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Strong preference for mint snus flavor among research participants

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ABSTRACT

Introduction: The Family Smoking Prevention and Tobacco Control Act of 2009 allows the US FDA to regulate tobacco products, including the banning of characterizing flavors, such as fruit and candy, cigarettes. The availability of mint flavored snus may facilitate the use of the product if consumers find it more palatable with respect to taste, odor, pleasantness, and intensity.

Methods: This study assessed product evaluation (PES), odor identification, odor intensity, and odor hedonics among 151 smokers enrolled in a clinical trial of snus substitution for cigarettes.

Results: Far more participants selected Winterchill (N = 110) than Robust (N = 41), regardless of their menthol cigarette smoking status. Nicotine dependence was higher among those who selected Winterchill (4 vs 3 on Fagerstrom scale, p = 0.017). Those who found Winterchill to be more satisfying, less aversive, and having a more intense, more pleasant odor than Robust were substantially more likely to select Winterchill for their one week trial.

Conclusions: Findings indicate that subjective effect measures such as the PES and DEQ are capable of differentiating products in terms of flavor preference, and that smokers express a strong preference for mint flavored snus.

1. Introduction

The Family Smoking Prevention and Tobacco Control Act of 2009 allows the US Food and Drug Administration (FDA) to regulate tobacco products, including the banning of characterizing flavors, such as fruit and candy, in cigarettes (US Food and Drug Administration, 2009). These products were of concern to public health advocates because of the appeal of the enticing names, package design and pleasing flavors to youth (Klein et al., 2008; Kostygina & Ling, 2016). Menthol flavoring, however, was not included in the Tobacco Control Act (US Food and Drug Administration, 2009). Econometric evaluations suggest that this ban was effective in reducing the probability of adolescent tobacco use by 6%, even though some substitution with remaining legal flavored products (menthol cigarettes, little cigars, pipes) was observed (Courtemanche, Palmer, & Pesko, 2017). Characterizing flavors were not banned in non-cigarette tobacco products at the federal level, though several localities (e.g., Providence, New York City, Chicago, and Santa Clara) have done so (Board of Supervisors of the County of Santa Clara, 2014; City of Providence, 2012; Commissioner of Health and Mental Hygiene, 2010; Emanuel, Thompson, & Mitts, 2013). Still, data from the Population Assessment of Tobacco and Health study suggests that flavored tobacco use remains particularly common among youth and young adults (Villanti et al., 2017) and may serve to aide initiation to tobacco use. Consumer initiation and continued use of a tobacco product is dependent upon many factors including nicotine content, as well as pH of the product and palatability of the product (US Department of Health and Human Services, 2010). Chemical additives, such as menthol, can alter the taste and flavor of the product, creating a more pleasurable taste and making it more acceptable among consumers (US Department of Health and Human Services, 2010).

The favorable perceptions of flavorings may have important implications for regulatory science, particularly with respect to modified risk tobacco products (MRTP). The population health effect of an MRTP in part depends on uptake, which is influenced in part by the palatability and acceptability of the product. For example, prior studies suggest that cigarette smokers have a preference for flavored snus products (Meier et al., 2016). A similar pattern is also observed for smokeless users (Oliver, Jensen, Vogel, Anderson, & Hatsukami, 2013). The availability of flavored snus may facilitate its use in place of more toxic cigarettes, if consumers find it more palatable with respect to

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taste, odor, pleasantness, and intensity (Meier et al., 2016). Therefore, these products may be of public health importance if research demonstrates that these products reduce exposure or risk in individuals (Meier et al., 2016). And, conducting such research is dependent on participants using the product being studied.

The question whether smokeless tobacco (ST) products, such as snus, is a potential modified risk tobacco product has been debated (Meier et al., 2016). First, smokeless tobacco has been established as toxic and carcinogenic, but it is thought that it will reduce population harm from tobacco by preventing smoking initiation, promoting smoking cessation and partially replacing the use of cigarettes among current smokers (Kozlowski, 2007; Tomar, 2007). Second, the advertisement of smokeless tobacco as less harmful than cigarettes may increase the prevalence of all tobacco use (Tomar, 2007). Final, there is concern that it will only provide temporary reduced risk, and act as a gateway to cigarette use (Tomar, 2007). With respect to ST, surveys suggest that 59% of current ST users under aged 18 are using a flavored ST product, as are 51% of current adult ST users. A systematic review suggests that flavored tobacco products may be perceived more favorably overall (Feirman, Lock, Cohen, Holtgrave, & Li, 2016), and that their use is more common among the young.

Given the regulatory interest in characterizing flavors in the USA and EU, developing methods to assess flavor awareness and preference is important (Henkler & Luch, 2015; Talhout, van de Nobelen, & Kienhuis, 2016). This report aimed to determine the preference of menthol vs. tobacco flavored snus among smokers, and to provide validation of sensory measures of product preference and adoption. Data was collected for a randomized, multi-site open-label trial examining the ability to predict who enrolls in a clinical trial of Camel Snus (O'Connor, Lindgren, Schneller, Shields, & Hatsukami, 2017).

2. Methods

2.1. Eligibility criteria

Participants were eligible if they were at least 18 years of age, currently smoked at least 10 cigarettes per day, had not used ST for at least 3 months, were able to provide consent and read and understand study documents, and had no medical contraindications such as pregnancy, breastfeeding, uncontrolled hypertension, uncontrolled diabetes, recent myocardial infarction, or cancer. A total of 151 individuals were eligible for the study across 3 sites: University of Minnesota (UMN; Minneapolis, MN), Ohio State University (OSU; Columbus, OH), and Roswell Park Cancer Institute (RPCI; Buffalo, NY) (O'Connor et al., 2017).

2.2. Sampling phase procedure

Eligible participants completed a core questionnaire on tobacco use and behaviors at an initial orientation visit. Participants were then shown the two snus products, Camel Snus Winterchill and Camel Snus Robust in blinded tins. A coin flip determined which product was given to the participant first. The nicotine content was 8.9 mg/g in Camel Snus Winterchill and 9.5 mg/g in Camel Snus Robust (wet weight of product), and the levels of unprotonated nicotine were 1.6 mg/g and 2.1 mg/g, respectively. Participants were asked to smell each of the products and to try them for up to 5 min. Participants indicated their preferred flavor (Winterchill vs. Robust) of which they were given 4 tins to use at home. Participants were instructed to use as much or as little of the product as they wanted over a 7 day period. During these 7 days, participants were allowed to smoke. Participants could request more snus if needed.

2.3. Sensory assessments

In addition to the tobacco use and nicotine dependence (FTND), this study incorporated a number of sensory measures designed to tap into participants' subjective responses to the products themselves. Some dimensions of interest include odor identification, odor intensity (measured on a Likert-type scale), and odor hedonics (pleasantness-unpleasantness), as well as touch sensations and hedonics drawn from approaches used in the food, cosmetics, tobacco, and textile industries for assessing sensory responses (Dravnieks, 1982; Meilgaard, Civille, Carr, & Civille, 2006; Pederson & Nelson, 2007). Our Odor/Haptics scale consisted of a list of 31 odor descriptors (i.e., sweet, peppermint, bitter, etc.) that preliminary work showed some response for smokeless tobacco products, each rated on a 1–6 ('not at all' to 'very much') scale. Odor intensity was rated on a 0–6 (none to intolerable) scale, and odor pleasantness was assessed on a 1–5 ('extremely pleasant' to 'extremely unpleasant') scale. In addition, participants rated the products using the Product Evaluation Scale (PES), which is a 7-point Likert scale (Hatsukami, Zhang, O'Connor, & Severson, 2013), as well as the Drug Effects Questionnaire (DEQ), a 100 mm visual analog scale with descriptive anchors including "not at all" and variants of "extremely" (de Wit & Phillips, 2012; Morean et al., 2013).

Frequency distributions were used to initially characterize the data and statistical comparisons were carried out by the Chi-square and Fisher's exact test, and non-parametric methods including the two-sample Wilcoxon rank-sum test, the Kruskal-Wallis test and the bivariate Spearman correlation coefficient given non-normal distributions. Multivariate logistic regression was performed to identify subject characteristics and subjective measures related to product preference. p-Values < 0.05 were considered statistically significant. All analyses were carried out using SAS 9.3 (SAS Institute, Inc., Cary NC).

3. Results

3.1. Flavor selection and participant demographics

Table 1 describes the profile of participants by preferred flavor. Most participants were White males, averaged about 39 years of age, about half had lifetime experience with smokeless tobacco, and about 40% used menthol cigarettes. Only FTND was significantly different between preferred flavors, the median score for those who chose Winterchill higher compared to those who chose Robust (4 vs. 3, Wilcoxon rank sum p-value = 0.017). On average, participants smoked about 17 cigarettes per day, and have been smoking for 12 to 15 years.

3.2. Ratings that differentiate menthol flavored vs. tobacco flavored products

Participants clearly distinguished the characteristic odors of Winterchill and Robust products. Winterchill scored much higher than Robust on mint- and coolness-related odors, while Robust scored higher than Winterchill on plant-related odors (see Fig. 1). Within each product flavor, the rated intensity of Winterchill was marginally predictive of Winterchill selection ($p = 0.055$). Though there was no apparent difference in the group medians, those who selected Robust tended to have higher scale values on intensity (range 3–6) than those who selected Winterchill (range 1–6). Intensity ratings of Robust were not significantly related to Robust selection ($p = 0.18$), though the median score for those who chose Robust was lower (3, range 2–5) than for those who chose Winterchill (4, range 0–6). Ratings of odor pleasantness were also predictive of product selection. Those who selected Winterchill were more likely to rate its odor as pleasant or extremely pleasant (80%) than those who selected Robust (43.9%; $p < 0.001$). This also held for ratings of Robust, though pleasantness was lower for this product overall. Those who selected Robust were more likely to have rated it pleasant or extremely pleasant (39.0%) versus those who

Table 1
Participants' demographic characteristics according to product selection.

Characteristic	Selected Winterchill N = 110 Frequency (%)	Selected Robust N = 41 Frequency (%)	p-Value*
Site			0.309
UMINN	25 (22.7%)	5 (12.2%)	
OSU	78 (70.9%)	32 (78.1%)	
RPCI	7 (6.4%)	4 (9.8%)	
Gender			1.00
Male	68 (61.8%)	26 (63.4%)	
Female	42 (38.2%)	15 (36.6%)	
Race - white			1.00
No	23 (20.9%)	8 (19.5%)	
Yes	87 (79.1%)	33 (80.5%)	
FTND			0.017
0	3 (2.7%)	0 (0.0%)	
1	2 (1.8%)	2 (4.9%)	
2	12 (10.9%)	8 (19.5%)	
3	35 (31.8%)	18 (43.9%)	
4	29 (26.4%)	8 (19.5%)	
5	20 (18.2%)	5 (12.2%)	
6	8 (7.3%)	0 (0.0%)	
9	1 (0.9%)	0 (0.0%)	
Prior smokeless use			1.00
No	58 (52.7%)	22 (53.7%)	
Yes	52 (47.3%)	19 (46.3%)	
Usual brand menthol			0.194
No	61 (55.5%)	28 (68.3%)	
Yes	49 (44.6%)	13 (31.7%)	
Variable	Mean (SD) Median [range]	Mean (SD) Median [range]	p-Value
Age in years	39.2 (12.2) 39.5 [19/83]	39.9 (12.5) 37.0 [21/71]	0.743
CPD at visit 93	17.5 (8.3) 15.0 [6/45]	16.8 (6.6) 15.0 [6/40]	0.924
Years of use at this CPD	12.5 (11.5) 10.0 [0.02/44]	14.7 (12.9) 10.0 [0.33/46]	0.370

* The p-value for the comparison between the two flavors is from the Chi-square, Fisher's exact test and Wilcoxon rank sum test.

did not select Robust (21.8%; p = 0.005).

3.3. Predictors of selection of tobacco products

For the PES and DEQ subscales, participants who went on to select Winterchill tended to have higher scores on that product in initial ratings, while those who selected Robust tended to have higher scores on Robust (see Table 2).

Based on this pattern of results, we decided to examine difference scores on each of the PES and DEQ scales, as well as odor intensity and pleasantness, between ratings of Winterchill and Robust (calculated as Winterchill score − Robust score).

FTND was positively associated with difference in PES-satisfaction, r_s = 0.24 (p = 0.004), but was not significantly associated with other PES or DEQ difference scores. We saw no association of difference scores with age. Men tended to have more negative difference scores for DEQ-'feel any effects?' than women (p = 0.031). Whites had a higher median (1.3) for the difference in PES-satisfaction compared to a median of 0.5 for non-whites, though this did not quite achieve traditional levels of significance (p = 0.075). Those who had used smokeless tobacco in the past had more negative difference scores for DEQ-'feel any effects?' than non users (p = 0.005). For those whose usual brand was menthol, a more negative difference score than those with non-menthol was seen (p = 0.037).

3.4. Multivariate analysis

Due to the large number of items, demographic factors were initially entered, and only those with a p-value < 0.15 were retained — only FTND (p = 0.044) met this criteria. Next, the DEQ differences were entered. From this model, 'liked the product?' (p = 0.065) and 'Use the product again?' (p = 0.036) met retention criteria. Next, the PES differences and the intensity/pleasant differences were entered. PES-satisfaction (p < 0.001), PES-aversion (p = 0.094), intensity of the odor (p = 0.029) and how pleasant was the odor (p = 0.003) were all retained (Model 1). The model was then refined to retain only variables with a p-value < 0.05 (Model 2); this had minimal impact on model fit as assessed by AUC (0.97 in Model 1, 0.96 in Model 2) (Table 3).

Interpreting Model 2, for every one unit difference in satisfaction, the odds of selecting Winterchill increased > 5 fold. Similarly, for every one unit difference in aversion, the odds of selecting Winterchill dropped by 3 fold. For every one unit change in odor intensity, the odds of selecting Winterchill increased by over 2 fold. And, finally, for every one unit change in odor unpleasantness, the odds of selecting Winterchill dropped by over 3 fold. That is, those who found Winterchill to be more satisfying, less aversive, and having a more intense, more pleasant odor than Robust were substantially more likely to select Winterchill for their one week trial.

4. Discussion

Participants in the study, all current smokers, and about half of whom had prior experience with some form of smokeless tobacco, showed a strong preference for Winterchill (a mint flavor) over Robust (a tobacco-dominant flavor). This is consistent with earlier reports (Meier et al., 2016; Oliver et al., 2013) which showed that mint-flavored products were preferred by both smokers and ST users, but this preference was unrelated to dependence or exposure measures.

The current study showed the utility of an odor perception measure

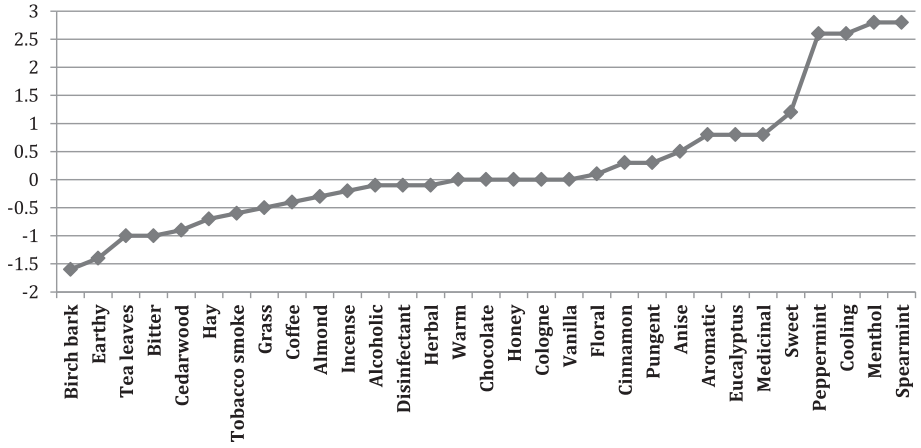

Fig. 1. The mean difference in degree of odor for Winterchill minus Robust (N = 151). Items are from the short form and the scores range from 1 to 6.

Table 2
Sensory assessment scores of Winterchill and Robust by the product chosen for the Camel Snus trial.

PES subscale		Choose *Winterchill* for trial		Choose *Robust* for trial		p-Value
		N	Median (min/max)	N	Median (min/max)	
Satisfaction	Winterchill	110	3.3 (0.5/6.0)	41	1.5 (0.0/5.0)	< **0.001**
	Robust	110	1.5 (0.0/5.5)	41	2.8 (0.0/6.0)	< **0.001**
Psychological	Winterchill	110	1.2 (0.0/6.0)	41	1.2 (0.0/4.2)	0.863
	Robust	110	0.4 (0.0/4.0)	41	1.6 (0.0/5.0)	< **0.001**
Aversion	Winterchill	110	0.0 (0.0/3.8)	41	1.0 (0.0/4.5)	< **0.001**
	Robust	110	0.3 (0.0/4.5)	41	0.5 (0.0/4.5)	0.377
Relief	Winterchill	110	2.6 (0.0/6.0)	41	2.0 (0.8/6.0)	0.234
	Robust	110	2.1 (0.0/5.6)	41	2.6 (0.6/6.0)	**0.004**
DEQ questions						
Feel any effects?	Winterchill	100	2.0 (0.0/10.0)	41	3.0 (0.0/10.0)	0.237
	Robust	103	1.0 (0.0/10.0)	38	3.0 (0.0/10.0)	**0.007**
Any good effects?	Winterchill	104	4.0 (0.0/10.0)	41	2.0 (0.0/8.0)	**0.003**
	Robust	101	3.0 (0.0/10.0)	41	3.0 (0.0/10.0)	0.073
Any bad effects?	Winterchill	92	0.0 (0.0/8.0)	40	1.0 (0.0/10.0)	< **0.001**
	Robust	94	1.0 (0.0/10.0)	37	0.0 (0.0/7.0)	0.312
Like the product?	Winterchill	109	5.0 (0.0/10.0)	41	3.0 (0.0/10.0)	< **0.001**
	Robust	102	3.0 (0.0/10.0)	41	5.0 (1.0/10.0)	**0.001**
Desire the product?	Winterchill	106	3.5 (0.0/10.0)	41	1.0 (0.0/8.0)	**0.001**
	Robust	100	1.0 (0.0/10.0)	41	3.0 (0.0/10.0)	**0.001**
Use the product again?	Winterchill	110	5.0 (0.0/10.0)	41	2.0 (0.0/10.0)	< **0.001**
	Robust	102	2.0 (0.0/10.0)	41	5.0 (0.0/10.0)	< **0.001**

Bolded values are statistically significant ($p < .05$).

Table 3
Odds of selecting Winterchill by subjective measures.

Variable	Odds ratio (OR)[a]	95% CI for OR	p-Value
Model 1: logistic regression for the odds of selecting Winterchill (N = 141)			
FTND	1.06	0.65, 1.71	0.823
DEQ-diff: like product	1.25	0.86, 1.80	0.239
DEQ-diff: use product again	1.26	0.90, 1.77	0.184
PES-diff: satisfaction	3.39	1.57, 7.34	0.002
PES-diff: aversion	0.21	0.05, 0.88	0.033
Odor intensity-diff	2.73	1.11, 6.73	0.029
How unpleasant is odor-diff	0.24	0.09, 0.63	0.004
Model 2: logistic regression for the odds of selecting Winterchill (N = 151)			
PES-diff: satisfaction	5.14	2.51, 10.53	< 0.001
PES-diff: aversion	0.32	0.09, 1.08	0.067
Odor intensity-diff	2.51	1.14, 5.50	0.022
How unpleasant is odor-diff	0.29	0.13, 0.65	0.003

[a] All the odds ratios are associated with a one unit increase for each covariate.

to distinguish a mint flavored product from a tobacco-flavored one. Such measures could be increasingly useful given greater attention to the issue of characterizing flavors. The data here also suggest that subjective effect measures such as the PES and DEQ are capable of differentiating products in terms of flavor preference. However, other data from this same trial (O'Connor et al., 2017) suggest that while the PES and DEQ can predict the initial amount of product used during one week of sampling, they did not predict longer-term use (as assessed by trial enrollment and retention).

Interestingly, in the current study menthol status of their current cigarette brand was not related to preference of Winterchill over Robust, suggesting that this was not simply a matter of transferred sensory preference – even nonmenthol smokers were more likely to choose Winterchill over Robust. This suggests a basic attractiveness to mint flavorings, perhaps because they mask any unpleasant sensations from using an oral tobacco product. Other research suggests that the levels of menthol and methyl salicylate (wintergreen flavoring) are substantially higher in smokeless tobacco products than in confectionary products (Chen, Isabelle, Pickworth, & Pankow, 2010).

Beyond menthol, flavorings more broadly present challenges for tobacco control. Sweet flavorings in particular are popular in electronic cigarettes (Krishnan-Sarin, Morean, Camenga, Cavallo, & Kong, 2015), and appear to enhance appeal relative to other flavors (Goldenson et al., 2016). It is suggested that the preference for a sweeter flavor may be innate, that is developed to facilitate consumption of carbohydrates (i.e., mothers' milk) and also avoidance of acidic and bitter toxins (Mennella & Beauchamp, 2002; Ventura & Mennella, 2011). Furthermore, the preference for sweet flavors is not correlated with the level of sugar intake, which also suggests that it may not be a learned behavior (Mennella, Finkbeiner, Lipchock, Hwang, & Reed, 2014). This suggests that in addition to menthol/mint, consideration of sweeter flavors is warranted.

This study is subject to a number of limitations. Participants were recruited from multiple sites, and while no effects were statistically significant, there was suggestive evidence for differential ratings and preferences across sites, which could reflect either characteristics of the underlying local study population or differences in the fine operational details of study conduct across sites. The two products, while similar, were not identical in terms of nicotine content and possibly other constituents, which adds to uncertainty. In addition, this is the first study, to our knowledge, to use the Odor/Haptics scale to assess the sensory attributes of snus.

The finding that mint flavored oral products appear to be preferred by smokers in a clinical trial context represents a conundrum given other evidence suggesting flavorings make tobacco products more attractive to youth. Flavors may be necessary to interest cigarette smokers in novel nicotine products and draw them away from smoking. Yet, the availability of flavored nicotine products may also function to draw youth into tobacco product use. A potential regulatory approach may be to consider a broad prohibition of characterizing flavors in tobacco products. Regulators could then consider allowing flavorings in designated MRTPs if premarket evidence were provided on population impact of potentially shifting smokers to flavored product vs. potential uptake in youth, taking into account the relative toxicity of a product.

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decision to submit the paper for publication.

Contributors

DKH, PGS, and RJO designed the study and wrote the protocol. LMS conducted literature searches and provided summaries of previous research studies. BRL conducted the statistical analysis. Author LMS wrote the first draft of the manuscript and all authors contributed to and have approved the final manuscript.

Conflict of interest

All authors declare that they have no conflicts of interest.

References

Board of Supervisors of the County of Santa Clara (2014). *An ordinance of the Board of Supervisors of the County of Santa Clara Amending Chapter XXIII of Division A18 of the Santa Clara County Ordinance Code relating to permits for retailers of tobacco products and/or electronic smoking devices.* (Santa Clara).

Chen, C., Isabelle, L. M., Pickworth, W. B., & Pankow, J. F. (2010). Levels of mint and wintergreen flavorants: Smokeless tobacco products vs. confectionery products. *Food and Chemical Toxicology*, *48*(2), 755–763. http://dx.doi.org/10.1016/j.fct.2009.12.015.

City of Providence (2012). *An ordinance amending Article XV of Chapter 14 of the Code of Ordinances of the City of Providence.* (Providence).

Commissioner of Health and Mental Hygiene (2010). Chapter 28: Restriction on the sale of certain flavored tobacco products. New York City. Retrieved from https://www1.nyc.gov/assets/doh/downloads/pdf/smoke/flavored-law-implementing-rules.pdf.

Courtemanche, C. J., Palmer, M. K., & Pesko, M. F. (2017). Influence of the flavored cigarette ban on adolescent tobacco use. *American Journal of Preventive Medicine*. http://dx.doi.org/10.1016/j.amepre.2016.11.019.

Dravnieks, A. (1982). Odor quality: Semantically generated multidimensional profiles are stable. *Science*, *218*(4574), 799–801.

Emanuel, R., Thompson, A., & Mitts, A. (2013). Amendment of Chapter 4–64 of Municipal Code by adding new Section 4-64-098 regarding flavored tobacco products and amending Section 4-64-180 (a) no person shall sell tobacco products or accessories within 100 feet of any building, school or child care facility; (b) no person shall sell tobacco products at any location within 500 feet of public, private or parochial elementary school or secondary school. Chicago. Retrieved from https://www.cityofchicago.org/content/dam/city/depts/bacp/tobacco/flavoredtobaccord04212014.pdf.

Feirman, S. P., Lock, D., Cohen, J. E., Holtgrave, D. R., & Li, T. (2016). Flavored tobacco products in the United States: A systematic review assessing use and attitudes. *Nicotine & Tobacco Research*, *18*(5), 739–749. http://dx.doi.org/10.1093/ntr/ntv176.

Goldenson, N. I., Kirkpatrick, M. G., Barrington-Trimis, J. L., Pang, R. D., McBeth, J. F., Pentz, M. A., ... Leventhal, A. M. (2016). Effects of sweet flavorings and nicotine on the appeal and sensory properties of e-cigarettes among young adult vapers: Application of a novel methodology. *Drug and Alcohol Dependence*, *168*, 176–180. http://dx.doi.org/10.1016/j.drugalcdep.2016.09.014.

Hatsukami, D. K., Zhang, Y., O'Connor, R. J., & Severson, H. H. (2013). Subjective responses to oral tobacco products: Scale validation. *Nicotine & Tobacco Research*, *15*(7), 1259–1264. http://dx.doi.org/10.1093/ntr/nts265.

Henkler, F., & Luch, A. (2015). European tobacco product directive: How to address characterizing flavors as a matter of attractiveness? *Archives of Toxicology*, *89*(8), 1395–1398. http://dx.doi.org/10.1007/s00204-015-1563-0.

Klein, S. M., Giovino, G. A., Barker, D. C., Tworek, C., Cummings, K. M., & O'Connor, R. J. (2008). Use of flavored cigarettes among older adolescent and adult smokers: United States, 2004–2005. *Nicotine & Tobacco Research*, *10*(7), 1209–1214. http://dx.doi.org/10.1080/14622200802163159.

Kostygina, G., & Ling, P. M. (2016). Tobacco industry use of flavourings to promote smokeless tobacco products. *Tobacco Control*, *25*(Suppl. 2), ii40–ii49. http://dx.doi.org/10.1136/tobaccocontrol-2016-053212.

Kozlowski, L. T. (2007). Effect of smokeless tobacco product marketing and use on population harm from tobacco use policy perspective for tobacco-risk reduction. *American Journal of Preventive Medicine*, *33*(6 Suppl), S379–386. http://dx.doi.org/10.1016/j.amepre.2007.09.015.

Krishnan-Sarin, S., Morean, M. E., Camenga, D. R., Cavallo, D. A., & Kong, G. (2015). E-cigarette use among high school and middle school adolescents in Connecticut. *Nicotine & Tobacco Research*, *17*(7), 810–818. http://dx.doi.org/10.1093/ntr/ntu243.

Meier, E., Isaksson Vogel, R., O'Connor, R. J., Severson, H. H., Shields, P. G., & Hatsukami, D. K. (2016). Preference for flavored noncombustible nicotine products among smokers motivated to switch from cigarettes. *Nicotine & Tobacco Research*, *18*(5), 892–893. http://dx.doi.org/10.1093/ntr/ntv259.

Meilgaard, M. C., Civille, G. V., Carr, B. T., & Civille, G. V. (2006). *Sensory evaluation techniques* (4th Edition). Boca Raton: CRC Press.

Mennella, J. A., & Beauchamp, G. K. (2002). Flavor experiences during formula feeding are related to preferences during childhood. *Early Human Development*, *68*(2), 71–82.

Mennella, J. A., Finkbeiner, S., Lipchock, S. V., Hwang, L. D., & Reed, D. R. (2014). Preferences for salty and sweet tastes are elevated and related to each other during childhood. *PloS One*, *9*(3), e92201. http://dx.doi.org/10.1371/journal.pone.0092201.

Morean, M. E., de Wit, H., King, A. C., Sofuoglu, M., Rueger, S. Y., & O'Malley, S. S. (2013). The drug effects questionnaire: Psychometric support across three drug types. *Psychopharmacology*, *227*(1), 177–192. http://dx.doi.org/10.1007/s00213-012-2954-z.

O'Connor, R. J., Lindgren, B. R., Schneller, L. M., Shields, P. G., & Hatsukami, D. K. (2017). Evaluating the utility of subjective effects measures for predicting product use and enrollment in a clinical trial of a smokeless tobacco product. *Addictive Behaviors* (in press).

Oliver, A. J., Jensen, J. A., Vogel, R. I., Anderson, A. J., & Hatsukami, D. K. (2013). Flavored and nonflavored smokeless tobacco products: Rate, pattern of use, and effects. *Nicotine & Tobacco Research*, *15*(1), 88–92. http://dx.doi.org/10.1093/ntr/nts093.

Pederson, L. L., & Nelson, D. E. (2007). Literature review and summary of perceptions, attitudes, beliefs, and marketing of potentially reduced exposure products: Communication implications. *Nicotine & Tobacco Research*, *9*(5), 525–534. http://dx.doi.org/10.1080/14622200701239548.

Talhout, R., van de Nobelen, S., & Kienhuis, A. S. (2016). An inventory of methods suitable to assess additive-induced characterising flavours of tobacco products. *Drug and Alcohol Dependence*, *161*, 9–14. http://dx.doi.org/10.1016/j.drugalcdep.2015.12.019.

Tomar, S. L. (2007). Epidemiologic perspectives on smokeless tobacco marketing and population harm. *American Journal of Preventive Medicine*, *33*(6 Suppl), S387–397. http://dx.doi.org/10.1016/j.amepre.2007.09.009.

US Department of Health and Human Services (2010). *How tobacco smoke causes disease: What it means to you*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.

US Food and Drug Administration. Tobacco Control Act. (2009). Retrieved from http://www.fda.gov/TobaccoProducts/GuidanceComplianceRegulatoryInformation/ucm246129.htm (August 7 2016) .

Ventura, A. K., & Mennella, J. A. (2011). Innate and learned preferences for sweet taste during childhood. *Current Opinion in Clinical Nutrition and Metabolic Care*, *14*(4), 379–384. http://dx.doi.org/10.1097/MCO.0b013e328346df65.

Villanti, A. C., Johnson, A. L., Ambrose, B. K., Cummings, K. M., Stanton, C. A., Rose, S. W., ... Hyland, A. (2017). Flavored tobacco product use in youth and adults: Findings from the first wave of the PATH study (2013–2014). *American Journal of Preventive Medicine*. http://dx.doi.org/10.1016/j.amepre.2017.01.026.

de Wit, H., & Phillips, T. J. (2012). Do initial responses to drugs predict future use or abuse? *Neuroscience and Biobehavioral Reviews*, *36*(6), 1565–1576. http://dx.doi.org/10.1016/j.neubiorev.2012.04.005.