that nicotine dependence increases with age, it was first posited that polytobacco use would also increase with age. In order to satisfy their cravings, young adults might initiate the use of ATPs in settings where conventional cigarettes are not allowed. This finding that college students are less likely to engage in polytobacco use as they get older might suggest that they are committing to the single use of conventional cigarettes. Another possible explanation for the significance of the age variable in this model is the age cohort effect of the students. The older students in the sample would not have spent their adolescent years surrounded by the emergence of ATPs like e-cigarettes. The results from this model suggest that these older students, who would have grown up in a different tobacco age, have different tobacco use behaviors. The odds ratios and prevalence rates between race/ethnicity groups vary between studies. Our data suggest that only Blacks have significantly higher odds of participating in polytobacco use when compared to Whites. Other studies have suggested that Whites have the highest odds or prevalence rates of polytobacco use (10, 69). These variations may be attributable to geographic differences in study populations and substance use behaviors.

This study contributes to the existing body of literature by examining the motivations of engaging in polytobacco use. The data suggest that out of the four tobacco use motives surveyed in the study (social, self-enhancement, boredom, affect regulation), only boredom was found to be a significant predictor of polytobacco use. The college student population is known to engage in risky behaviors with many substances, such as drugs and alcohol among other things. Therefore, it makes sense that feelings of boredom in this population increases the likelihood of polytobacco use. The tobacco use behaviors in this population could have easily transitioned from a single experimental use to more consistent consumption. Our findings are also likely

connected to the lower harm perceptions of tobacco products that are often demonstrated in polytobacco users, as seen in a study conducted by Latimer et al (12). College students that are both bored and have low harm perceptions of a tobacco product may be more likely to use multiple tobacco products.

Our results indicated that the tobacco use motives for the use of a single product are distinct between the tobacco products examined in this study. The boredom and affect regulation motive dimensions were the only ones to significantly predict the consumption of cigarettes. These findings differ from those of the original study from which the tobacco use motives scale was adapted (38). The original study examined cigarette use stratified by sex, but in a population of high school students in Hungary. Their findings indicated that the boredom and affect regulation motive dimensions were significant in males, but that the social and affect regulation motive dimensions were significant in females. Our findings reinforce the significance of the affect regulation motive dimension as an important factor in determining cigarette use. While our study was mainly focused on determining the distinct tobacco use motives between products, future studies, with ample sample size, should be conducted to compare the differences in motives among products between sexes.

Little is currently known about motives for LCCs use. Research indicates that a prominent reason that distinguishes LCCs use from cigarette use is the higher levels of attraction due to flavors (71, 72). Despite this however, levels of LCCs use still remain low in comparison to cigarettes, and the findings from our study suggest different predictive motive dimensions (4). Our findings reflect that the use of LCCs is similar to the use of cigarettes through the affect regulation motive dimension. However, due to the sole significance of the affect regulation motive, this indicates that LCCs only users may be for specific coping purposes, in contrast to

the use of cigarettes also serving as a source of stimulation when bored. With the significance of the affect regulation motive dimension in LCCs only users, it is surprising that LCCs use did not contribute to nicotine dependence in polytobacco users, given the high correlation between HONC scores and affect regulation scores. This may suggest critical differences in the use patterns, behaviors, and profiles of LCCs only versus polytobacco users that smoke LCCs. A previous study has suggested that LCCs only users are not as gendered, more likely to use marijuana, and slightly more sensation seeking than LCCs polytobacco users when compared to non-smokers (73). The study also found that LCCs users, as a whole, perceived LCC smoking to be less harmful than cigarette smoking. Therefore, this population of smokers may be using LCCs for similar instrumental purposes as conventional cigarettes, but only use LCCs due to lower harm perceptions. However, more research is still needed to explore the context of and reasons behind LCCs use.

Regarding smokeless tobacco, the social motive dimension had a significant negative predictive value on smokeless tobacco consumption, while the self-enhancement and boredom dimensions had significant positive values. The negative predictive value of the social motive dimension is likely a result of statistical artifice due to a low sample size of smokeless tobacco single product users. Additionally, bivariate correlations initially indicated a significant, but weak positive association between smokeless tobacco consumption and the social motives subscale. Given that smokeless tobacco consumption was predictive of nicotine dependence in our regression model among cigarette users, it was also surprising to find that the affect regulation motive dimension was not significant in predicting the level of only smokeless tobacco use. Therefore, among smokeless tobacco only users, smokeless tobacco may not be used to typically address the mood swings of nicotine cravings and dependence.

The significance of the self-enhancement and boredom dimensions may be explained by the current trend and masculine identity of smokeless tobacco use (74, 75). Smokeless tobacco use has been found to be associated primarily with younger age, White race, living in rural areas, residence in the South, and low educational attainment (74). Since this study was conducted among college students, they may feel embarrassed to be using smokeless tobacco in front of their peers, given the current “rural and uneducated” identity of its use. However, these students may still be using it as a method to maintain their self-perceptions of masculinity, resulting in the positive predictive values of the self-enhancement and boredom motive dimensions.

None of the tobacco use motive dimensions predicted the use of e-cigarettes in the regression model. The regression model only explained 5% of the variance in data, suggesting that a significant factor determining e-cigarette use remains unadjusted after controlling for the tobacco use motive dimensions and sociodemographic variables. Previous studies have found that the main reasons for the use of e-cigarettes is either experimentation or for the purpose of quitting conventional cigarettes (76, 77). One study found that nearly two-thirds (65%, n=2281) of those who had used e-cigarettes later discontinued use (76). Nearly half (49%) of the e-cigarette users that discontinued reported that they were only experimenting with the product. A significant percentage of our population was likely to be comprised of experimenters as well. These experimenters would not be particularly motivated towards a certain reason to use the product. Therefore, their levels of e-cigarette use would not be sensitive to the tobacco use motive dimensions utilized in our study.

All four of the tobacco use motive dimensions were significant predictors of the level of hookah use. Interestingly, the self-enhancement and affect regulation motive dimensions were negatively associated. Based on previous research, it would not have been surprising to find

these dimensions to be non-significant. Hookah has been known to be used primarily for socialization, pleasure, and entertainment (78-80). However, our data suggest that self-enhancement and affect regulation were negative predictors of hookah use. Since the HONC and affect regulation motive dimension have a moderate, positive bivariate association, the HONC was also significantly, negatively associated with hookah consumption levels in bivariate correlations. From these findings, it appears that hookah users are genuinely less motivated by affect regulation and subsequently much less dependent on nicotine.

Conclusions

After controlling for sociodemographics, use of smokeless tobacco and e-cigarettes among cigarette users contributed to nicotine dependence. Our data also revealed that boredom and being Black were key factors in predicting polytobacco use. Moreover, the consumption levels of tobacco products, both conventional cigarettes and ATPs, were predicted by unique combinations of tobacco use motive dimensions. It is important to realize that excluding the significant motive dimensions from the regression model predicting cigarette use, the significant motive dimensions in other models resulted in very small changes in consumption. A one-unit change in past-month consumption level for the tobacco products is essentially one day of consumption. Although the consumption levels for the ATPs were low (range of means: 0.93-2.10), a 0.05 unit change in consumption is not practically significant in effect size. The significant motive dimensions for the regression model predicting cigarette use, however, were resulting in 0.8-0.9 unit changes.

Strength and Limitations

One strength of this study is the large sample of college students with representation from a variety of school types and locales. The robust sample also has a wide range of

sociodemographic backgrounds. Another strength is the thorough exploration of tobacco product use, examining cigarettes, LCCs, smokeless tobacco, e-cigarettes, and hookah, simultaneously. Information regarding ever use, past 4-month use, and past-month use were all collected. This study also expanded the application of measures that have been traditionally used to examine cigarette smoking to ATP consumption, while also documenting high internal consistency.

Limitations to this study include limited generalizability of the findings due to its recruitment from colleges and universities in the Southeast region of the United States. This region has different perceptions and practices of health behaviors and preventive care when compared to the rest of the country. In addition, the sample sizes for some of the ATPs was very low. The samples for the LCCs, smokeless tobacco, and e-cigarette regression models were too small to detect a medium effect size at a power of 0.80 (81). An additional limitation is the relatively low response rate (22.9%) through the email recruitment method. Possible selection and/or response bias may have affected the data and the conclusions we were able to draw. No analysis was able to be done to determine if any significant differences existed between those who responded to the recruitment email and those who did not. However, the intent of the recruitment method was to target participants more engaged with email, and subsequently more likely to be retained throughout the duration of the study. This intent was also a critical factor in having a short recruitment period for the baseline survey. Individuals that completed the baseline survey after the recruitment period were not considered for study participation.

Implications and Recommendations

This study reveals initial and important differences in the motivational factors affecting the use of ATPs and the use of multiple tobacco products. It is imperative that public health research continue to profile smokers to better understand tobacco behaviors and underlying

motivations. A better understanding of the motivational factors can benefit the creation of novel interventions. Instead of focusing on harm perceptions, tobacco use interventions can reach the fundamental behavioral affinity for tobacco use. Interventions that focus on harm perceptions often tend to neglect the reality of the situation and merely aim to prevent tobacco use through scare tactics. By focusing on motivations, interventions can assess the true nature of tobacco use and be better equipped to encourage tobacco cessation. Future studies on this topic should focus on recruiting larger samples sizes in order to better detect differences in the users of specific ATPs. Additionally, future research should aim to examine motivational factors in non-college young adult populations. These populations, with less education, are at higher risk of substance use and will likely have different profiles (2).

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Table 1. Participant sociodemographic and tobacco use characteristics (n=679)

Variable	Mean (SD) or N (%)
<i>Sociodemographics</i>	
Age (SD)	20.55 (1.86)
Sex (%)	
Female	373 (54.93)
Male	306 (45.07)
Race/ethnicity	
White	398 (58.62)
Black	154 (22.68)
Hispanic	23 (3.39)
Asian	42 (6.19)
Other	62 (9.13)
<i>Tobacco Use</i>	
Cigarette use, past 30 days (%)	332 (48.90)
Among cigarette users, median number of days used	5
Little cigars/cigarillos (LCC) users, past 30 days (%)	198 (29.16)
Among LCC users, median number of days used	2
Smokeless tobacco use, past 30 days (%)	87 (12.81)
Among smokeless tobacco users, median number of days used	15
E-cigarette use, past 30 days (%)	204 (30.04)
Among e-cigarette users, median number of days used	2.5
Hookah use, past 30 days (%)	245 (36.08)
Among hookah users, median number of days used (SD)	1
Hooked on Nicotine Checklist scores (SD)	1.93 (3.19)
Motives Scale Social subscale score (SD)	6.74 (3.37)
Motives Scale Self-enhancement subscale score (SD)	6.11 (3.04)
Motives Scale Boredom subscale score (SD)	3.82 (2.28)
Motives Scale Affect Regulation subscale score (SD)	10.08 (5.40)

^a 4 participants indicated “other gender”.

^b Not Hispanic/Latino 91.8% (n=3139); Don’t know 0.5% (n=17); Refused 0.2% (n=7); More than one race 4.0% (n=135); Other 1.6% (n=53); Don’t know 0.7% (n=24); Refused 0.5% (n=18).

Table 2. Past 30-day Polytobacco Use Patterns Across Cigarettes and Alternative Tobacco Products (n=679)

Tobacco Product n(%)	Cigarettes n=332	LCC n=198	Smokeless Tobacco n=87	E-cigarettes n=204	Hookah n=245
Only	140 (42.2)	65 (32.8)	29 (33.3)	59 (28.9)	116 (47.3)
Cigarettes	--	77 (38.9)	36 (41.4)	106 (52.0)	70 (28.6)
Little cigars/cigarillos (LCC)	77 (23.2)	--	22 (25.3)	56 (27.5)	61 (24.9)
Smokeless Tobacco	36 (10.8)	22 (11.1)	--	29 (14.2)	19 (7.8)
E-cigarettes	106 (31.9)	56 (28.3)	29 (33.3)	--	53 (21.6)
Hookah	70 (21.1)	61 (30.8)	19 (21.8)	53 (26.0)	--

Cell proportions indicate proportion of users represented by column header (eg, 23.2% of cigarette users are also LCC users)

Table 3. Correlations among HONC scores and Motives Scale subscale scores (n=679)

Variable	1 r	2 r	3 r	4 r	5 r
1. HONC scores	1	0.16	0.28	0.43	0.51
2. Motives Scale Social subscale	0.16	1	0.66	0.43	0.47
3. Motives Scale Self-enhancement subscale	0.28	0.66	1	0.47	0.59
4. Motives Scale Boredom subscale	0.43	0.43	0.47	1	0.59
5. Motives Scale Affect Regulation subscale	0.51	0.47	0.59	0.59	1

All correlations were significant with $p < .001$

Table 4. Ordinary least squares regression examining tobacco use in relation to nicotine dependence per HONC scores in cigarette smokers (n=332)

Variable	B	CI	p
<i>Sociodemographics</i>			
Age	0.36	0.19, 0.53	<.001
Sex			
Male	Ref	--	--
Female	0.56	-0.11, 1.23	.098
Race/Ethnicity			
White	Ref	--	--
Black	0.16	-0.91, 1.22	.772
Hispanic	-0.61	-2.35, 1.13	.488
Asian	0.24	-0.99, 1.47	.699
Other ^f	-0.14	-1.14, 0.86	.786
<i>Level of Past 30-day Use</i>			
Cigarettes	0.14	0.12, 0.16	<.001
LCCs	0.02	-0.38, 0.41	.939
Smokeless tobacco	0.55	0.16, 0.94	.006
E-cigarettes	0.32	0.11, 0.53	.004
Hookah	-0.36	-0.73, 0.01	.056

Adjusted R²=0.449

Table 5. Binary logistic regression examining motives for use in relation to polytobacco use versus cigarette only use (n=332)

Variable	OR	CI	p
<i>Sociodemographics</i>			
Age	0.79	0.70, 0.90	<.001
Sex			
Male	Ref	--	--
Female	0.39	0.24, 0.65	<.001
Race/Ethnicity			
White	Ref	--	--
Black	3.79	1.61, 8.91	.002
Hispanic	0.67	0.17, 2.68	.567
Asian	1.37	0.51, 3.72	.532
Other ^f	1.26	0.58, 2.73	.557
<i>Motives Subscales</i>			
Social	1.03	0.94, 1.13	.567
Self-enhancement	1.02	0.91, 1.15	.680
Boredom	1.19	1.05, 1.35	.007
Affect Regulation	0.97	0.91, 1.02	.218

Nagelkerke R²=0.182

Table 6. Ordinary least squared regression models examining Motives Scale subscale scores in relation to use of cigarettes, LCCs, smokeless tobacco, e-cigarettes, and hookah only, respectively

	Cigarettes (n=140)			LCCs (n=65)			Smokeless tobacco (n=29)			E-cigarettes (n=59)			Hookah (n=116)		
	B	CI	p	B	CI	p	B	CI	p	B	CI	p	B	CI	p
<i>Sociodemographics</i>															
Age	0.72	0.17, 1.27	.011	-0.06	-0.09, -0.02	.001	0.01	-0.03, 0.05	.548	-0.04	-0.09, 0.01	.129	-0.01	-0.04, 0.03	.627
Sex															
Male	Ref	--	--	Ref	--	--	Ref	--	--	Ref	--	--	Ref	--	--
Female	4.46	2.14, 6.78	<.001	-0.06	-0.20, 0.08	.401	-0.47	-0.62, -0.31	<.001	-0.13	-0.34, 0.08	.222	0.13	-0.02, 0.27	.085
Race/Ethnicity															
White	Ref	--	--	Ref	--	--	Ref	--	--	Ref	--	--	Ref	--	--
Black	-5.55	-8.19, -2.90	<.001	0.70	0.55, 0.86	<.001	-0.14	-0.32, 0.04	.118	-0.34	-0.59, -0.10	.005	0.31	0.15, 0.48	<.001
Hispanic	2.02	-4.36, 8.39	.534	-0.13	-0.51, 0.25	.515	-0.42	-0.84, 0.00	.052	0.69	0.10, 1.27	.021	-0.12	-0.52, 0.28	.556
Asian	0.06	-4.47, 4.58	.980	-0.14	-0.41, 0.13	.313	-0.41	-0.71, -0.11	.008	-0.36	-0.77, 0.06	.091	0.62	0.33, 0.90	<.001
Other	-2.52	-6.36, 1.33	.199	-0.01	-0.23, 0.23	.982	-0.12	-0.38, 0.13	.340	0.13	-0.22, 0.48	.460	0.13	-0.12, 0.37	.307
<i>Motives Subscales</i>															
Social	-0.31	-0.75, 0.13	.172	0.01	-0.01, 0.04	.319	-0.05	-0.07, -0.02	.003	-0.02	-0.07, 0.02	.234	0.04	0.02, 0.07	.002
Self-enhancement	-0.36	-0.93, 0.21	.218	-0.01	-0.04, 0.03	.703	0.05	0.01, 0.08	.017	0.04	-0.02, 0.09	.186	-0.05	-0.09, -0.02	.004
Boredom	0.82	0.10, 1.54	.025	-0.02	-0.07, 0.01	.263	0.07	0.02, 0.11	.007	-0.01	-0.10, 0.04	.356	0.05	0.01, 0.09	.033
Affect Regulation	0.91	0.63, 1.20	<.001	0.02	0.01, 0.04	.035	0.01	-0.01, 0.02	.651	0.01	-0.02, 0.03	.685	-0.03	-0.05, -0.01	.001
<i>Model Fit</i>															
Adjusted R ²	0.237			0.186			0.184			0.050			0.150		