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EFFECTS OF TOBACCO PRODUCT TYPE AND CHARACTERISTICS ON APPEAL AND PERCEIVED HARM: RESULTS FROM A DISCRETE CHOICE EXPERIMENT AMONG GUATEMALAN ADOLESCENTS

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Abstract

Guatemala is one of the few countries where both heated tobacco products (HTPs) and electronic cigarettes (e-cigarettes) remain unregulated(Institute for Global Tobacco Control, 2020; Johns Hopkins Bloomberg School of Public Health, 2020). We used a discrete choice experiment (DCE) administered to 2038 high school students to assess how tobacco product attributes influence their appeal among Guatemalan adolescents. Participants were randomly assigned to evaluate 4 of 32 contrasting sets, each containing 3 packs (1 of each product type). Experimental manipulations included: product type, brand, nicotine content and flavor. Participants then indicated which product they were most and least interested in trying and would be most and least harmful to their health. Conditional logistic regression models were used to assess the impact of product characteristics on choice. Product type accounted for almost 90% of variation in choices. Respondents were less interested in trying HTPs (B=−0.93; p<0.001) and viewed them as more harmful (B=2.77; p<0.001) compared to cigarettes. They were more interested in trying e-cigarettes (B=1.22; p<0.001), which were also perceived as less harmful (B=−1.47; p<0.001) compared to cigarettes. Products without nicotine were of more interest for trying (B=0.14; p<0.001) and perceived as more harmful (B=0.20; p<0.001) than those with. Students were

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more interested in trying a flavor compared to regular tobacco and among the flavors, berry was the highest rated one (B=0.28; p<0.001). Finally, in this country with weak tobacco control, e-cigarettes appear to be more appealing and perceived as less harmful than HTPs and cigarettes. Packaging and flavoring regulations are urgently needed on these products as they are a marketing strategy targeting adolescents.

Keywords

E-cigarettes; Adolescent use; Heated tobacco products; Packaging and labeling

INTRODUCTION

Worldwide, use of electronic cigarettes (e-cigarettes) and heated tobacco products (HTPs) continues to ris (Bialous and Glantz, 2018; Jamal et al., 2017; Kang and Cho, 2019; Miech et al., 2019; Pepper and Brewer, 2014). E-cigarettes use a battery to heat (as opposed to burn as in cigarettes) a liquid that usually contains nicotine and is available in over 7,700 flavors (Chakma et al., 2019; Zhu et al., 2014). HTPs are electronic devices that heat (as opposed to burn) tobacco and produce an aerosol containing nicotine with a limited number of flavor options depending on the market(Simonavicius et al., 2019; “WHO | Heated tobacco products (HTPs) market monitoring information sheet,” 2018). Commercially available HTPs have been introduced by British American Tobacco (BAT) and Philip Morris International (PMI). As of May, 2020, PMI has introduced its HTP iQOS in 51 countries. HTPs are legally available in only 5 Latin American countries, including Guatemala(Phillip Morris International, n.d.; “WHO | Heated tobacco products (HTPs) market monitoring information sheet,” 2018).

Even though Guatemala ratified the World Health Organization’s Framework Convention on Tobacco Control (FCTC) in 2005 (World Health Organization., 2005), it has one of the weakest tobacco control policy environments worldwide (Barnoya et al., 2016; World Health Organization, 2017). Indeed, it is one of the few countries where e-cigarettes and HTPs sales are both available and without any labeling or nicotine restrictions (Johns Hopkins Bloomberg School of Public Health, 2020). Currently, iQOS is the only brand available through retailers in Guatemala and although there is no data on adult HTP use, a recent study found 2.9% of adolescents from private schools used HTPs in the prior 30 days and 52.4% of respondents were aware of and susceptible to future use (Gottshclich et al., 2020). This is consistent with experiences elsewhere; among young adults in South Korea, for instance, awareness and current use of HTPs reached 38% and 3.5% respectively, after only 3 months of entering the market (Kim et al., 2018).

Regarding e-cigarettes, first, second and third generation e-cigarettes and e-liquid cartridges are readily available and marketed in stores and pharmacies in Guatemala City(Chacon et al., 2018; Viteri et al., 2012). Most packaging have no warning labels and some product ads even explicitly publicize their use to “circumvent smoke-free environments” and most brands offer a variety of flavors and nicotine concentrations(Arriaza, 2016; Barnoya et al., 2020; Chacon et al., 2018). E-cigarette prices are relatively expensive compared to

cigarettes, therefore presenting cost barriers for consumers from lower socioeconomic status (SES) groups(Chacon et al., 2018). A report in 2015 found that 5.6% of high school students are current e-cigarette users (World Health Organization., 2015), however, a more recent study of middle to high SES urban areas in 2019, found a prevalence of 27.7% of e-cigarette use suggesting its use is rising (Gottshclich et al., 2020). Additionally, other studies have consistently reported that the percentage of youth who only smoke e-cigarettes and not conventional cigarettes is increasing (Gentzke et al., 2020; Gottshclich et al., 2020; Jamal et al., 2017; Weintraub, 2014). Data from the US and Latin America even suggests that e-cigarettes may appeal to some youth who would not otherwise have used tobacco products (Barrientos-Gutierrez et al., 2019; Barrington-Trimis et al., 2015; Dutra and Glantz, 2017; Gottshclich et al., 2020; Lozano et al., 2017; J. Thrasher et al., 2016). This trend may be a potential public health concern because e-cigarette use may prompt progression to conventional cigarette use (Aleyan et al., 2018; Barrington-Trimis et al., 2016).

These novel products are viewed by youth as posing little to moderate harm, particularly when compared to cigarettes, making them appealing(Ambrose et al., 2014; Chaffee et al., 2015; Czoli et al., 2017; Pepper et al., 2014; Stratton et al., 2018). These perceptions of tobacco products are influenced by several factors including brand(Islam et al., 2018a; Skaczkowski et al., 2017). Premium tobacco product brands may be misperceived as less harmful than cheaper counterparts(Czoli and Hammond, 2014) because they are also perceived as having higher quality and lighter taste(Skaczkowski et al., 2017). Consistently, among US smokers and Canadian youth it has also been reported that harm perception and trial intent vary by cigarette brand(Czoli and Hammond, 2014; Kotnowski et al., 2016; Salloum et al., 2018).

Another important tobacco attribute is flavor. Tobacco product flavors can also reduce risk perceptions and increase its appeal, particularly among youth(Abad-Vivero et al., 2016; Anderson, 2011; Barrientos-Gutierrez et al., 2020; Islam et al., 2018b; Klausner, 2011; Kong et al., 2019; J. F. Thrasher et al., 2016a; Villanti et al., 2017b). Menthol flavored tobacco may make it easier for youth to smoke by reducing throat and lung irritation(Krishnan-Sarin et al., 2017; Villanti et al., 2017a). A tobacco product innovation that has rapidly gained popularity worldwide, but particularly in Latin America, concerns flavor capsules in the filter that consumers can crush to flavor the smoke(Paraje et al., 2019; Thrasher et al., 2017). Traditionally, capsule cigarette varieties contain menthol, but in recent years they have expanded to include berry, citrus, and even alcoholic beverage flavors(Moodie et al., 2018). Evidence suggests that these novel flavor capsules offered in several different flavors make cigarettes more appealing to adolescents and young adults(Abad-Vivero et al., 2016; Barrientos-Gutierrez et al., 2020; Moodie et al., 2018; J. F. Thrasher et al., 2016b).

Consumers generally recognize that nicotine makes tobacco products addictive, but mistakenly believe that nicotine is the primary source of health harms from tobacco use. For example, US adults report that nicotine is the main carcinogen in cigarettes and that low-nicotine cigarettes are less harmful(Denlinger-Apte et al., 2017; Justin Byron et al., 2018; O'Brien et al., 2017). Other nicotine-delivering products, such as e-cigarettes, are increasingly viewed by adults as equally or more harmful than cigarettes, which appears, at least in part, to be due to misperceptions about risks of nicotine content(King et al.,

2018; Majeed et al., 2017). While less is known about nicotine perceptions amongst youth, findings suggest that patterns of belief are similar(East et al., 2018). Nevertheless, many youth believe that e-cigarettes do not contain nicotine, which may help explain the recent rapid rise in use(East et al., 2018; Vallone et al., 2019; Willett et al., 2019). Given emerging policy initiatives to reduce and even eliminate nicotine in tobacco products, it is important to better understand how the presence of nicotine influences the appeal and perceived harmfulness of diverse products for adolescents(Gottlieb and Zeller, 2017). However, there is no evidence examining attributes such as brand, nicotine content or flavor across common sources of nicotine (i.e. HTPs, e-cigarettes and cigarettes).

Discrete choice experiments (DCEs) use fractional factorial designs to create sets of alternatives from participants choose. As such, DCEs allow assessment of the independent effects of systematically manipulated stimulus characteristics on decision-making, including estimates of the relative impact of each characteristic on choices(Louviere et al., 2000). While the stimuli participants evaluate are often hypothetical, the results have been shown to have external validity(Barber et al., 2019; Linley and Hughes, 2013; Mohammadi et al., 2017; Quaife et al., 2018), and DCEs increasingly been used to assess the factors that influence tobacco product perceptions and behaviors (Barrientos-Gutierrez et al., 2020; Regmi et al., 2018; Thrasher et al., 2018). The current study used a DCE to assess how tobacco product type, flavors, and nicotine content influence appeal and risk perceptions among Guatemalan adolescents. These attributes were chosen as they are potential targets for regulation (e.g., nicotine flavors), with the use of brand variations because they influence choice amongst youth (Abad-Vivero et al., 2016; Barrientos-Gutierrez et al., 2020) and make the choice task more representative of choices in the marketplace. To our knowledge, this is the first experiment of this type in a country where e-cigarettes and HTPs are readily available.

MATERIALS AND METHODS

Sample

All students from 7th grade through high school (ages 13–18) in a convenience sample of eight private schools in Guatemala City were recruited to complete self-administered, pencil and paper survey, between May and September of 2019. After being granted permission from each school principal, passive parental consent and active student assent were obtained. The self-administered survey questions were based on those from a survey and DCE with Mexican adolescents(Barrientos-Gutierrez et al., 2020). The survey was first adapted to Guatemalan Spanish and then pilot tested with students from other private schools not enrolled in the current project(J. Thrasher et al., 2016). All study protocols were approved by the Institutional Review Board at the Central American Institute of Nutrition (INCAP) in Guatemala City.

Study Design and Protocol

We used a DCE with a 2×2×4 within-subject alternative specific block design where the three alternatives in each choice were defined by product type (cigarette, HTPs, e-cigarette). Other attributes that were systematically manipulated included brand (2 per product type),

nicotine content (none, 12mg), and flavors (tobacco, menthol, cherry, berry) (Table 1). Brands used were Marlboro or Lucky Strike for cigarettes, iQOS or BLU for HTPs, and VYPE or JUUL for e-cigarettes. They were selected based on those that were most prevalent at point of sale at the time of data collection. For HTPs however, only one brand was available (iQOS), so we used an e-cigarette brand (Blu) that is not available in Guatemala to depict another HTP product. These attributes were chosen as they have been found to be used by the tobacco industry to reach consumers and may have potential policy implications(Johns Hopkins Bloomberg School of Public Health, 2020). The most efficient design involved 32 choice sets, each containing one of each product type with contrasting attributes. However, to minimize response burden, participants were randomly assigned to evaluate 1 of 8 blocks, each with 4 choice sets printed on a separate sheet of paper from the rest of the questionnaire (see Annex Figure). Systematic randomization was used to order choice sets within blocks.

Outcomes

"Best-worst" scaling was used, in which participants indicated which product in each choice set they were "most" and "least" interested in trying, as well as which they considered the "most" and "least" harmful to their health. Each set showed the three product types as well as a "no difference" option (see Annex Figure for an example choice set). Participants could view each set for as long as they wished given that the survey was self-administered. The choices selected were used to construct paired comparisons for all combinations within a set (i.e., product 1 vs product 2; product 2 vs. product 3; product 1 vs. product 3). Comparisons were coded as 1 if the product was chosen as having more of the characteristic and 0 if less of the characteristic. If participants selected the no difference option (i.e. none of the products are interesting/harmful), both products within each pair were assigned a 0.

Participant Characteristics

Participant sociodemographic characteristics included sex and age in years (13 or less, 14, 15, 16, 17 or more). Smoking-related characteristics included smoking, HTP, and vaping status which were classified into non-susceptible never, susceptible never, tried but not current, or current users. Susceptibility was assessed with a single question adapted from Pierce et al's validated scale (Pierce et al., 1996). This question (prompt: 'If one of your friends offered you a heated tobacco product like IQOS (cigarette and e-cigarette for smoking or vaping respectively), would you use it?' possible responses: 'Definitely yes', 'Probably yes', 'Probably no', 'Definitely no'). Those who answered 'Definitely yes', 'Probably yes' or 'Probably no' were considered susceptible to continued or future use, while those who reported 'Definitely no' were categorized as unsusceptible, similar to prior studies that have found that this single indicator has similar predictive validity as the use of multiple questions (Morello et al., 2016). Chi-square tests showed no significant differences in these participant characteristics across blocks (results not shown) suggesting participants were randomized effectively, and thus we did not adjust for these characteristics as covariates.

Data Analysis

For each outcome (interest in trying, perceived harmfulness), only data from participants who selected at least one product across all choice sets were included in the analytic sample. Therefore, the product chosen for each outcome was interpreted as being more interesting to try or more harmful than its alternatives respectively. This is common practice in DCE data analyses, as the samples who "opt out" are effectively constant across all choice sets and only add to the error variance of the estimates. To understand the characteristics of students with no preferences for one product over another (which is reasonable given the young age of our sample), we compared those who were included in the analytic sample and those who were excluded for each outcome using chi-square tests. To assess the impact of product attributes on choice, we used conditional logistic regression models controlling for repeated measures and block assignment. Dependent variables were the choice of product for each outcome (interest in trying, perceived harmfulness). Independent variables included product attributes (product type, brand, nicotine content, and flavor), which were coded such that the reference level was the dominant product attribute. We also tested for interactions between product attributes (i.e. product type by nicotine, product type by flavor, and flavor by nicotine). Each interaction was assessed in separate models that include a set of indicators representing the interaction of interest and the main effects for the other product attributes in the DCE. All models were re-run for the entire sample, including those who opted out of all choice sets they evaluated, and the results were consistent in terms of the direction of effect, statistical significance and interpretation (Appendix A). To determine the relative impact of each product attribute on choice, we calculated the difference between each attribute's highest and lowest estimated effect on choices (i.e. utility range) from the main effect models, where the reference level holds a value of zero. The utility range was then divided by the sum of all the attributes' utility ranges for a given outcome. All analyses were conducted using the choice modelling package in Stata 16.

RESULTS

Sample Characteristics

A total of 2274 students were invited to participate. Of these, 2038 ended up answering the questionnaire (90% response rate), approximately half of whom were female (48%) and 14 or 15 years old (48%) (Table 2). Most participants were non-susceptible never smokers (63%), non-susceptible never HTP users (69%), and non-susceptible never vapers (42%). For the interest in trying outcome, 325 participants opted out of all choice sets leaving 1713 in the analysis, and for the perceived harmfulness outcome, 86 participants opted out leaving 1952 in the analysis. Sensitivity analyses between the analytic and excluded samples revealed no significant differences in sex or age for either outcome. However, the analytic sample did consist of a significantly lower proportion of non-susceptible never smokers, non-susceptible never HTP users, and non-susceptible never vapers and higher proportions of current smokers, current HTP users, and current vapers ($p<0.001$ for all).

Effect of product attributes on choice

The main effects model (Table 3) indicated that students were more likely to be interested in trying e-cigarettes ($b=1.22$) and less in HTPs ($b=-0.93$) compared to cigarettes.

Students were also more interested in trying products without than with nicotine (b=0.14). Additionally, students were more interested in trying products with menthol (b=0.17), cherry (b=0.24) or berry (b=0.28) flavor compared to products with tobacco flavor. In models predicting harmfulness, students were less likely to select e-cigarettes (b=−1.47) and more likely to select HTPs (b=2.77) as more harmful than cigarettes. Products without nicotine (b=0.20) and those with cherry flavor (b=0.14) were also more likely to be selected as harmful compared to those products with nicotine and those with menthol, berry or tobacco flavor respectively.

Figure 1 displays the relative importance of each product attribute on choice. For interest in trying, product type had the biggest (83%) influence, followed by flavor (11%), nicotine (6%), and brand (1%). For the perceived harmfulness outcome, product type also had the largest (90%) influence, followed by nicotine (4%), flavor (3%), and brand (2%).

Interactions between product attributes

Product type significantly interacted with nicotine and flavor (Models 2 and 3 in Table 3), such that products without nicotine and with flavors other than tobacco (i.e. menthol, cherry, berry) increased interest in trying a product and reduced perceptions of harmfulness for e-cigarettes but had either no or the opposite effect for cigarettes and HTPs. The product type by nicotine interaction showed that e-cigarettes without nicotine were most interesting to try (b=1.30) and perceived as the least harmful (b=−1.70) relative to cigarettes with nicotine. HTPs with without nicotine were considered least interesting (b=−1.05) and most harmful (b=3.68) compared to cigarettes with nicotine. The product type by flavor interaction indicated that HTPs with berry flavor were least interesting to try (b=−1.15) and e-cigarettes with berry flavor were the most interesting (b=1.49). HTPs with cherry flavor were perceived as most harmful (b=3.11) and e-cigarettes with menthol flavor were perceived as least harmful (b=−1.53), although the point estimates for all non-tobacco flavors for e-cigarettes were similar (ranging from −1.29 to −1.53).

DISCUSSION

Guatemala ratified the FCTC in 2005(World Health Organization., 2005), however no progress other than the introduction of a partially-compliant smoke-free environments law(Barnoya et al., 2016; Corral et al., 2011) and a non-compliant single cigarette sale ban(Ojeda et al., 2012) has been accomplished. Additionally, no e-cigarette and HTP regulation exists so far, making it a country with a weak tobacco control. In this study we found that adolescents clearly perceive e-cigarettes as more appealing and less harmful than cigarettes and, especially, more than HTPs. Conversely, HTPs were the least appealing and were perceived as the most harmful which is contrary to what has been reported elsewhere(Gravely et al., 2020). These findings are particularly relevant in Guatemala, since e-cigarettes are the most readily available, come in different prices(Chacon et al., 2018) and their sales are unrestricted.

Regarding nicotine content, it was found to influence product appeal and perception of harmfulness but with conflicting results. Products without nicotine generated more interest in trial, but this was limited to e-cigarettes whereas cigarettes without nicotine and HTPs

generated less interest than their counterparts with nicotine. A similar pattern was found for models of harm, where perceived lower harm from eliminating nicotine was limited to e-cigarettes, whereas the inverse was true for cigarettes and HTPs. These misconceptions along with curiosity may lead adolescents to use them and become addicted(Ambrose et al., 2014; Pepper et al., 2014), given the nicotine properties in tobacco products. Additionally, this inaccurate harmfulness perceptions relative to e-cigarettes are similar to other studies of adults in Great Britain(Brose et al., 2015) and the elsewhere (Pearson et al., 2012)(Zhu et al., 2013)(Richardson et al., 2014).

Flavors were also found to increase product appeal and influence perception of harmfulness in our study and elsewhere(Islam et al., 2018b), although the positive effects of flavors appeared most apparent for e-cigarettes. However, we found some mixed results. While berry was the most appealing in the main effects analysis and consistent with previous studies(Abad-Vivero et al., 2016; Hoek et al., 2019; Moodie et al., 2019), it was also the least appealing flavor for cigarettes and HTPs in the product by flavor interaction one. These might be due to the novelty of the products and therefore may not reflect a longer-term behavior regarding appealing or risk perception or need longer follow-ups to establish a behavioral trend. Finally, although menthol has been reported as a popular flavor, we found that it is less appealing when other flavors are present. This is consistent with results from another DCE study among youth where fruit/candy flavors were preferred(Buckell and Sindelar, 2019). This becomes relevant when creating novel tobacco control policies, particularly those oriented to ban flavors that have been successful among younger users as reported elsewhere(Yang et al., 2020).

Our study has strengths and limitations. To the best of our knowledge, this is the first DCE to examine all three products together in a country with a very weak tobacco control environment. In addition, our sample of adolescents includes not only users but also those susceptible to trying each product. These findings should be interpreted in light of some limitations. Our sample was drawn from private school students who mostly come from relatively high SES groups. Given that e-cigarettes and HTPs are more costly than regular cigarettes, it is unlikely to be affordable for those from low SES. Therefore, our findings are unlikely to generalize to students from lower SES groups who attend public schools. Also, given that we did not perform manipulation checks, it is not possible to verify that respondents based their choices on the differences between the attributes of interest; however, the presentation of these attributes was realistic and may nevertheless reflect how youth would respond to these products in real life. Finally, placement of attributes were not depicted in the same way across products therefore some may have interpreted them as package attributes or other variables within the stimuli may have influenced the participant choices and thus underestimate the effects of flavor and nicotine levels over the product type.

Regulations are urgently needed on these products packaging attributes, particularly because flavoring of these products have been deemed to be youth oriented(Bam et al., 2014; Stratton et al., 2018) and appeal to them specifically as reported elsewhere(McKelvey et al., 2018).

CONCLUSIONS

Here we present evidence of the independent and interactive effects on novel nicotine productś attributes (brand, nicotine content and flavor effects) on appeal and risk perception among Guatemalan adolescents based on a discrete choice experiment. This paper presents the potential role distinct attributes have on how attractive a product is or how much it makes you think about the harm it may cause. Finally, the identification of these productś attributes effects on adolescentś appeal and risk perception may orient tailored control policies for these nicotine products. These tailored policies could potentially halt the epidemic at an earlier stage where most established smokers initiate trial and regular use.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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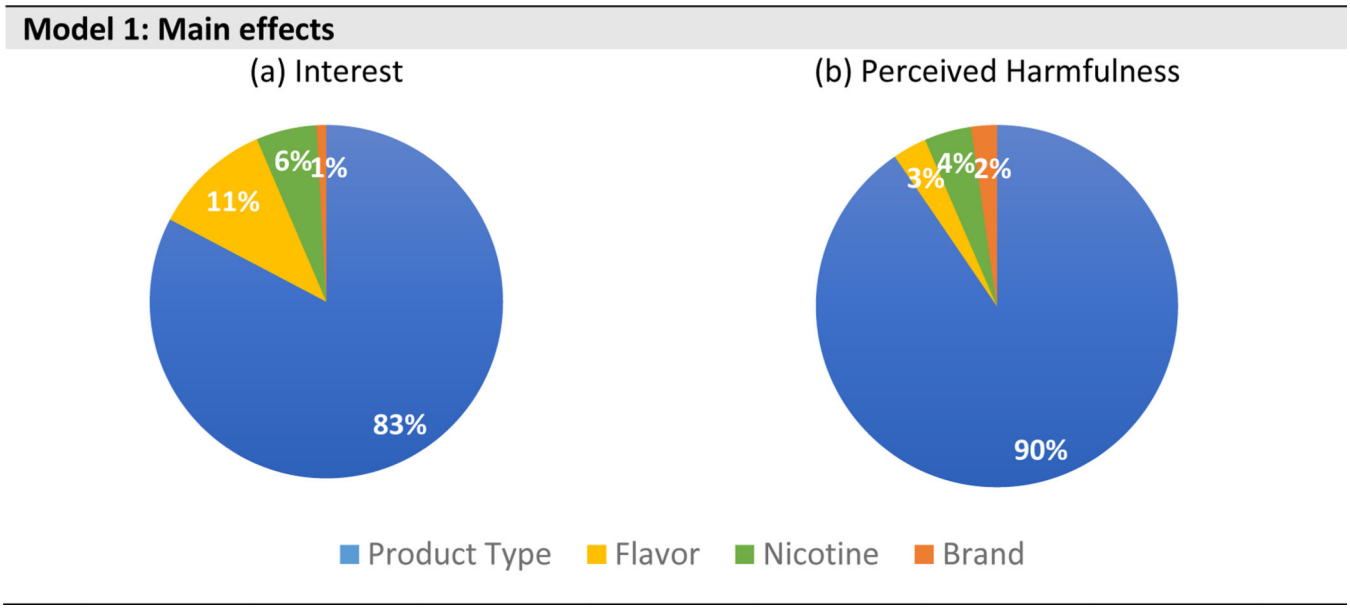

Figure 1:
Relative importance of product attributes on choice (color printed)

Table 1:

Pack attributes and levels tested in the discrete choice experiment

Attributes	Cigarette	Heated Tobacco	E-cigarette
Brand	Marlboro	iQOS	VYPE
	Lucky Strike	BLU	JUUL
Nicotine	None	None	None
	12 mg	12 mg	12 mg
Flavor	Tobacco	Tobacco	Tobacco
	Menthol	Menthol	Menthol
	Cherry flavor capsule	Cherry flavor capsule	Cherry
	Berry flavor capsule	Berry flavor capsule	Berry

Table 2:

Participant characteristics of the total, analytic and excluded samples

Characteristics	Total (n=2038)	Interest in trying			Perceived Harmfulness		
		Analytic (n=1713)	Opted out[1] (n=325)	p-value[2]	Analytic, (n=1952)	Opted out[1] (n=86)	p-value[2]
Sex				0.181			0.836
female	48% (978)	49% (839)	45% (146)		48% (937)	47% (40)	
male	52% (1060)	51% (874)	55% (179)		52% (1015)	53% (46)	
Age				0.078			0.105
13 or less	17% (346)	17% (291)	22% (71)		17% (331)	26% (22)	
14	24% (489)	23% (394)	26% (84)		23% (448)	29% (24)	
15	24% (489)	24% (411)	21% (68)		24% (468)	17% (14)	
16	20% (408)	20% (342)	18% (58)		20% (390)	16% (13)	
17 or more	16% (326)	16% (274)	13% (42)		16% (312)	12% (10)	
Smoking Status				<0.001			<0.001
non-susceptible, never smoker	63% (1284)	58% (993)	92% (299)		62% (1210)	85% (73)	
susceptible, never smoker	8% (163)	9% (154)	2% (6)		8% (156)	8% (6)	
tried but not current smoker	21% (427)	23% (394)	6% (19)		21% (409)	7% (6)	
current smoker	8% (163)	10% (171)	0% (0)		9% (175)	0% (0)	
HTP Status				<0.001			<0.001
non-susceptible, never HTP user	69% (1406)	63% (1079)	96% (312)		68% (1327)	86% (73)	
susceptible, never HTP user	22% (448)	25% (428)	3% (9)		22% (429)	11% (9)	
tried but not current HTP user	7% (142)	8% (137)	1% (3)		7% (136)	2% (2)	
current HTP user	3% (61)	3% (51)	0% (0)		3% (58)	1% (1)	
Vaping Status				<0.001			<0.001
non-susceptible, never vaper	42% (855)	35% (599)	78% (253)		41% (800)	70% (60)	
susceptible, never vaper	9% (183)	10% (171)	3% (9)		9% (175)	9% (7)	
tried but not current vaper	29% (591)	31% (531)	17% (55)		30% (585(	14% (12)	
current vaper	20% (408)	24% (411)	3% (9)		21% (409)	7% (6)	

[1] Opted out indicates that the participant did not choose any options from any of the choice sets in the experiment and thus were excluded from the analysis

[2] All p-values were calculated using chi-square tests

Table 3:

Main and interaction effects of product attributes on outcomes

Product attributes	Interest, n=1713 coef. (SE)	Perceived harmfulness, n=1952 coef. (SE)
Model 1: Main effects		
Product Type		
cigarette	Ref	Ref
heated tobacco	−0.93 (0.19)***	2.77 (0.21)***
e-cigarette	1.22 (0.12)***	−1.47 (0.24)***
Brand		
0	Ref	Ref
1	−0.02 (0.03)	0.11 (0.03)***
Nicotine		
12 mg	Ref	Ref
none	0.14 (0.03)***	0.20 (0.04)***
Flavor		
tobacco	Ref	Ref
menthol	0.17 (0.04)***	0.03 (0.04)
cherry	0.24 (0.04)***	0.14 (0.04)***
berry	0.28 (0.04)***	−0.01 (0.05)
Model 2: Product type by Nicotine interaction		
Product type x Nicotine		
cigarette, 12 mg	Ref	Ref
cigarette, without nicotine	−0.12 (0.05)*	1.02 (0.07)***
HTP, 12 mg	−0.94 (0.19)***	2.97 (0.22)***
HTP, without nicotine	−1.05 (0.20)***	3.68 (0.22)***
e-cigarette, 12 mg	0.77 (0.13)***	0.27 (0.27)
e-cigarette, without nicotine	1.30 (0.12)***	−1.70 (0.29)***
Overall p-value	*<0.001*	*<0.001*
Model 3: Product type by Flavor interaction		
Product type x Flavor		
cigarette, tobacco	Ref	Ref
cigarette, menthol	−0.06 (0.06)	0.23 (0.08)***
cigarette, cherry	−0.06 (0.07)	0.26 (0.07)***
cigarette, berry	−0.06 (0.07)	0.06 (0.09)
HTP, tobacco	−0.69 (0.20)***	2.77 (0.22)***

Product attributes	**Interest, n=1713** **coef. (SE)**	**Perceived harmfulness, n=1952** **coef. (SE)**
HTP, menthol	−1.05 (0.20)***	2.93 (0.22)***
HTP, cherry	−1.13 (0.21)***	3.11 (0.22)***
HTP, berry	−1.15 (0.21)***	2.84 (0.22)***
e-cigarette, tobacco	0.56 (0.13)***	−1.07 (0.26)***
e-cigarette, menthol	1.19 (0.13)***	−1.53 (0.25)***
e-cigarette, cherry	1.37 (0.13)***	−1.39 (0.25)***
e-cigarette, berry	1.49 (0.13)***	−1.29 (0.25)***
Overall p-value	*<0.001*	*<0.001*

Coef. = coefficient; SE = standard error; Ref = reference level;

* p < 0.05;

** p < 0.01;

*** p < 0.001

All models adjust for block. Interaction models also include the attributes not present in the interaction.