Electronic Cigarette Users' Reactions and Responses to a Hypothetical Ban of Flavored Electronic Cigarette Liquids

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Abstract

Background: Regulations have been proposed to limit e-cigarette flavors, but limited research has examined potential impacts of such policies. This study examined adult e-cigarette users' reactions to a hypothetical e-cigarette flavor ban.

Methods: In 2019, a convenience sample of current e-cigarette users in the U.S. (n=81, 52.4% women, mean age=37.6, 59.3% dual users of cigarettes) completed an online concept mapping study. Participants provided statements describing anticipated reactions to a hypothetical policy in which only tobacco, menthol, or unflavored e-cigarettes were available for purchase. Seventy-one unique statements were generated. Participants sorted statements into thematic groups and rated statements on how likely they would be to have each reaction. Multidimensional scaling was used to identify thematic clusters of statements.

Results: Twelve clusters were identified: Negative Reaction, Take Action Against Flavor Limitation, Youth Prevention Effectiveness Perception, Tolerance, Acceptance, Willingness to Try

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Contribution Statement

ES, AB, MG, and PF conceptualized the study. ES led planning and conduct of the study. ES, SM, and WS contributed to data collection and analysis. WS and LT assisted with development of tables and figures. ES wrote the first draft of the manuscript and all authors provided critical review of the manuscript.

Conflicts of Interest

ES is named on a patent application for a smartphone app that determines electronic cigarette device and liquid characteristics. All other authors have no conflicts to report.

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New Flavors, Maintain Vaping, Reduce Vaping, New Flavors as Vaping Cessation Transition, Alternative Sources for Banned Flavors, Do-it-yourself Mixing Behaviors, and Alternative Tobacco Products. The highest rated cluster (Negative Reaction) described being angry or upset that flavors were banned, while the lowest rated clusters related to quitting/reducing e-cigarette use or switching to other tobacco products. Non-tobacco or non-menthol/mint flavored e-cigarette users had higher ratings for clusters describing negative sentiment for the hypothetical policy.

Conclusions: Some e-cigarette users may dislike an e-cigarette flavor ban, however, some e-cigarette users would likely be willing to use tobacco, menthol, or unflavored e-cigarette liquids with lower likelihood of quitting vaping or switching to other tobacco products.

Keywords

Electronic cigarettes (e-cigarettes) use an electric heater to aerosolize a liquid often containing propylene glycol, vegetable glycerin, nicotine, and chemical flavorants for user inhalation [1] and are available in a great variety of flavors. E-cigarette use has increased since e-cigarettes were introduced to the United States (U.S.) market in 2006. In the U.S., prevalence of current e-cigarette use (i.e., use in the past 30 days) among adults increased from 1.9% in 2012 [2] to 4.5% in 2019.[3] E-cigarette use among youth and young adults has increased more rapidly. In 2011, current e-cigarette use was reported by 1.5% of high school students and 0.6% among middle school students.[4] In 2020, current e-cigarette use was reported by 19.6% of high school students and 4.7% of middle school students in the U.S.[5]

There were more than 7,700 unique e-cigarette flavors in 2013 [6] and over 15,000 flavors in 2016.[7] Flavor is a less endorsed reason for use among adults 25 years and older compared to youth and young adults under the age of 25, and more adults 25+ years old prefer tobacco flavored e-cigarettes.[8] Conversely, flavored e-cigarette products are appealing to youth,[9,10] who use non-tobacco sweet flavors most commonly.[11] Among youth, the availability of appealing flavors is the most important factor when trying e-cigarettes [12] and is a frequently reported reason for use.[13] Data from 2020 show that 84.7% of high school students and 73.9% of middle school students who currently use e-cigarettes in the U.S. use non-tobacco flavored e-cigarettes.[14]

Policies have been proposed to prevent youth e-cigarette use. Some countries, such as India, have banned all e-cigarette products.[15] Others, including Canada, have proposed a ban on non-tobacco and non-menthol/mint flavored e-cigarette products,[16] while the U.S. announced an enforcement policy to remove non-tobacco and non-menthol flavored e-cigarettes in "cartridge-based" e-cigarette products from the market in January of 2020 and began removing products from the market after allowing manufacturers time to comply.[17] However, policy implementation and change in available products on the market may result in unintended consequences. Data are needed to inform possible outcomes of flavor-limiting e-cigarette policies.

One approach for examining the effect of policies before they are implemented is to ask consumers to report anticipated responses to a hypothetical policy, such as a ban of flavored tobacco products. Surveys of tobacco users have been used to examine anticipated impacts of hypothetical menthol cigarette bans [18–22] and responses can be predictive of actual behaviors after policy implementation.[23] While surveys allow researchers to gather data from many participants, the closed ended nature of surveys may not assess all the possible reactions to proposed policies. Concept mapping,[24] a mixed methods participatory approach, is ideally suited to examine potential impacts of policies restricting e-cigarette flavors and has been used previously to examine users' responses to implemented policies limiting flavored tobacco products.[25] This study's purpose was to examine e-cigarette users' reactions to a hypothetical policy limiting the availability of e-cigarette flavors to only tobacco, menthol, or unflavored.

Methods

Participants

This study was approved by the East Carolina University and Medical Center Institutional Review Board. In 2019 (prior to the implementation of the U.S. policy prohibiting non-tobacco and non-menthol flavored cartridge-based e-cigarette devices), current (past-30 day) e-cigarette users were recruited by posting advertisements at 24 randomly selected Craigslist locations from each of the four U.S. census regions (eight per region; as in [26,27]). Advertisements invited current e-cigarette users to complete a screening questionnaire. Research staff sent email invitations to eligible participants. Participants were eligible if they reported past 30-day e-cigarette use and were over the age of 18 at the time of screening. Eligible individuals were invited to participate (n=249) and 82 participants consented to participate in the study (response rate = 32.9% among those who completed the screening questionnaire and were invited to participate). However, one participant did not complete any study tasks after consenting, resulting in a final sample of 81.

Brainstorming

At the study website (The Concept System® Global MAX™), participants completed a demographic questionnaire including items assessing e-cigarette/tobacco use and product preferences. Preferred e-cigarette flavor was assessed using the question, "Which of the following best categorizes the e-liquid/e-juice flavors (i.e., smell and taste) you used the most in the past 30 days?" After the questionnaire, participants brainstormed statements that completed the prompt, "If e-liquid flavors were limited so that the only e-liquid flavors available for purchase in the U.S. were tobacco only flavor, menthol only flavor, or unflavored (and no other flavors), what is a specific action you would take or a specific reaction you would have?" To increase understanding, detailed instructions provided examples of flavors that would be prohibited, including fruit, sweet, chocolate, flavors with spices, as well as "ice" flavors (such as "strawberry-ice"). Participants were encouraged to provide multiple statements. Each statement was added to an ongoing list that was visible to other participants such that participants who completed the brainstorming task after others were able to see statements generated previously. Participants were asked to review previous statements and attempt to avoid duplicating previous content. Having participants

contribute to a shared statement list, but complete the task individually prevents interference due to having to wait one's turn to speak (as in a focus group setting) [28] and also can generate more [29,30] unique [31,32] ideas. Statements were monitored by the study team and when content saturation was reached (i.e., additional participants no longer provided unique content), a final reminder email was sent to the invited participants to complete the brainstorming task. After three days, the brainstorming task was closed. A total of 81 participants generated 153 statements and each participants received $10 for completing brainstorming.

After brainstorming, three reviewers examined each statement independently to identify statements that did not relate to the prompt or did not describe a specific reaction or response (e.g., "WHO DOES THAT???") as well as statements that represented duplicate content (e.g., "I would try to quit" and "I would work on quitting"). Statements were candidates for removal if two or three reviewers identified statements as not relating to the prompt. These statements were removed based on group discussion to reach consensus among the reviewers that the statement did not relate to the prompt. Similarly, when multiple statements were identified by two or three reviewers as representing redundant content, the statements were identified as candidates for removal. Based on group discussion and consensus, the statement that was the simplest (i.e., fewest words) that best conveyed the idea was retained and all others were removed. After review, 71 statements were retained. The study team reviewed and edited statements for consistency (e.g., "vaping" used throughout for e-cigarette use) and corrected grammar and spelling errors.

Sorting

All participants that completed the brainstorming task (n=81) were invited to return to the study website to complete a sorting and rating task. For sorting, participants grouped statements into "piles" of similar content with the following instructions: piles were to represent a single idea or theme, there could not be an "other/miscellaneous" pile or pile that grouped statements relating to multiple themes together, and all statements could not be in a single pile. This task was completed by each participant independently. The research team reviewed each participant's sorting and contacted those who did not follow instructions. After review, 54 participants completed sorting, however, 15 did not follow instructions and did not return to the study website to complete sorting correctly. Thirty-nine participants completed the sorting task according to instructions, consistent with the number of participants needed to achieve good model fit based on a pooled analysis of concept mapping studies.[33] Participants received $25 for completing sorting.

Rating

Participants were asked to rate each of the 71 statements based on the prompt, "This is an action I would take or a reaction I would have if the only e-liquid flavors available for purchase in the U.S. were tobacco only, menthol only, or unflavored (and no other flavors)," with response options ranging from 1 (Definitely NOT true for me) to 7 (Definitely true for me). Research staff reviewed participants' rating responses for straightlining or obvious patterns in responses. Fifty participants completed the rating task and received $10.

Representation

A 71×71 matrix of similarities was generated that identified the number of times statements were sorted together by participants. Using an algorithm,[34] nonmetric multidimensional scaling (MDS) of participant sorting data was used to create a point map (see Figure 1). Each point on the map represented a statement with the location corresponding to sorting data, such that points that were closer together represented statements that were sorted together by more participants and thus represented similar content. The final stress of the model, an indicator of congruence between sorting data and the MDS,[35] was 0.25, consistent with previous concept mapping studies indicating good model fit.[33]

Analysis and Interpretation

To identify content themes, an algorithm [36] was used to identify clusters of statements that limited the total distance between points on the point map to the centroid of the identified cluster of statements. First, a two-cluster model was examined. Subsequent models were examined in a hierarchical cluster analysis process by using the same algorithm to identify additional clusters of statements by separating one cluster from the previous model into two clusters. For example, a three-cluster model was created by separating one cluster from a two-cluster model into two clusters and leaving the other cluster the same. This procedure was repeated, and the research team examined each model until a final model was identified that was most parsimonious (i.e., fewest clusters preferred) with each cluster only describing a single idea or theme. The final model was determined based on group consensus. Mean cluster ratings were calculated by averaging the ratings of each statement within each cluster by all participants who completed the rating task. Mean cluster ratings were compared between participants based on their preferred e-cigarette liquid flavors and e-cigarette device type using independent *t*-tests.

Results

Participant Characteristics

As displayed in Table 1, the mean age of participants was 37.6 (SD=11.4) and the majority identified as women (53.1%), non-Hispanic (85.2%), and White/European American (74.1%). Regular e-cigarette use for 1 year or more was reported by 60.5% of the participants. On the days participants used e-cigarettes, over half (54.4%) reported using e-cigarettes "almost always throughout most of the day" or "fairly frequently throughout the day." Most common regular e-cigarette devices included pod mods (39.5%), rebuildable/box mods (29.6%), or disposable e-cigarettes (13.6%). Just under one-third reported that their preferred e-cigarette liquid flavor was menthol/mint (30.9%), followed by fruit (24.7%) or other flavors (24.7%) including clove, spice, nut, alcoholic drink, coffee/tea, candy, or dessert. No participants reported using unflavored e-cigarettes. Most (86.4%) reported 100+ lifetime cigarettes and 59.3% reported current cigarette smoking.

Reactions and Responses to a Hypothetical Flavor Restriction Clusters

A 12-cluster model was determined to be the best fit (see Figure 1). Each cluster is described below in groups of related clusters (see Table 2).

Cognitive, Emotional, and Protesting Reactions to Policy—The first group of four clusters described perceptions that e-cigarette users would have negative reactions to a flavor-limiting policy. The first cluster, *Negative Reaction*, had the most statements of all clusters (n=11) and the highest mean cluster rating (M=4.68 out of 7, SD=0.80). The statements described disapproval and negative affect as anticipated responses, such as the highest rated of all statements in the study, "I would think consumers have a right to choose what they want to buy." Other statements described that e-cigarette users would "hate" or be upset by the policy because they enjoyed flavors and that flavors helped some quit smoking cigarettes. The next highest rated cluster in this group, *Youth Prevention Effectiveness Perceptions* (n=5 statements, M=4.04, SD=0.49), described anticipation of mixed beliefs regarding how the policy may be effective in preventing youth from using e-cigarettes or tobacco products. Statements were opposed, with some describing perceptions that a flavor ban would be ineffective and inappropriate, while others described how the ban may deter youth from tobacco use due to not being targeted with flavored e-cigarette liquids. Despite describing positive and negative sentiment towards the flavor-limiting policy, all statements shared a common theme of perceptions related to the appropriateness or effectiveness of the hypothetical policy.

The statements in the *Take Action Against Flavor Limitation* cluster (n=7 statements, M=3.58, SD=0.62) described plans to take political or other actions to directly affect or challenge the flavor-limiting policy. Actions included "never vote for anyone who backed the ban," "protest the flavor limitation," or "post about the flavor limitation on social media." The last cluster in this group, *Tolerance* (n=4, M=3.63, SD=0.23) described similar disappointment or disapproval of a flavor-limiting policy, however, statements suggested that participants perceived they would tolerate the ban and would not take any actions to change the policy.

Adapting to and Accepting Flavor Limitation—The next group of three clusters described more neutral to positive responses to a flavor-limiting policy. The cluster with the most statements in this group, *Acceptance* (n=9, M=3.61, SD=0.51) described being content and grateful that all flavors were not removed. One statement compared flavors in e-cigarette liquids to cigarettes: "I would think menthol and non-menthol are how cigarettes come, so it makes sense for e-liquid too." Several statements also described how e-cigarette users may desire or miss non-tobacco or non-menthol flavors, but in general e-cigarette users would not be affected by limiting e-cigarette flavors to only tobacco, menthol, or unflavored. The highest rated cluster in this group, *Willingness to Try New Flavors* (n=5, M=4.43, SD=0.26) included statements describing how e-cigarette users would try menthol, tobacco, and unflavored liquids to see if they liked them. Similarly, the highest rated statement in this cluster indicated that e-cigarette users would try the new flavors that were available and continue to use them if they were "tolerable." One statement also described curiosity about unflavored liquids. The last cluster in this group, *Maintain Vaping Behaviors* (n=7, M=3.93, SD=0.50) included statements that described how e-cigarette users would maintain their same e-cigarette use behaviors, but with the new e-cigarette flavors. Several statements described how e-cigarette purchasing and use would not change after the flavor limitation.

One statement suggested a strategy of alternating between tobacco and menthol flavors, and several statements described a preference for menthol flavored liquid.

E-cigarette Use Reduction and Cessation—Two related clusters included statements that described intentions to decrease e-cigarette use after a flavor limitation. The *Reduce Vaping* cluster (n=4, M=3.23, SD=0.25) included statements that described intentions to "consider quitting" e-cigarette use if a preferred flavor was affected, "slowly taper down" e-cigarette use, "vape less", and "quit vaping." The *New Flavors as Vaping Cessation Transition* cluster (n=5, M=3.23, SD=0.25) had the same mean rating as the *Reduce Vaping* cluster, but most statements in this cluster described how participants would use the new flavors as part of a transition away from e-cigarette use.

Alternative E-cigarette Liquid Sources and Tobacco Products—The final group of three clusters described attempts to continue e-cigarette use with flavors beyond tobacco, menthol, or unflavored liquid or use other tobacco products. The *Alternative Sources for Banned Flavors* cluster had the highest rating and most statements (n=8, M=3.95, SD=1.02) in this group, however, there was a large range in mean statement ratings. For example, higher rated statements in this cluster included "Stock up on the e-liquid I currently use" (M=5.44), "Try to find a place that still has the flavored e-liquid" (M=5.28), and "I would buy my current e-liquid flavors online" (M=4.80). Lower rated statements included "Look into buying flavored e-liquids off the dark web" (M=2.82) and "Buy 'black market' e-liquid" (M=2.56).

The *Do-it-yourself Mixing Behaviors* cluster (n=4, M=3.44, SD=0.37) described e-cigarette users' planned attempts to create their own liquids (i.e., DIY liquids). Behaviors included adding flavors, learning how to make DIY liquids, adding flavors to the tobacco, menthol, or unflavored liquids that were available, or adding CBD or essential oils in e-cigarette liquids. The *Alternative Tobacco Products* cluster had three statements, had the lowest mean cluster rating (M=2.73, SD=0.73), and identified smoking cigarettes, hookah, or using smokeless tobacco as an alternative to e-cigarette use if flavors were limited.

Mean Cluster Comparisons

Mean cluster ratings were associated with preferred e-cigarette liquid flavor. As displayed in Figure 2, compared to participants who reported tobacco or menthol/mint as their preferred e-cigarette liquid flavor, participants who reported using other flavors that would be prohibited in the hypothetical flavor limitation had higher ratings (i.e., rated as more true) for the *Negative Reaction* (t=3.11, p<0.01), *Take Action Against Flavor Limitation* (t=2.48, p<0.05), and *New Flavors as Vaping Cessation Transition* clusters (t=3.00, p<0.05). Non-tobacco and non-menthol/mint flavor users had lower ratings for *Acceptance* (t=6.51, p<0.001)*, Maintain Behaviors with New Flavors* (t=5.46, p<0.001)*,* and *Willingness to Try New Flavors* (t=7.14, p<0.001) clusters.

Mean cluster ratings also differed by e-cigarette device type. Compared to those who used pod mod or disposable devices, mechanical/box mod users had higher ratings for the *Negative Reaction* cluster (t=3.35, p<0.005) and lower ratings for the *Acceptance* (t=6.81,

p<0.001)*, Maintain Behaviors with New Flavors* (*t*=5.34, *p*<0.001), and *Willingness to Try New Flavors* (*t*=8.31, *p*<0.001) clusters.

Discussion

This study identified 12 themes describing current e-cigarette users' responses to a hypothetical policy prohibiting the sale of flavored e-cigarette products besides tobacco, menthol, and unflavored products. Reported responses included those describing tolerance, acceptance, or even support for an e-cigarette flavor-limiting policy. Other responses described negative emotions in response to the policy, with some statements describing planned actions in attempts to challenge or change the new policy. Finally, some responses described behaviors e-cigarette users might engage in to adapt to a flavor-limiting policy, including trying the new flavors, reducing or quitting e-cigarette use, or seeking alternative sources to access e-cigarette or other products with desired flavors.

Findings from this study are consistent with previous research examining bans on flavored e-cigarettes. In the current study, non-tobacco or non-menthol/mint e-cigarette users had higher ratings for the *New Flavors as Vaping Cessation Transition* cluster compared to tobacco or menthol/mint flavored e-cigarette users. This is similar to findings from a study examining responses to a hypothetical e-cigarette flavor ban among e-cigarette users recruited from vape shops in California in which non-tobacco flavored e-cigarette users were less likely to report planning to continue e-cigarette use after a flavor ban.[38] Additionally, those who reported e-cigarette use for smoking cessation reported they would be more likely to continue e-cigarette use with tobacco-only flavors if all non-tobacco flavored e-cigarettes were banned.[38] These data in combination with the findings displayed in Figure 2 of the current study which demonstrate greater acceptability of a flavor-limiting policy among tobacco or menthol/mint flavored e-cigarette users have important implications. If cigarette smokers are willing to use tobacco or menthol only flavored e-cigarettes, then a policy that limits e-cigarette flavors to only tobacco or menthol may prevent youth or tobacco naïve individuals from e-cigarette use while still maintaining e-cigarettes as an acceptable option for combustible cigarette smokers.

Other studies examining tobacco flavor bans have also described negative sentiment towards flavor bans, but limited evidence for unintended consequences. Similar to the *Negative Reaction* cluster, analyses of Twitter posts related to a flavor ban in New York State found that a vast majority of posts before and after an imposed flavor ban were negative.[39] While there is often mixed sentiment regarding support for a flavor ban,[18] many tobacco users report intentions to quit following a flavor ban.[20] Additionally, analyses of behaviors after tobacco product flavor ban implementation suggest tobacco use decreases after ban implementation [23,40,41] with minimal unintended consequences, such as "black market" purchasing behaviors.[25]

This study has important regulatory implications in the U.S. and globally. First, policies limiting e-cigarette flavors may be viewed unfavorably by e-cigarette users whose preferred flavors are eliminated. However, higher rated statements relating to trying new flavors suggest e-cigarette users may adapt to the reduced flavors and some e-cigarette users who

prefer non-tobacco and non-menthol flavors may consider reducing or quitting vaping. At the same time, having flavors that are known to be appealing to youth removed from the market may prevent youth e-cigarette use. High ratings for statements in the *Alternative Sources for Banned Flavors* cluster suggest that flavor-limiting policies need to consider that if available, e-cigarette users will likely seek out appealing flavors, and menthol may have higher appeal than tobacco flavor. One study of JUUL product sales found that after JUUL removed crème brulée, mango, and other flavors from the market in 2019, mint flavored JUUL products became the most popular products among high school students,[42] and menthol sales increased after mint was removed in 2020.[43] Other research suggests that flavor-limiting policies that are not comprehensive across all e-cigarette products will likely be ineffective: after all non-tobacco or non-menthol flavored cartridge-based e-cigarettes were removed from the U.S. market beginning in 2020, there was a rapid increase in disposable e-cigarette products that resembled cartridge-based products, but were available in flavors prohibited in cartridge-based products due to a regulatory loophole.[44,45]

Some statements indicated that e-cigarette users may attempt to obtain prohibited flavors through alternative sources, either the black market, make their own liquids, or stock up from locations that currently or continue to sell prohibited flavors. Unlike other flavored tobacco products, such as menthol cigarettes, flavored e-cigarette liquids can be made relatively easily in large quantities. As long as open system e-cigarettes remain available, regulating e-cigarettes and their devices will present challenges.[46] Because the primary ingredients in flavored e-cigarette liquids can be purchased easily, and all but nicotine likely fall outside of tobacco regulatory authority, regulators may consider product standards that prevent or limit the ability of consumers from adding non-authorized e-cigarette liquids to e-cigarette devices, such as requiring that e-cigarette devices be "closed-systems." Additionally, enforcement efforts following an e-cigarette flavor ban will likely need to ensure that e-cigarette retailers continue to sell only e-cigarette products in authorized flavors. Industry responses should also be monitored that would undermine the intended effects a flavor-limiting policy, such as the introduction of products that consumers can add to products to provide desired flavors/tastes.[47]

This study had several limitations. The sample size may limit generalizability to all e-cigarette users. However, participants included current e-cigarette users from 22 states across the U.S. and the sample size was appropriate for generation of content themes and is consistent with recommended sample sizes for concept mapping studies.[48] While menthol is derived from the mint plant, some policies may allow menthol flavors but prohibit mint flavors. The survey item in the current study assessing flavor preference did not distinguish between participants who preferred mint vs. menthol. Therefore, while this study treated mint and menthol as being allowed in the hypothetical policy, responses may have differed if mint was not included as an authorized flavor. Finally, while reported responses to a hypothetical flavor-limiting policy may be predictive of future behaviors, future research is needed to evaluate the consistency between the predicted behaviors reported in the current study and actual behaviors that result if a similar policy is implemented in the U.S.

A ban on flavored e-cigarettes may be seen as unpopular by some e-cigarette users whose flavors are impacted, but the current study and others suggest that policies limiting flavors in

tobacco products could have a positive public health impact (e.g., tobacco use reduction and decreased youth tobacco use). Indeed, proponents of e-cigarette use for smoking cessation or harm reduction suggest that eliminating flavored e-cigarettes "enhances their safety profiles and maintains the avenue as a possible smoking cessation aid" [49] and clinical laboratory studies demonstrate that tobacco flavored e-cigarettes can suppress withdrawal in current cigarette smokers (e.g., [50,51]). Results from the current study may provide insights into e-cigarette users' behaviors after flavor-limiting policies are implemented, with several behaviors highlighted in the current study already being documented after a ban on non-tobacco or non-menthol flavored cartridge-based e-cigarettes in the U.S. With data from the current study suggesting tobacco only flavored e-cigarettes may be acceptable among current e-cigarette users and some cigarette smokers, implementing policies that limit e-cigarette flavors to tobacco and menthol only (or tobacco only) would likely have a positive impact on public health, especially if these flavors have limited appeal to youth and non-tobacco users.

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Data Availability Statement

Deidentified data available upon reasonable request.

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What is already known about the topic:

Flavored tobacco products appeal to youth and young adults. Many jurisdictions have banned flavored combustible cigarettes (excluding menthol) and policies have been proposed and implemented in jurisdictions that limit flavors in e-cigarette products. Flavor-limiting policies have been associated with decreased tobacco product use previously, but little is known about the reactions and responses e-cigarette users may have if flavors were limited in e-cigarette products.

What this study adds:

This study identified adult e-cigarette users' anticipated reactions to a hypothetical policy that limited e-cigarette flavors to tobacco, menthol, or unflavored only. Some e-cigarette users may view a flavor-limiting policy with negative sentiment; however, some may support flavor-limiting policies and be willing to use tobacco or menthol e-cigarette flavors. Potential unintended consequences of e-cigarette flavor-limiting policies may include users attempting to obtain prohibited flavors from alternative sources that may increase risk to users, such as from black markets or making their own e-cigarette liquids. E-cigarette users rated switching to combustible tobacco products as less likely than other responses.

How this study might affect research, practice or policy:

This study provides data that suggest e-cigarette flavor-limiting policies would likely have a positive public health impact and also identifies potential unintended consequences of flavor-limiting policies. The data may allow regulators to anticipate and prevent unintended consequences of an e-cigarette flavor-limiting policy, such as informing surveillance efforts or supporting affected populations.
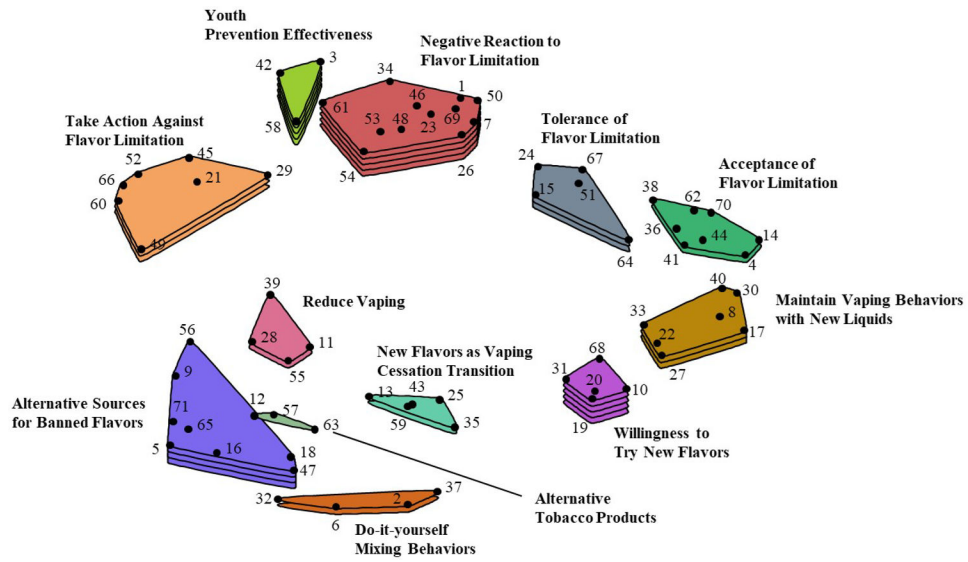
Figure 1.
Concept map displaying 12 e-cigarette user-identified clusters and statements describing a specific action/reaction if the only e-liquid flavors available for purchase in the U.S. were tobacco only flavor, menthol only flavor, or unflavored (and no other flavors). Numbered points on the map that are closer to one another represent statements of more similar content whereas points on the map that are further apart represent statements of less similar content. Greater number of layers in clusters indicate higher mean ratings of statements within each cluster based on the rating task.

Figure 2.

Pattern match of mean cluster ratings between e-cigarette users who report their preferred flavor as tobacco or menthol/mint (n=24) and e-cigarette users who report their preferred flavor as a non-tobacco or non-menthol/mint flavor (n=25). Asterisks (*) indicate significantly different mean cluster ratings between groups (ps<0.05).
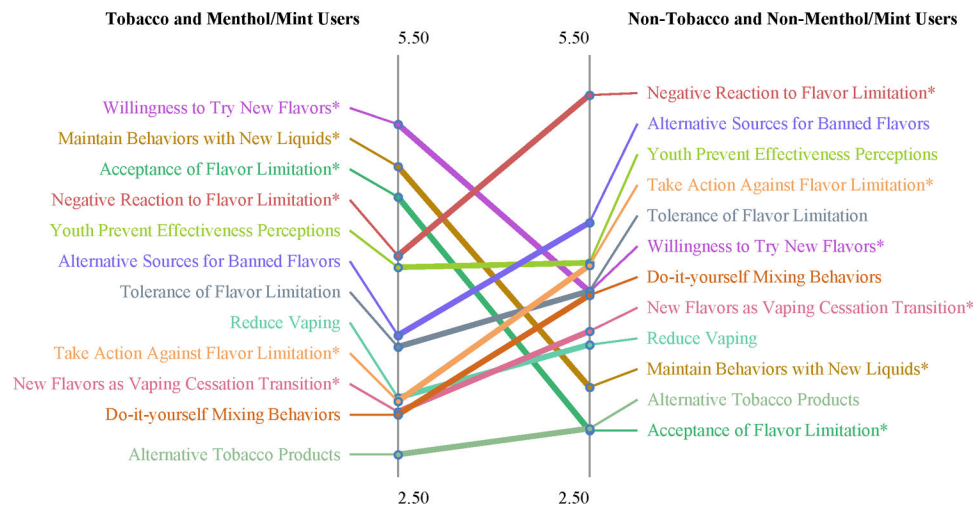
Table 1.

Sample demographics and e-cigarette/tobacco use characteristics (n=81).

Characteristic	N	%
Age (M, SD)	37.6	11.4
Gender		
Women	43	53.1
Men	33	40.7
Transgender or other	2	2.5
Did not respond	3	3.7
Ethnicity		
Hispanic/Latino(a)	12	14.8
Race		
American Indian/Alaskan Native	0	0
Asian	4	4.9
Native Hawaiian/Pacific Islander	1	1.2
Black/African American	11	13.6
White/European American	60	74.1
More than one race	2	2.5
Did not respond	4	4.9
Education		
High School diploma or GED	13	16.0
Some college credit, but less than 1 year	11	13.6
1 or more years of college, no degree	18	22.2
Associate's degree	10	12.3
Bachelor's degree	20	24.7
Higher than a bachelor's degree	6	7.4
Did not respond	4	4.9
Regular e-cigarette use history [1]		
0–3 months	5	6.2
4–6 months	10	12.3
7–12 months	16	19.8
Between 1–2 years	16	19.8
More than 2 years	33	40.7
Did not respond	2	2.5
E-cigarette use frequency		
At least once per day	12	14.8
Every once in a while throughout the day	24	29.6
Fairly frequently throughout the day	22	27.2
Almost always throughout most of the day	22	27.2
Did not respond	2	2.5
Regular e-cigarette device		
Prefilled disposable/Cig-alike	11	13.6

Characteristic	N	%
E-hookah	1	1.2
Vape pen/eGo style device	10	12.3
Rebuildable/Mechanical Mod or Box Mod	24	29.6
E-cigar	2	2.5
Pod mod such as JUUL	32	39.5
E-cigarette liquid nicotine concentration		
0–4 mg/ml	17	21.0
5–10 mg/ml	21	25.9
11–20 mg/ml	13	16.0
21–30 mg/ml	8	9.9
31–40 mg/ml	1	1.2
50–60 mg/ml	14	17.1
Don't know	5	6.1
E-cigarette liquid flavor preference		
Menthol or mint	25	30.9
Tobacco	14	17.3
Fruit	20	24.7
Other (including clove, spice, nut, alcoholic drink, coffee/tea, candy, or dessert)	20	24.7
E-cigarette use after waking		
After 60 minutes	20	24.7
31–60 minutes	16	19.8
6–30 minutes	19	23.5
Within 5 minutes	24	29.6
E-cigarette Dependence Scale - Reach for e-cigarette [2]		
Never	3	3.7
Rarely	8	9.9
Sometimes	30	37.0
Often	25	30.9
Almost always	13	16.0
E-cigarette Dependence Scale – Vape more before not allowed [2]		
Never	9	11.1
Rarely	7	8.6
Sometimes	24	29.6
Often	21	25.9
Almost always	18	22.2
E-cigarette Dependence Scale - Drop everything to buy e-cigarettes [2]		
Never	15	18.5
Rarely	20	24.7
Sometimes	28	34.6
Often	10	12.3
Almost always	5	6.2

Characteristic	N	%
E-cigarette Dependence Scale - Craving gets intolerable [2]		
Never	15	1853
Rarely	14	17.3
Sometimes	27	33.3
Often	17	21.0
Almost always	6	7.4
Lifetime use of 100+ cigarettes		
Yes	70	86.4
Current use of other tobacco products		
Cigarettes	48	59.3
Cigar	9	11.1
Cigarillo or little cigar	17	21.0
Smokeless	5	6.2
Waterpipe	15	18.5

Note. Total n and percentages for sample characteristics is based on the 81 participants who completed the participant questions.

[1] Regular use was defined as using an e-cigarette some days or most days.

[2] Items from the 4-item E-cigarette Dependence Scale [37] including "I find myself reaching for my e-cigarette without thinking about it," "I drop everything to go out and buy e-cigarettes or e-juice," I vape more before going into a situation where vaping is not allowed," and "When I haven't been able to vape for a few hours, the craving gets intolerable."

Table 2.

E-cigarette user-identified clusters and statements describing a specific action/reaction if the only e-liquid flavors available for purchase in the U.S. were tobacco only flavor, menthol only flavor, or unflavored (and no other flavors).

Cluster	Statement	Average Rating
Negative Reaction to Flavor Limitation		4.68
	34. I would think consumers have a right to choose what they want to buy.	5.84
	69. I would think that limiting the flavors is silly.	5.36
	26. I would feel bad for the people that liked different flavors.	5.00
	1. I would hate it because I enjoy vaping with flavored e-liquid as an outlet.	4.88
	50. I would not like the flavors being banned.	4.82
	48. I would hate it since it did help me/others quit cigarettes.	4.76
	46. I would be annoyed.	4.62
	7. I think that using the same flavor would get boring after a while.	4.47
	23. I would be upset.	4.44
	53. I would panic.	2.60
Willingness to Try New Flavors		4.43
	19. Try the new e-liquids and if they were tolerable, I would keep vaping.	4.70
	20. Vape/try the menthol flavored e-liquid to see if I liked it.	4.52
	31. Vape/try the unflavored e-liquid to see if I liked it.	4.50
	10. Vape/try the tobacco flavored e-liquid to see if I liked it.	4.48
	68. I would be curious about the unflavored e-liquid and be interested in trying it.	3.94
Perception of Youth Prevention Effectiveness		4.04
	3. I would think limiting flavors will not stop kids from vaping.	4.84
	42. I would wonder if having less flavors would reduce vaping among youth.	4.26
	58. I would be happy that kids are not being targeted with flavored e-liquids.	3.88
	54. I would think that it might make vaping less tempting to youth who shouldn't be using tobacco and/or nicotine products.	3.86
	61. Lose all respect for the U.S. government.	3.38
Alternative Sources for Banned Flavors		3.95
	9. Stock up on the e-liquid I currently use.	5.44
	18. Try to find a place that still has the flavored e-liquid.	5.28
	47. I would buy my current e-liquid flavors online.	4.80
	56. Talk to friends to find another option.	3.58
	5. Encourage others to make their own e-liquid.	3.56
	71. Find a way to order flavored e-liquid from outside the U.S.	3.56
	16. Look into buying flavored e-liquids off the dark web.	2.82
	65. Buy 'black market' e-liquid.	2.56
Maintain Vaping Behaviors with New Liquids		3.93
	17. Vape about the same as I do with my current e-liquid flavor(s).	4.68
	33. I would eventually adapt to the limited flavors.	4.50
	8. My e-liquid buying habits would stay the same.	4.10

Cluster	Statement	Average Rating
	30. I would be fine as long as menthol/mint flavored e-liquid is available.	3.88
	27. I would vape only menthol or unflavored e-liquids.	3.72
	40. I would enjoy the menthol flavored e-liquid – menthol is good.	3.44
	22. Alternate between tobacco only and menthol only flavors.	3.18
Tolerance of Flavor Limitation		3.63
	67. It would bother me, but not enough to go out and actively do anything about it.	3.88
	24. I like menthol flavored e-liquid, but it does get boring after a while.	3.76
	51. I would be mad, but I would tolerate the flavor ban.	3.60
	15. I would try these new flavors, but I do not think I would like them.	3.28
Acceptance of Flavor Limitation		3.61
	62. I would be grateful that all e-liquid was not banned.	4.36
	36. I would not do anything about the flavors being limited.	4.10
	64. Even though I mainly use the tobacco flavor, I like having the option to try something new.	3.84
	44. I would remain content since I only use these flavors anyway.	3.72
	41. I would not be bothered if e-liquid flavors were limited.	3.60
	4. I would think menthol and non-menthol are how cigarettes come, so it makes sense for e-liquid too.	3.56
	14. I like many different flavors, but I would not be affected by the flavor ban.	3.46
	70. I would be fine with limiting e-liquid flavors to tobacco, menthol, and unflavored only.	3.46
	38. I would think this is perfect.	2.42
Take Action Against Flavor Limitation		3.58
	29. I would be concerned about illegal or black market e-liquid flavors being put on the market.	4.94
	66. Never vote for anyone who backed this flavor ban.	3.62
	21. I would do whatever I could to fight the flavor ban.	3.58
	60. I would protest the flavor limitation.	3.54
	45. Post about the flavor limitation on social media.	3.50
	52. I would write every representative I can to complain about the flavor ban.	3.10
	49. Call customer service.	2.78
Do-it-yourself Mixing Behaviors		3.44
	37. Add different flavors to the new e-liquids.	3.94
	6. I would make my own or learn how to make my own e-liquid.	3.58
	2. Use/add CBD oil in my e-liquid.	3.32
	32. Add essential oils to the new e-liquid.	2.92
New Flavors as Vaping Cessation Transition		3.23
	13. Change my habit to something else besides vaping.	3.70
	43. Try the new e-liquids and if I didn't like them, I would try to stop vaping.	3.20
	35. I would use menthol flavored e-liquid and work on quitting vaping.	3.18
	25. I would use the tobacco flavored e-liquid and work on quitting vaping.	3.10
	59. I would use the unflavored e-liquid and work on quitting vaping.	2.98
Reduce Vaping		3.23
	39. I would consider quitting vaping if my particular flavor was affected.	3.46
	11. Slowly taper my vaping down.	3.42
	55. I would vape less.	3.20

Cluster	Statement	Average Rating
	28. I would quit vaping.	2.84
Alternate Tobacco Products		2.73
	12. I would smoke cigarettes.	3.76
	63. Buy a hookah pipe or hookah tower.	2.34
	57. I would use smokeless tobacco (i.e., dip, chew, snus, etc.).	2.10

Note. Mean ratings are based on responses to the prompt "If e-liquid flavors were limited so that the only e-liquid flavors available for purchase in the U.S. were tobacco only flavor, menthol only flavor, or unflavored (and no other flavors), what is a specific action you would take or a specific reaction you would have?" using a 7-point scale from 1 (Definitely NOT true for me) to 7 (Definitely true for me). Statement numbers refer to point numbers displayed in Figure 1.