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The impact of flavors, health risks, secondhand smoke and prices on young adults' cigarette and e-cigarette choices: a discrete choice experiment

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Abstract

Aims—To estimate young adults' preferences for cigarettes and e-cigarettes, and how preferences vary by policy-relevant factors. A related aim was to provide information on potential substitution/complementarity across cigarettes and e-cigarettes ahead of policy selection.

Design—An online discrete choice experiment (DCE) in which respondents chose their preferred option among cigarettes, two types of e-cigarettes (disposable/reusable) and 'none'. Each cigarette-type was characterized by policy-relevant attributes: flavors, short-term health risks to self, secondhand smoke risks and price. A latent class model identified smoking types that respond differently to these.

Setting—US tobacco market.

Participants—A total of 2003 young adults (aged 18–22 years) who ever tried either cigarettes or e-cigarettes, recruited via the survey platform Qualtrics, matched to the 2015 National Health Interview Survey by age, gender, education and census region.

Measurements—Respondents' DCE choices.

Findings—Young adults fell into two broad categories. One latent group, termed 'prefer smoking group', preferred cigarettes and another, 'prefer vaping group', preferred e-cigarettes. The 'prefer smoking group' preferred lower prices and lower health harms more than other attributes. The 'prefer vaping group' valued these, although price less intensely, and valued health and fruit/candy flavors more.

Conclusion—Banning all flavors in cigarettes and e-cigarettes might improve the health of young adults who ever tried either cigarettes or e-cigarettes. Young adult ever-tryers might be deterred from smoking by increasing cigarette prices and encouraged to switch to e-cigarettes by reducing the health harms of e-cigarettes. Reducing health harms of e-cigarettes could also make the 'prefer vaping group' less likely to quit, resulting in increased health harm.

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Declaration of interests
None.

Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Keywords

Cigarettes; discrete choice experiment; e-cigarettes; latent class analysis; tobacco regulation; young adults

INTRODUCTION

The market for tobacco products has changed markedly over the past decade, and a noteworthy change has been the emergence of e-cigarettes [1,2]. The rapid growth in electronic cigarette (e-cigarette) use presents governments world-wide with new challenges and opportunities in protecting the health of the public. This is because e-cigarettes are generally believed to be less harmful than cigarettes, but not necessarily harmless [3]. Tobacco regulations are responding to the changing markets [4–7]. A notable change is that in 2009, the Food and Drug Administration (FDA) gained the authority to regulate tobacco products. Thus, the FDA can now regulate the manufacturing, distribution and marketing of tobacco products and as of 2016 can regulate e-cigarettes. Specifically, the FDA can regulate cigarettes and e-cigarettes and their attributes, including ‘characterizing’ flavors and factors that affect cigarettes’ health impacts with the goal of improving the health of the public [8].

The overall aim of this study was to assess young adults’ preferences for cigarettes and e-cigarettes, and how preferences vary by key policy-relevant factors. The ultimate aim was to provide results useful for regulation and taxation decisions. This study used an online discrete choice experiment (DCE) to examine trade-offs of young adults across cigarettes and e-cigarettes and key policy-relevant attributes. The DCE approach enabled gathering of preference data in advance of a regulatory decision, which is useful for informing policy prior to implementation [9–16]. Other approaches used experimental markets [17–20].

We considered four key, policy-relevant attributes of tobacco products: flavor availability, health effects on self and others, and prices. These were selected as evidence indicates that flavors and perceived lower harm were among the most common reasons for young adults using e-cigarettes [21]. Also, substantial evidence suggested that prices affect the demand for both cigarettes [22–24] and e-cigarettes [9,25–29] and price differentials affected the substitutability or complementarity across cigarette types [10,27,30].

In the United States the FDA, along with states and municipalities, can ban flavors in tobacco products. The FDA can improve tobacco-related health impacts by prohibiting harmful ingredients and false or misleading health claims. For e-cigarettes, the FDA can also regulate the voltage of e-cigarette batteries so that they do not exceed dangerous thresholds [31]. Prices can be increased by higher taxes imposed by multiple levels of the government including the federal government. The FDA does not have the authority to tax but can indirectly affect prices by imposing product standards and marketing regulations that increase firms’ production costs.

Young adults are important for tobacco regulators because they have the highest general tobacco use across age categories, with 38% using various kinds of tobacco products and approximately 18% using a tobacco product daily [24,32]. Also, cigarettes and e-cigarettes

are popular in this age group [32]. Importantly, many are consolidating their tobacco habits, and others are switching, expanding the products they use or quitting [24,33,34].

The two specific research questions were: (i) how do flavors, health effects and prices of cigarettes and e-cigarettes shape young adults' preferences for cigarettes and e-cigarettes; and (ii) how do these preferences vary over subpopulations?

METHODS

Sample

The sample consisted of 2003 individuals, aged 18–22 years, in the United States who reported ever trying either cigarettes or e-cigarettes. We focused on these 'ever-tryers' as they are likely to be making decisions about smoking [33,34]. Those who have never tried prior to age 18 would probably be unresponsive to products and attributes and thus would not provide informative data. The sample was matched to quotas derived from the 2015 National Health Interview Survey by: reported ever use of cigarettes/e-cigarettes, age (each year, 18–22), gender, education (any college versus no college) and census region (Northeast, North Central/Midwest, West, South). Our sample size exceeds minimum calculations necessary and is larger than most other health-based DCEs [35]. Data were collected by the firm Qualtrics (Provo, UT, USA) between November 2016 and May 2017. This survey platform is commonly used to study tobacco use [5,36]. Qualtrics provided 2710 US responses; the 707-person over-sample was available to use to fill in quotas. Seventy-nine were dropped for data quality failures (see later section). Using the 2631 observations that passed these checks, the sample of 2003 was populated with the latest survey-date responses until each quota was filled.

Survey

Socio-demographic and smoking status data were collected alongside the experiment. Survey variables that were used in regressions, their definition and descriptive statistics are provided in Table 1.

Discrete choice experiment

The DCE is a method used to elicit causal effects of attributes on product choices [37]. DCEs are used in tobacco research [9], including e-cigarettes [10–15]. In this paper, the DCE was used to elicit preferences for tobacco products which were described by their attributes. Respondents chose their preferred option from a set of cigarette/attribute combinations across choice scenarios. In each scenario, the levels of the attributes were experimentally varied; respondents' choices implicitly traded-off across products and attributes, thus providing data to estimate preferences in the econometric choice model.

Cigarette types and their attributes and levels

In each choice scenario, respondents chose among product types as a function of product attributes. The products, attributes and experimental levels are presented in Table 2 and an example choice scenario is given in the Supporting information, Fig. S1. Products were: disposable e-cigarette, reusable e-cigarette, cigarette; and opt-out option, 'none of these'.

The cigarette types were described by four attributes: flavor, health effects on self, health effects on others and price. The four flavor categories were ‘tobacco’, ‘menthol’, ‘fruit’ and ‘candy’. They account for the overwhelming majority of e-cigarette flavors used in the United States [38–40]. We constrained flavor availability differentially across cigarette types because, due to regulations, only tobacco and menthol flavors are allowed on the market for cigarettes. In contrast, tobacco, menthol, fruit and candy flavors are allowed in e-cigarettes.

Own-health effects were characterized based on whether the product ‘causes trouble breathing’. We focused on this salient, short-term indicator (e.g. airways can be impaired by e-cigarette and cigarette use [41–43]) because short-term effects are most pertinent to young adults [44]. Due to their high discount rates and the long time until they are likely to suffer from severe tobacco-related problems, they might not be responsive to long-term risks such as cancer. Also, they might be optimistic about their ability to quit smoking and thus be relatively unresponsive to long-term risks [45,46]. For e-cigarettes, four levels were used: ‘never’, ‘sometimes’, ‘often’ and ‘unknown’; the latter reflects uncertainty around the health harms of e-cigarettes. Only ‘often’ was used for cigarettes for realism. Harms from secondhand smoke reflect health effects on others. For e-cigarettes, four levels were used: ‘not harmful’, ‘mildly harmful’, ‘very harmful’ and ‘unknown’. For cigarettes, ‘very harmful’ was used in all cases for realism.

Price was defined to be the price paid for 20 cigarettes or the equivalent volume for e-cigarettes. Price options were \$5, \$8, \$11 and \$14, based on a survey of market prices and on retail data [10,47].

Generating experimental scenarios

The principle of Bayesian D-optimality was used to generate the experimental scenarios using the software Ngene (www.choice-metrics.com) [48]. Priors used in the process were generated from analysis of pilot data on 100 respondents. In this DCE there were 24 choice sets, which were ‘blocked’ into three groups to allow greater design efficiency. Individuals were randomly assigned to each of the blocks of eight choice sets, which balances the concern of learning versus respondent fatigue [49]. Kruskal-Wallis tests indicated no group-wise differences across variables (results available on request).

Statistical approach

Based on utility theory, we built an econometric choice model. We used multinomial logit (MNL) models and a latent class MNL model (see Supporting information, Appendix S2 for details); and the choice data to estimate the magnitude of preferences for cigarette types and attributes [50]. An individual’s choice depends on an observed (V_{ijc}) and unobserved (e_{ijc}) component of utility. We defined the observed component in terms of attributes and product types,

$$\begin{aligned}
 \text{Choice}_{ijc} &= V_{ijc} + \varepsilon_{ijc} \\
 &= \beta_p \cdot \text{Price}_{ijc} + \beta_f \cdot \text{Flavor}_{ijc} + \beta_o \cdot \text{Out of breath}_{ijc} \\
 &\quad + \beta_s \cdot \text{Secondhand smoke}_{ijc} + \text{ECIG}_{\text{disposable}} \\
 &\quad + \text{ECIG}_{\text{reusable}} + \text{None - of - these} + \varepsilon_{ijc},
 \end{aligned}$$

where V_{ijc} is the observed utility that respondent i derives from option j in choice scenario c . Observed utility comprises the product attributes of flavor, out of breath, second-hand smoke and price. The β s are the preferences for the attributes to be estimated. Observed utility also comprises individuals' preferences for disposable e-cigarettes, reusable e-cigarettes and the 'none-of-these' option, which are, respectively, $\text{ECIG}_{\text{disposable}}$, $\text{ECIG}_{\text{reusable}}$ and none of these. These alternative-specific constants (ASCs) capture underlying product-specific preferences for each product (e.g. a reusable e-cigarette) relative to the omitted category (cigarette). ε_{ijc} is a type-I extreme value error distribution. See Supporting information, Appendix S2.

Dependent variables

The dependent variable was the choice of each respondent in each of the eight choice scenarios, yielding eight observations for each individual.

Independent variables and constant terms

The independent variables were attributes and ASCs as well as socio-demographic and smoking behavior variables; see Table 1.

Promoting data quality

We used several techniques to promote data quality. The experiment is 'labeled', which is beneficial for survey realism and data quality [51,52]. Before the experiment, respondents were given detailed narrative and visual information describing the products, attributes and levels, and an example choice task was provided Table 2. The survey was piloted on 100 respondents and feedback was used to improve the survey. 'Forced responses' prevented respondents from skipping through the survey. Attention filters were embedded in the survey (e.g. 'select option 2 to show that you are paying attention'; four responses dropped). Finally, respondents were prompted to provide honest answers [53–55]. A minimum time threshold was used to remove respondents who rushed through (one response was dropped). Also, respondents were removed if they provided inconsistent responses (47 responses dropped) or appeared to be duplicates (27 responses dropped).

Validity checks

We checked whether estimated coefficients were in line with prior expectations, e.g. lower utility for increased health risk. We found that about 5% of respondents selected the opt-out for all choices. However, these individuals had previously tried one or both cigarettes types yet reported little or no intention to use, suggesting that opt-outs were reflective of their preferences.

RESULTS

Cigarette type preferences

The results from the models are shown in Table 3. Model A is the basic MNL model; model B extends this model to the latent class. In the basic MNL, the underlying preferences for e-cigarettes and ‘none of these’, relative to a cigarette (omitted category), are shown by the ASCs. From Table 3, on average, young adult ever-triers preferred cigarettes to all other options, i.e. all ASCs are negative and significant. A Wald test on the ASCs for ‘reusable e-cigarettes’ and ‘disposable e-cigarettes’ indicates that young adults preferred the reusable e-cigarette ($P < 0.01$). Pairwise Wald tests indicate that all options, including ‘none of these’, were preferred to disposable e-cigarettes ($P < 0.01$ for all tests), which is reflected in the large, negative ASC on disposables. These young adult ever-triers appeared to be indifferent between reusable e-cigarettes and opting-out; Wald test ($P = 0.58$).

A latent class model, used to uncover group-wise behavior, revealed two classes of individuals; see model B in Table 3. Table 3 also provided class sizes and class membership regression results. We termed one class as ‘prefer smoking group’ as they had strong preferences for cigarettes, as seen by the negative, large and statistically significant ASCs for the other options. Despite using a single term to label the groups, the probability of membership is explained by multiple variables. The order of preferences by the ‘prefer smoking group’ for products was: cigarette > reusable e-cigarettes > disposable e-cigarette; Wald tests ($P < 0.01$ for all). That is, if ‘prefer smoking group’ switched from cigarettes, they would most probably have chosen reusable e-cigarettes. The ‘prefer smoking group’ accounted for 37% of the sample.

The second class, ‘prefer vaping group’, had strongest preferences for reusable e-cigarettes. Their order of preferences for products was: reusable e-cigarettes > disposable e-cigarette > cigarette; Wald tests ($P < 0.01$ for all). They also had a strong preference for ‘none’; thus, because ‘prefer vaping group’ preferred ‘none’ to cigarettes, if they switch from e-cigarettes, they will most probably abstain from all products. The ‘prefer vaping group’ accounted for 63% of the sample.

Attribute preferences

Results from model A suggested that, overall, young adults preferred healthier products and preferred fruit and candy flavors to tobacco. However, the latent class model, model B, revealed important differences in these preferences by groups. Results indicated that the ‘prefer smoking group’ preferred tobacco to all other flavors, but the negative coefficients were significant only for menthol and fruit. In contrast, results indicated that the ‘prefer vaping group’ preferred all flavors to tobacco, but this was significant for only fruit and candy flavors. The omitted levels for both health harm attributes were the highest levels of health harm (‘always’ for ‘out of breath’ and ‘very harmful’ for ‘secondhand smoke’). The ‘prefer smoking group’ and the ‘prefer vaping group’ both significantly preferred to be ‘never out of breath’ to any other level and preferred ‘not harmful’ secondhand smoke to all other levels. For both attributes, preferences of the ‘prefer vaping group’ were stronger than those of the ‘prefer smoking group’ (Wald tests did not reject the null in direct comparison).

However, more of the ‘prefer vaping group’ coefficients were statistically significantly different from the reference category than for ‘prefer smoking group’. Both the ‘prefer smoking group’ and the ‘prefer vaping group’ preferred lower prices to the omitted level of \$14. However, preferences of the ‘prefer smoking group’ were stronger than those of the ‘prefer vaping group’, i.e. the ‘prefer smoking group’ appeared to be much more price-sensitive than the ‘prefer vaping group’ (some evidence supports this finding; P-values for price = \$5: < 0.01, price = \$8: 0.07, price = \$11: 0.07).

Non-monotonicity of price preferences

In model A, we found that price coefficients were nonmonotonic; that is, a lower price was not always preferred to a higher price as would be expected. In the latent class model, we found only the ‘prefer vaping group’ exhibited this behavior. Interacting high health harm (equal to 1 if either health variable is its most harmful level; 0 otherwise) with price resulted in monotonic price coefficients on the main price variables and dampening of preferences for lower prices when health harm was high (see negative interaction terms). The full impact of price included the main and interacted price coefficients. These findings suggested that the ‘prefer vaping group’ were averse to highly harmful products even when prices were low which, in turn, suggests that they may prioritize health when making choices. The full details of the price interactions, their interpretation and robustness tests, are given in the Supporting information, Appendix S3.

Latent class composition

Classes were characterized by sets of socio-demographic and smoking-behavior variables. Compared to the ‘prefer vaping group’, the ‘prefer smoking group’ were: older, white, non-Hispanic, lower socio-economic status (SES) (as proxied by parents’ education) and less likely to be a student. They were also far more likely than the ‘prefer vaping group’ to have used cigarettes and not to have used e-cigarettes in the past 30 days. These patterns were seen in the class membership probability coefficients at the bottom of Table 3.

DISCUSSION

We found two underlying groups with distinct product and attribute preferences and different responses to policy interventions. Specifically, we found that the latent group that we term ‘prefer smoking group’ preferred cigarettes to e-cigarettes, and either cigarette type to none. The ‘prefer smoking group’ group (3.7% of the sample) is unlikely to abstain as they prefer all tobacco products to none. This group preferred tobacco to other flavors and healthier products but did not value healthiness as much as the ‘prefer vaping group’ did. In contrast, the ‘prefer vaping group’ group preferred reusable e-cigarettes and none, then disposable e-cigarettes, and lastly cigarettes. This group preferred fruit and candy flavors to tobacco and valued lower harm to their own and others’ health. Consistent with literature and economic principles, we found that both groups preferred lower prices [22,23,27,29], but the ‘prefer smoking group’ were more price-sensitive. These groups also differed in their personal characteristics.

Policy implications

Encouraging young adults to resist or quit smoking is a public health priority. Encouraging current smokers to switch to e-cigarettes is a reasonable goal to reduce harms and eliminating tobacco use is a gold standard [8,56]. Our findings suggest that banning all flavors in cigarettes and e-cigarettes would tend to improve public health. It would make e-cigarettes less attractive to the ‘prefer vaping group’ and so encourage the ‘prefer vaping group’ not to use either cigarette type. However, such a ban would have little impact on the use of either cigarette type in the ‘prefer smoking group’; they would not be less likely to smoke nor more likely to switch to e-cigarettes.

Regulators can prohibit harmful ingredients and misleading health claims of e-cigarettes. Our findings suggest that a reduction in harms could encourage some in the ‘prefer smoking group’ and some who might newly initiate smoking to select the healthier e-cigarettes instead. However, because the ‘prefer vaping group’ are sensitive to the health harms, some of the ‘prefer vaping group’ would be more likely to vape and less likely to quit, resulting in increased health harm. These conflicting impacts present a conundrum for the FDA and possibly for tobacco regulators world-wide; reducing the health harms of e-cigarettes has beneficial effects but also could have unintended, negative impacts.

Our findings suggest that the policy with the greatest reduction in smoking is to increase prices of cigarettes while not increasing the price of e-cigarettes. In response to the higher price, some in the ‘prefer smoking group’ might switch to e-cigarettes and others might quit. However, many in the ‘prefer smoking group’ would be more likely to switch to e-cigarettes than to quit using tobacco products overall. One potential risk of this policy is that the ‘prefer smoking group’ might switch to cigars and cigarillos, or other harmful options that are not equally taxed. Note that taxing all combustible products might address this harmful substitution effect.

The differential impacts of prices and of other attributes across the ‘prefer smoking group’ and the ‘prefer vaping group’ show the value of conducting latent class analyses as opposed to examining the sample only as a whole. For example, multiple governments world-wide are considering taxing e-cigarettes, or already have done so, to raise revenue and limit the growth of e-cigarette use [57]. However, this evidence that the ‘prefer smoking group’ and the ‘prefer vaping group’ may respond differently to taxes across cigarette types suggests that the substitutability and complementarity generated by differential price responses complicates determination of the optimal public health tax policy. An examination of results separately by the ‘prefer smoking group’ and the ‘prefer vaping group’ is needed for policy determination.

Limitations

Our study has several limitations. First, there is risk of hypothetical bias [58], but we help to address this by sampling only ever-tries who necessarily have knowledge of cigarette types. Further, because the number of choice options is low, the DCE should perform well [59]. Secondly, despite our sampling quotas, the sample may not be representative of US smokers,

and is not representative of other countries. Thirdly, not all combinations of products and attributes are presented in the experiment.

Despite these limitations, there are several key strengths. We produce new, policy-relevant information prior to the implementation of tobacco policies aimed at young adults. Thus, our findings are useful to policy formulation in the United States and possibly to other countries. In addition, we use a large sample based on a national tobacco survey and examine the heterogeneity in policy impacts across groups yielding important policy insights. An advantage of the DCE is that it recovers causal estimates of changes in attributes on choices. Finally, our results are robust to sensitivity analyses (see Supporting information, Appendix S4). We add to the literature in the following ways. (1) Unlike other DCEs, we focus exclusively on young adults' cigarette and e-cigarette choices using a large sample of ever-triers based on a national tobacco survey. (2) We study preferences for, and substitution across cigarettes, two types of e-cigarettes, and choosing 'none'. Many related studies have focused only on e-cigarettes. (3) We also allow for the uncertainty in the health risks of e-cigarettes [60,61]. (4) We are the first, to our knowledge, to focus on young adult ever-triers in a DCE. (5) We examine multiple policy options in a single study allowing for meaningful comparisons of findings across options. (6) We use latent class analysis to capture group-wise choices and preference heterogeneity, providing critical policy insights otherwise unavailable.

Conclusions

We find that young adults fall into two categories: 'prefer smoking group' who prefer cigarettes and 'prefer vaping group' who prefer e-cigarettes. The 'prefer smoking group' most prefer lower prices and healthier tobacco products. The 'prefer vaping group' value these, although less intensely, but value fruit and candy flavors more. These results suggest that the 'prefer smoking group' could be deterred from smoking by increasing cigarette prices and encouraged to switch to e-cigarettes by reducing the health harms of e-cigarettes. However, results also suggest that reducing health harms of e-cigarette users could encourage the 'prefer vaping group' to keep vaping instead of quitting, resulting in increased health harm. This presents a conundrum for regulators; reducing the health harms of e-cigarettes have beneficial effects but also could have unintended, negative impacts.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Descriptive sample statistics.

Variable	All observations		
	Mean	SD	Obs.
Age: 18	0.14	0.35	2003
Age: 19	0.15	0.36	2003
Age: 20	0.20	0.4	2003
Age: 21	0.22	0.41	2003
Age: 22	0.29	0.45	2003
Gender: Female	0.41	0.49	2003
Gender: Male	0.59	0.49	2003
Race: White	0.81	0.39	2003
Race: Black	0.12	0.32	2003
Race: Other	0.07	0.25	2003
Ethnicity: Hispanic	0.16	0.36	2003
Current student	0.49	0.50	2003
Parents have obtained an undergraduate degree or higher	0.38	0.49	2003
LGBTQ	0.15	0.36	2003
At least one cigarette quit attempt past year	0.38	0.48	2003
At least one e-cigarette quit attempt past year	0.09	0.29	2003
Used cigarettes in the past 30 days	0.64	0.48	2003
Used e-cigarette in the past 30 days	0.38	0.48	2003

Race: Other = Asian, American Indian/Native Alaskan, Native Hawaiian/Other Pacific Islander Current student includes those that are currently enrolled in higher education, but not those who are not nor those who are planning to enroll in the coming year. For LGBTQ, the reference category comprises those who did not wish to answer this question as well as those who identified as straight. Quit attempt variables include individuals that attempted to quit at least once in the past year (the reference category—no quit attempts—includes the remainder of the sample who may not be regular product users). SD = standard deviation; LGBTQ = lesbian, gay bisexual and transgender.

Table 2

Experimental products, attributes and levels.

	Disposable e-cigarette		Reusable e-cigarette		Cigarette	
Flavor	Plain tobacco	Menthol	Plain tobacco	Menthol	Plain tobacco	Menthol
	Menthol	Fruit	Menthol	Fruit		
	Candy	Never	Candy	Never		Often
Causes trouble breathing	Sometimes	Often	Sometimes	Often		
	Unknown	Not harmful	Unknown	Not harmful		Very harmful
Harm from secondhand smoke?	Mildly harmful	Very harmful	Mildly harmful	Very harmful		
	Unknown	Unknown	Unknown	Unknown		
Price (\$)	5	8	5	8	5	8
	11	14	11	14	11	14

Table 3

Multinomial logit (MNL) choice models.

	Model A: basic MNL				Model B: latent class MNL							
	Beta	SE	P-value	Sign.	Beta	SE	P-value	Sign.				
	Prefer smoking group				Prefer vaping group							
ASC: disposable e-cigarette	-1.415	0.054	0.000	**	-3.045	0.28	0.000	**	0.596	0.215	0.000	**
ASC: re-usable e-cigarette	-0.612	0.056	0.000	**	-2.641	0.304	0.000	**	1.499	0.212	0.000	**
ASC: none of these	-0.653	0.059	0.000	**	-3.923	0.499	0.000	**	1.541	0.204	0.000	**
Price = \$ 5	0.293	0.027	0.000	**	1.711	0.273	0.000	**	0.427	0.066	0.000	**
Price = \$8	0.063	0.039	0.116		0.837	0.215	0.000	**	0.377	0.11	0.001	**
Price = \$11	0.193	0.034	0.000	**	0.761	0.254	0.003	**	0.258	0.068	0.000	**
Menthol	0.034	0.028	0.213		-0.237	0.101	0.018	*	0.103	0.058	0.077	
Fruit	0.284	0.035	0.000	**	-0.663	0.281	0.018	*	0.455	0.06	0.000	**
Candy	0.413	0.041	0.000	**	-0.45	0.232	0.052		0.578	0.064	0.000	**
Never out of breath	0.481	0.037	0.000	**	0.623	0.21	0.003	**	0.496	0.069	0.000	**
Sometimes out of breath	0.122	0.036	0.000	**	-0.023	0.209	0.912		0.065	0.072	0.368	
Unknown out of breath	0.082	0.039	0.036	*	-0.022	0.224	0.921		0.047	0.077	0.540	
Secondhand smoke: not harmful	0.585	0.037	0.000	**	0.289	0.187	0.123		0.585	0.072	0.000	**
Secondhand smoke: mildly harmful	0.281	0.037	0.000	**	0.081	0.21	0.700		0.191	0.074	0.010	*
Secondhand smoke: unknown harmful	0.346	0.044	0.000	**	0.403	0.234	0.085		0.294	0.069	0.000	**
Price = \$5 [†] high health harm									-0.416	0.091	0.000	**
Price = \$8 [†] high health harm									-0.498	0.135	0.000	**
Price = \$11 [†] high health harm									-0.119	0.109	0.280	
Probability of 'prefer smoking group'												
constant					-4.614	0.49	0.000	**				
Age					0.132	0.02	0.000	**				
Female					0.007	0.056	0.907					
Black					-0.503	0.083	0.000	**				
Other					-0.308	0.09	0.001	**				
Hispanic					-0.321	0.077	0.000	**				
Parents have a college degree					-0.162	0.056	0.004	**				

	Model A: basic MNL						Model B: latent class MNL					
	Prefer smoking group			Prefer vaping group			Prefer smoking group			Prefer vaping group		
	Beta	SE	P-value	Sign.	Beta	SE	P-value	Sign.	Beta	SE	P-value	Sign.
Student												
LGBTQ												
Quit attempt in past year: cigarette												
Quit attempt in past year: e-cigarette												
Used cigarettes in the past 30 days												
Used e-cigarettes in the past 30 days												
LL(b)				-20677.88								-18 822.62
k				15								46
Class membership probability									0.37			0.63

Dependent variable: cigarette choice. Reference (omitted) category: cigarette. Reference price: \$14. Reference flavor: tobacco. Reference out of breath: always. Reference secondhand smoke: very harmful. All demographic variables in the probability membership are binary coded (except for age which is treated continuously). LGBTQ = lesbian, gay, bisexual, and transgender. Diagnostic information: observations = 16,024, number of individuals = 2003, number of parameters (k), log-likelihood [LL(b)] of the fitted model. Beta denotes the coefficient estimates. ASC = alternative-specific constant; SE = standard errors, clustered at the individual level. Sign. - significance:

* $P < 0.05$;

** $P < 0.01$.