

Preferred Electronic Nicotine Delivery Systems Flavors and Tobacco Use Patterns

BY

KRISTIN BRIKMANIS

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Defense Committee:

Dr. Robin Mermelstein, Chair and Advisor

Dr. Amanda Roy, Community and Prevention Research Psychology

Dr. Margaret Wardle, Clinical Psychology

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LIST OF ABBREVIATIONS

EMA	Ecological Momentary Assessment
ENDS	Electronic Nicotine Delivery Systems
FDA	U.S. Food and Drug Administration
NDSS	Nicotine Dependence Syndrome Scale
WISDM	Wisconsin Inventory Smoking Dependence Motives

Preferred ENDS Flavors and Tobacco Use Patterns

While combustible cigarette smoking has been declining in the United States, use of electronic nicotine delivery systems (ENDS) has been rising (Phillips, 2017). The class of ENDS includes e-cigarettes, vaporizers, and other products in which a solution, containing varied levels of nicotine and characterizing flavorings, is heated to create an inhalable aerosol. Given substantial evidence that ENDS are less harmful than combustible cigarettes (NASEM, 2018), there is potential for reducing combustibles-related harms if adult smokers are able to switch from cigarettes to ENDS. However, there is also concern that ENDS use may spread beyond adult smokers who have been unable to quit, ultimately serving as a catalyst to initiating combustible tobacco use among low risk youth (NASEM, 2018; Schneider & Diehl, 2016; Warner & Mendez, 2019).

Product characteristics, such as flavors, further complicate the debate as to whether the potential benefits of ENDS as a means of harm reduction outweigh the potential risks of tobacco use initiation at the population-level. One of the most commonly reported reasons for using ENDS is the availability of appealing flavors (Bonhomme et al., 2016; Coleman et al., 2017; Kong, Morean, Cavallo, Camenga, & Krishnan-Sarin, 2014; Patel et al., 2016). There are a multitude of unique ENDS flavor options (Zhu et al., 2014), and researchers have suggested classifying them into 13 main categories: tobacco, menthol/mint, fruit, dessert, candy, other sweets, nuts, spices, coffee/tea, alcohol, other beverages, other flavors, and unflavored e-liquids (Krüsemann, Boesveldt, Kees, & Talhout, 2018). Sweet flavors like fruit, candy, and dessert tend to be the most commonly used nontobacco and nonmenthol flavors (Berg, 2016; Harrell et al., 2017). While nontobacco flavors, including menthol and sweet flavors, may make ENDS more appealing to adult smokers as a substitute for combustible tobacco products, there is concern that

nontobacco flavors also make ENDS more attractive to adolescent and young adult nonsmokers (FDA, 2018).

Under the Family Smoking Prevention and Tobacco Act and the 2016 Deeming Rule, the U.S. Food and Drug Administration (FDA) has the power to regulate ENDS product standards, including characterizing flavors, with the goal of reducing the net risk of harm to public health (HHS, 2016). In 2009, the FDA banned all characterizing flavors in cigarettes other than menthol, but flavors of other tobacco products remain unregulated. Presently, the FDA is considering banning some or all ENDS flavors (FDA, 2018), yet little is known about who uses tobacco flavored vs menthol flavored vs sweet flavored ENDS. Understanding how user characteristics like age, gender, race, tobacco use history, dependence, motives, and expectancies for ENDS differ by flavor preference could help inform regulatory decisions regarding ENDS flavors.

Demographics

To date, the most extensively studied correlate of ENDS flavor preference is user age. Previous studies have found that younger ENDS users are more likely to prefer nontobacco flavors and less likely to prefer tobacco flavors compared to older users (Bonhomme et al., 2016; Harrell et al., 2017; Villanti et al., 2017). Data suggest older adults may be more likely to prefer menthol compared to younger adults (Bonhomme et al., 2016). Findings specific to fruit flavors are mixed, with one study reporting an inverse association and another reporting no association (Bonhomme et al., 2016; Harrell et al., 2017).

Few studies have examined how other user characteristics relate to ENDS flavor preference. Findings regarding differences in flavor preference by gender are mixed. Studies suggest women may be more likely than men to prefer nontobacco and nonmenthol flavors

(Chen et al., 2018; Dawkins, Turner, Roberts, & Soar, 2013; Odani, Armour, & Agaku, 2019; Piñeiro et al., 2016); however, other studies have not observed differences by gender (Bonhomme et al., 2016; Harrell et al., 2017; Kim et al., 2016). In terms of race/ethnicity, Black ENDS users may be more likely to use menthol flavored ENDS and less likely to use fruit flavored ENDS (Bonhomme et al., 2016; Bowler et al., 2017). ENDS users who have completed high school may be more likely to use nontobacco and nonmenthol flavors (Chen et al., 2018). It would be important to better understand how flavor preference is correlated with user characteristics.

Tobacco use

Little is known about how flavor relates to ENDS use and dependence. Initial evidence suggests longer-term ENDS users (Etter, 2016) and those who use ENDS more frequently (Coleman et al., 2017; Morean et al., 2018; Odani, Armour, & Agaku, 2019) may prefer nontobacco flavors. Rodent and human laboratory behavioral pharmacology experiments support that risk of dependence may differ by ENDS flavor used. Rodent models have indicated that nicotine enhances the reinforcing value of sweeteners found in ENDS flavors (Rupprecht, Smith, Schassburger, Donny, & Sved, 2016). Given these synergistic effects, use of sweet flavored ENDS could result in greater dependence risk relative to nonsweet flavored ENDS.

Reported subjective effects, behavioral choice task outcomes, and observed self-administration behaviors from human studies are consistent with this notion. Sweet ENDS flavors have been associated with greater satisfaction, liking, and tasting, relative to flavorless and tobacco, menthol, and mint flavors (Bono et al., 2019; Goldenson et al., 2016; Kim et al., 2016; McGovern, Strasser, & Wileyto, 2016). Menthol flavored ENDS also have been associated with greater liking, wanting, and positive physical sensations, relative to unflavored ENDS (Krishnan-Sarin et al., 2017; Rosbrook & Green, 2016). In two choice tasks, young adults

perceived sweet flavored ENDS as worth more money and worked harder for them (Audrain-McGovern, Strasser, & Wileyto, 2016; Goldenson et al., 2016). During an ad-libitum session, young adults took more puffs of sweet flavored ENDS than unflavored ENDS.

Despite concerns that users of nontobacco flavored ENDS may be particularly susceptible to nicotine dependence and increased use of ENDS and combustible tobacco products like cigarettes, little is known about how tobacco use trajectories may differ by use of ENDS flavor preference. Associations have also been found between ENDS flavor preference and cigarette smoking status, such that nonsmokers tend to prefer nontobacco flavored ENDS (Berg, 2016; Harrell et al., 2017; Krishnan-Sarin et al., 2014). To our knowledge, naturalistic studies have not observed how ENDS flavor preferences relate to ENDS and cigarette use over time, and only one experimental study has addressed this question. Adult cigarette smokers, who had no intention to quit cigarettes, agreed to try to substitute e-cigarettes for cigarettes for six weeks (Litt, Duffy, & Oncken, 2016). Those who were assigned chocolate flavored e-cigarettes used e-cigarettes the least intensely and reduced their cigarette use the least, compared to those assigned to cherry, tobacco, and menthol (Litt, Duffy, & Oncken, 2016). Those who used menthol flavored e-cigarettes, showed the largest decrease in cigarettes per day, and e-cigarettes per day was highest among those who used tobacco flavored e-cigarettes (Litt, Duffy, & Oncken, 2016).

Current study

The present study focused on adult dual users—individuals who use both combustible cigarettes and ENDS— and their use of tobacco, menthol, sweet, or other flavored ENDS. We examined how users' characteristics (demographics, tobacco use, dependence, motives, and expectancies for ENDS use) differed by their preferred ENDS flavor. We also observed how

ENDS flavor preference related to use of cigarettes and ENDS over 6 months. We hypothesized younger users, women, lighter cigarette smokers, and heavier ENDS users would be more likely to prefer sweet flavored ENDS than tobacco and menthol. We expected Black users and those whose regular brand of cigarettes was menthol flavored to prefer menthol flavored ENDS. We also hypothesized those who preferred nontobacco flavors would more strongly endorse motives related to taste and sensory experience. Finally, we expected ENDS use would escalate more quickly over time among those who preferred nontobacco flavored ENDS.

Methods

Participants

Participants ($N = 406$; 40% female) were adult ($M = 34.6$, $SD = 12.6$) dual cigarette and ENDS users who were recruited as part of a longitudinal study of cigarette and ENDS use trajectories. Approximately 12% identified their ethnicity as Hispanic or Latino. Approximately 48% identified as White, 34% as Black or African American, 12% as Asian, and 12% as either American Indian or Alaskan Native, Native Hawaiian or other Pacific Islander, or from multiple racial backgrounds. Eligibility criteria included being a Chicago area resident aged 18 or older, having smoked combustible cigarettes at least weekly in the past 30 days, having used ENDS at least once in the past 14 days, and indicating susceptibility to using ENDS in the near future. A response of moderately likely or very likely to the questions, “how likely are you to use an e-cigarette/nicotine vaporizer in the next 2 weeks?” and “how likely are you to purchase an e-cigarette/nicotine vaporizer in the next 2 weeks?” indicated susceptibility. Those who were unable to speak and read English and those who were not willing or able to complete the baseline questionnaire and to carry an ecological momentary assessment (EMA) device for 7 days were excluded.

Procedures

Participants were recruited using print advertisements, online media (e.g., Craigslist), and targeted venue and snowball recruitment as part of a large ongoing longitudinal study of the context and subjective experience of dual cigarette and ENDS use. Those who were interested first completed an online eligibility screening survey, and then the research study staff contacted eligible individuals to complete a second screening over the phone. Those who were deemed eligible after the second screener and were interested in participating, completed a baseline visit at the research office. Participants provided informed consent, completed baseline questionnaires using Qualtrics, and completed seven days of EMA assessment of all tobacco use following the baseline and again approximately four to eight months later. Participants received bi-weekly emails asking them to complete a brief tobacco use survey, beginning two weeks post baseline. Participants received \$25 for completing the baseline visit, up to \$100 for completing each EMA week, and \$5 for each bi-weekly survey completed. To help improve compliance, participants who completed at least 3 of the last 4 emailed surveys were entered in a bi-monthly drawing for the possibility to win an additional \$100. All procedures were approved by the University of Illinois at Chicago Institutional Review Board. Data were collected October 2016–June 2019.

Measures

Demographics. Demographic variables assessed at baseline included age, gender, highest level of education attained, race, and Hispanic origin.

Tobacco use. Participants reported the frequency (number of days) they used cigarettes and ENDS in the past 7 and 30 days at baseline and in the past 14 days at each bi-weekly survey. Past 30-day frequency of cigarette and ENDS use at 6-months was approximated by combining

the frequency of days reported at the 12th and 13th bi-weekly surveys and transforming the result to reflect 30 days rather than 28 days.

Preferred product flavors. At baseline, participants reported whether their regular brand of cigarettes was menthol flavored. At baseline, participants indicated from a list of flavors typically found in ENDS products what their preferred e-liquid was flavored to taste like. At each bi-weekly survey, participants chose what e-liquid flavor they typically used. Participants were also given the option to choose ‘other’ and manually enter their preferred flavor; these responses were reviewed by study staff and recategorized when applicable. For ease of analysis, this item was collapsed into a variable reflecting tobacco (12%), menthol/mint (34%), sweet flavors (45%), and other flavors (9%). Sweet flavors included dessert, fruit, and candy, and other flavors included spice/clove, alcohol, and coffee/tea.

ENDS device type. At baseline, participants reported whether the ENDS device they usually used was disposable, rechargeable with a pre-filled cartridge (e.g. cigalike or personal vaporizer), or rechargeable with a refillable cartridge (e.g. personal vaporizer or tank system).

ENDS motives. At baseline, participants reported if they had ever used e-cigarettes/nicotine vaporizers to help quit cigarettes.

Dependence. The Nicotine Dependence Syndrome Scale Adult Version (NDSS; Shiffman, Waters, & Hickcox, 2004) and a modified 14-item version of the Wisconsin Inventory Smoking Dependence Motives (WISDM; Piper et al., 2004) were used to assess cigarette dependence. These two scales were modified by changing wording about cigarettes to wording about e-cigarettes/ nicotine vaporizers in order to assess ENDS dependence. Scales modified by similar methods have shown good reliability and validity for assessing e-cigarette dependence

(Piper et al., 2019). Internal consistency was good for the ENDS ($\alpha = 0.93$) and cigarette ($\alpha = 0.91$) WISDM scales, as well as the ENDS ($\alpha = 0.91$) and cigarette ($\alpha = 0.89$) NDSS scales.

ENDS expectancies. A 10-item scale, developed for the larger longitudinal study, was used to assess expectancies for smoking cigarettes. This scale was modified, by substituting cigarette for e-cigarette/nicotine vaporizer, to assess expectancies for using ENDS. Items were rated on a scale from 1 (disagree) to 4 (agree), with higher scores indicating more positive expectancies. Internal consistency was good for both the ENDS ($\alpha = 0.89$) and cigarette ($\alpha = 0.81$) scales.

Proposed analytic approach

Two-way between-subject ANOVAs and chi-squared tests were used to examine whether user's characteristics (demographics, tobacco use, dependence, motives, and expectancies) differed by e-cigarette flavor preference (tobacco, menthol, sweet, and other). Repeated measures (RM) ANOVAs were used to examine whether e-cigarette flavor preference is associated with differences in cigarette and ENDS use frequency at baseline and 6 months. Hypothesis tests were performed by fitting separate models of preferred ENDS flavor and each time-varying outcome (frequency cigarette and ENDS use). To account for multiple comparisons, a Bonferroni correction was used for all post hoc pairwise comparisons.

Results

User characteristics by ENDS flavors

Descriptive statistics for demographics, tobacco use, dependence, motives, and expectancies at baseline are shown for the full sample and by ENDS flavor preference in Table 1. Overall, sweet flavors were most frequently preferred by participants (44.6%), followed by menthol/mint (34%), tobacco flavor (12.1%), and other (9.4%). However, ENDS flavor

preference differed by participant age, $F(3, 402) = 23.56, p < .001$, and race, $\chi^2(9) = 54.42, p < .001$. Those who reported preferences for sweet and other flavored ENDS were more likely to be younger than those who reported preferences for tobacco and menthol flavored ENDS. Black dual users were more likely to prefer menthol flavored ENDS and less likely to prefer sweet flavored ENDS. No other significant differences in demographics by ENDS flavor preference were observed.

Tobacco use and dependence also varied by flavor preference at baseline. Dual users who preferred sweet flavored ENDS smoked conventional cigarettes fewer days during the past month, $F(3, 402) = 4.62, p < .001$ and week, $F(3, 402) = 4.62, p < .001$ than those who preferred menthol flavored ENDS. Frequency of ENDS use during the past month, $F(3, 402) = 2.46, p = .07$, and week, $F(3, 402) = 1.46, p = .22$, did not vary by ENDS flavor preference. Dual users who preferred sweet flavored ENDS were significantly less cigarette dependent than users who preferred non-sweet flavored ENDS, $F(3, 402) = 5.26, p = .001$. ENDS dependence did not differ by ENDS flavor preference, $F(3, 400) = 0.06, p = .98$.

Participants' usual cigarette brand flavor, $\chi^2(3) = 82.91, p < .001$, and ENDS device, $\chi^2(6) = 77.78, p < .001$, were also related to ENDS flavor preference. Those whose regular brand of cigarette was menthol were more likely to prefer menthol flavored ENDS than sweet and other flavored ENDS, which were preferred relative to tobacco flavored ENDS. Those who typically used rechargeable ENDS devices with pre-filled e-liquid cartridges were more likely to use menthol flavors, and those who typically used rechargeable ENDS devices with refillable e-liquid cartridges were more likely to use sweet and other flavors.

Dual users who preferred sweet flavored ENDS also differed significantly from those who preferred menthol flavors in their motives and expectancies for use. Those who preferred

sweet flavored ENDS more strongly endorsed boredom reduction expectancies, $F(3, 401) = 6.90$, $p < .001$, and dependence motives related to taste and sensory experience, $F(3, 398) = 8.74$, $p < .001$. Ever use of ENDS to help try to quit cigarettes was unrelated to ENDS flavor preference, $\chi^2(3) = 3.31$, $p = .346$. No other significant differences in ENDS dependence motives and expectancies by ENDS flavor preference were observed.

Missing data

Of the 406 participants who completed baseline measures, 88 participants did not complete the 12th bi-weekly survey, and 93 participants did not complete the 13th bi-weekly survey. The 280 participants who completed both the 12th and 13th bi-weekly surveys were included in the subsequent analyses. Those who were not included in subsequent analyses did not differ significantly at baseline with regard to age, race, gender, cigarette frequency, ENDS frequency, cigarette dependence, nor ENDS dependence.

Cigarette use frequency at 6 months

Descriptive statistics for past 30-day cigarette frequency at baseline and 6-months are shown for the full sample and by ENDS flavor preference in Table 2. A RM ANOVA examining past 30-day cigarette frequency at baseline and 6-month follow-up by ENDS flavor preference was conducted. There was a main effect of ENDS flavor preference, $F(3, 1) = 4.43$, $p = .004$, such that those who reported a preference for menthol flavored ENDS smoked cigarettes more days on average ($M = 26.0$, $SD = 11.3$) than those with a preference for sweet flavored ENDS ($M = 20.0$, $SD = 11.3$). Frequency of cigarette use days among those who preferred tobacco ($M = 25.4$, $SD = 8.3$) and other flavors ($M = 23.4$, $SD = 9.5$) did not differ from those who preferred sweet and menthol flavors. There was no significant main effect of time on the frequency of

cigarette use, $F(1, 1) = 1.96, p = .162$. There was no significant time x ENDS flavor preference interaction, $F(3, 1) = 0.40, p = .755$, on frequency of cigarette use.

ENDS use frequency at 6 months

Descriptive statistics for past 30-day ENDS frequency at baseline and 6-months are shown for the full sample and by ENDS flavor preference in Table 2. A RM ANOVA examining past 30-day ENDS frequency at baseline and 6-month follow-up by ENDS flavor preference was conducted. Frequency of ENDS did not significantly differ by ENDS flavor preference, $F(3, 1) = 0.257, p = .856$, or time, $F(1, 1) = 0.001, p = .971$. There was no significant time x ENDS flavor preference interaction, $F(3, 1) = 0.29, p = .837$, on frequency of ENDS use.

Discussion

The present study examined how characteristics of adult dual users differed by their preferred ENDS flavor and the extent to which ENDS flavor preference prospectively related to cigarette and ENDS use at 6 months. Preference for ENDS flavors differed in all domains: demographics, tobacco history, motives, and expectancies. Cigarette and ENDS use was relatively stable over 6 months, thus it was not surprising that product use between baseline and follow-up did not differ by ENDS flavor preference. These findings add to the few previous studies that have begun to address important questions for the FDA to answer when considering whether to restrict the sale of flavored ENDS: who uses which ENDS flavors and how those preferences relate to trajectories of tobacco use.

Consistent with previous literature, (Bonhomme et al., 2016; Harrell et al., 2017; Villanti et al., 2017), younger age was associated with a higher likelihood of reporting a preference for sweet flavored ENDS relative to tobacco flavored ENDS but also menthol flavored ENDS. While this finding is consistent with concerns that nontobacco flavored ENDS may be

particularly attractive to younger ENDS users (FDA, 2018), it is notable that sweet flavors were the most preferred, regardless of age. This suggests that the impact of limiting ENDS flavor options would not be specific to youth and young adult users.

Black dual users were more likely to report a preference for menthol flavored ENDS and less likely to report a preference for sweet flavored ENDS, which is supported by previous work (Bonhomme et al., 2016; Bowler et al., 2017). There are parallels with the cigarette literature, such that Black smokers tend to use menthol flavored cigarettes (Gardiner, 2004). It may be that the tobacco industry continues to market menthol tobacco products in Black communities (Lee et al., 2015) or that cigarette smokers are more likely to use ENDS products with flavors they are familiar using. Indeed, individuals whose regular cigarette brand was flavored to be menthol were more likely to report a preference for menthol flavored ENDS and less likely to report a preference for sweet flavored ENDS.

In terms of tobacco use history, individuals who endorsed less frequent cigarette use and weaker cigarette dependence were more likely to report preferences for sweet flavored ENDS, which may also be a function of younger age and shorter history of tobacco use. ENDS use and dependence did not differ by ENDS flavor preference. Those who typically used rechargeable ENDS devices with pre-filled e-liquid cartridges were more likely to use menthol flavors, and those who typically used rechargeable ENDS devices with refillable e-liquid cartridges were more likely to use sweet and other flavors.

Motives and expectancies for ENDS use also differed by flavor. Unsurprisingly, preference for sweet flavored ENDS was associated more strongly endorsing taste and sensory experience as motives for using ENDS. Preferring sweet flavored ENDS was also associated with more strongly endorsing expectancies that ENDS use reduces boredom. It may be that

sweet flavored ENDS users are more likely to expect ENDS to increase positive affect or it may be that younger ENDS users, who represent the largest group of sweet flavored ENDS users, may be more likely to expect ENDS will reduce their boredom. Endorsement of ever use of ENDS to try to quit cigarettes did not differ by ENDS flavor preference.

Strengths of the present study include the focus on adult dual cigarette and ENDS users, the size and racial diversity of the sample, and the study design, which provides a variety of important measures of tobacco use, dependence, and related factors over time. The present study also has limitations. Preferred ENDS flavors may not be representative of the individuals' actual use of ENDS flavors. The 6-month period of ENDS and cigarette use captured by this study does not reflect initiation and may reflect a relatively period of tobacco use. User characteristics and ENDS flavor preference were assessed cross-sectionally and may have changed over time, precluding examination of any temporal relationship between ENDS flavor preference and user characteristics, such as ENDS use expectancies.

Findings from the present study suggest that dual users who prefer sweet flavored ENDS may be a distinct subset of ENDS users who differ in all of the examined domains: demographics, tobacco use history, motives, and expectancies. These data suggest that trajectories of ENDS and cigarette use may not be impacted by preferred ENDS flavor. Additional research is needed to better understand the role of ENDS flavors in determining tobacco use and dependence as well as their impact on tobacco-related risks.

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Table 1. Descriptive statistics for baseline user characteristics by ENDS flavor preference

Variables	Total Sample (N = 406)	Tobacco (N = 49)	Menthol/Mint (N = 138)	Sweet (N = 181)	Other (N = 38)
Age, M (SD) **	34.6 (12.6)	39.1 (12.1) ^a	40.2 (13.2) ^a	29.9 (10.6) ^b	31.3 (10.2) ^b
Gender (%)					
Female	40.2%	36.7%	44.9%	35.9%	47.4%
Male	58.6%	59.2%	54.4%	63.0%	52.6%
Nonbinary	1.2%	4.1%	0.7%	1.1%	0%
Hispanic or Latino (%)	12.3%	10.2%	12.9%	13.3%	8.3%
Race (%)**					
White	48.3%	61.2%	29.7%	60.8%	39.5%
Black	33.7%	24.5%	55.8%	19.3%	34.2%
Asian	11.6%	10.2%	9.4%	12.7%	15.8%
Other	6.4%	4.1%	5.1%	7.2%	15.4%
Education (%)					
Some high school	6.4%	4.1%	10.1%	3.3%	10.5%
High school graduate	19.2%	10.2%	23.9%	18.8%	15.8%
Some college	50.2%	51.0%	46.4%	53.6%	47.4%
4-year college graduate	24.1%	34.7%	19.6%	24.3%	26.3%
Prefer menthol flavored cigarettes (%)**	60.2%	24.5% ^a	89.1% ^b	49.7% ^c	52.6% ^c
ENDS typical device type (%)**					
Disposable	18.5%	34.7%	23.9%	8.8%	23.7%
Rechargeable with a pre-filled cartridge	29.6%	23.9%	46.4%	17.7%	18.4%
Rechargeable with a refillable cartridge	51.9%	28.6%	29.7%	73.5%	57.9%
ENDS use days, M (SD)					
Past 30-day	14.9 (11.0)	14.1 (10.0)	13.3 (10.8)	16.5 (11.2)	14.0 (11.3)
Past 7-day	3.5 (2.8)	3.0 (2.5)	3.3 (2.7)	3.8 (2.9)	3.3 (2.9)
Cigarette use days, M (SD)					

Past 30-day**	25.2 (7.9)	26.8 (6.1) ^{ab}	26.5 (7.2) ^a	23.6 (8.6) ^b	25.8 (8.0) ^{ab}
Past 7-day**	5.8 (2.1)	6.2 (1.8) ^{ab}	6.2 (1.7) ^a	5.4 (2.2) ^b	5.9 (2.3) ^{ab}
ENDS NDSS, M (SD)	2.1 (1.0)	2.1 (1.1)	2.1 (1.0)	2.0 (0.9)	2.1 (1.1)
Cigarette NDSS, M (SD)**	2.9 (1.0)	3.0 (0.8) ^{ab}	3.0 (1.0) ^a	2.7 (1.0) ^b	3.2 (1.1) ^a
ENDS WISDM, M (SD)					
Affective enhancement	3.4 (1.9)	3.8 (1.8)	3.3 (1.9)	3.4 (1.9)	3.4 (2.0)
Automaticity	3.6 (2.2)	3.0 (2.1)	3.4 (2.2)	3.8 (2.2)	3.9 (2.4)
Cognitive enhancement	2.9 (1.8)	3.6 (2.1)	2.8 (1.9)	3.1 (1.9)	3.0 (2.1)
Craving	2.9 (1.8)	2.9 (1.7)	3.1 (1.9)	2.9 (2.9)	2.9 (2.0)
Loss of control	1.9 (1.4)	1.8 (1.3)	1.9 (1.4)	1.9 (1.3)	2.1 (1.7)
Taste/sensory experience**	5.2 (1.8)	4.6 (1.7) ^a	4.7 (1.9) ^a	5.6 (1.6) ^b	5.1 (1.9) ^{ab}
Tolerance	2.9 (2.0)	2.6 (1.9)	2.8 (1.9)	3.0 (2.0)	2.8 (2.0)
Ever used ENDS to try to quit cigarettes (%)	78.6%	81.7%	81.3%	74.6%	84.2%
ENDS expectancies					
Boredom reduction**	2.7 (1.0)	2.6 (1.0) ^{ab}	2.4 (1.0) ^a	3.0 (1.0) ^b	2.6 (1.0) ^{ab}
Negative reinforcement	2.4 (1.0)	2.6 (1.0)	2.4 (1.0)	2.3 (0.9)	2.2 (1.0)
Weight control	1.6 (0.8)	1.8 (0.8)	1.6 (0.8)	1.6 (0.8)	1.7 (1.0)

Note: Items within a row that share the same superscript letter do not significantly differ from each other. ENDS = electronic nicotine delivery systems. NDSS = Nicotine Dependence Syndrome Scale. 'Other' race includes 'American Indian/Alaskan Native,' 'Native Hawaiian/Pacific Islander,' and those who selected more than one race.

* = $p < .05$; ** = $p < .01$.

Table 2. Descriptive statistics for cigarette and ENDS use over time by ENDS flavor preference

Variables	Total Sample (N = 406)	Tobacco (N = 49)	Menthol/Mint (N = 138)	Sweet (N = 181)	Other (N = 38)
ENDS use days, M (SD)					
Baseline	15.0 (11.1)	14.6 (10.7)	13.3 (10.9)	16.4 (11.1)	14.8 (11.8)
6-months	12.9 (12.2)	12.7 (12.1)	11.2 (11.0)	14.5 (13.2)	12.2 (11.3)
Cigarette use days, M (SD)					
Baseline	25.3 (7.9)	26.7 (6.8)	27.0 (6.8)	23.7 (8.5)	24.7 (8.8)
6-months	21.0 (11.6)	24.0 (9.4)	25.7 (9.1)	16.2 (12.6)	22.1 (10.0)

VITA

NAME : Kristin Brikmanis

EDUCATION: B.A., Psychology, Pomona College, Claremont, California, 2014

PUBLICATIONS:

Doran, N. & **Brikmanis, K.** (2016). Expectancies for and use of e-cigarettes and hookah among young adult non-daily smokers. *Addictive Behaviors*, 60, 154-159.

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Mermelstein, R., & **Brikmanis, K.** (2019). Nicotine and tobacco use. In T. A. Revenson & R. A. R. Gurung (Eds.), *Handbook of Health Psychology*. London, UK: Informa UK Limited

CONFERENCE POSTERS:

Hong, K., Park, J., Garzon, C., DeMeules, M., **Brikmanis, K.**, & Pearson, A. (2014, April). *Does "Green" = White?: Race, identity, and environmental engagement*. Poster presented at the Western Psychological Association Annual Convention, Portland, OR.

Marshall, E., **Brikmanis, K.**, Lawson, K., & Groscup, J. (2015, March). *Call me maybe, but not on my smartphone: Privacy expectations for cell phones*. Poster presented at the American Psychology Law Society Annual Conference, San Diego, CA.

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Somers, J., **Brikmanis, K.**, Hilt, L., & Borelli, J. (2016, April). *Rumination and physiological emotion reactivity: Moderation by attachment and gender*. Poster presented at the Society for Research on Adolescence Biennial Meeting, Baltimore, MD.

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