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Reasons for Using Flavored Liquids among Electronic Cigarette Users: a Concept Mapping Study

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Abstract

Background—Electronic cigarettes (ECIGs) aerosolize liquids often containing flavorants for inhalation. Few studies have examined the role of flavors in ECIG use. This study's purpose was to examine reasons for flavored ECIG use using a mixed-method approach, concept mapping (CM).

Methods—Forty-six past 30-day adult ECIG users recruited from vape forums/conferences completed three online CM tasks. Participants brainstormed responses to a prompt: "A specific reason I use flavored e-liquid in my electronic cigarette product is…". The final 107 brainstormed statements were sorted by participants into groups of similar content. Participants rated each statement on a 7-point scale (1-Definitely NOT a reason to 7-Definitely a reason) based on a prompt: "This is a specific reason why I used flavored e-liquid in my electronic cigarette product in the past month." A cluster map was generated from participants' sorting and ratings using CM statistical software. Cluster mean ratings were compared.

Results—Analysis revealed five clusters of reasons for flavored ECIG use including Increased Satisfaction/Enjoyment, Better Feel/Taste than Cigarettes, Variety/Customization, Food Craving Suppression, and Social Impacts. Statements in the Increased Satisfaction/Enjoyment and Better

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Contributors

Dr. Soule contributed to the conceptualization of the study and the development of the concept mapping materials/protocol, analyzed the participant statements, conducted the data analysis, and wrote the primary manuscript draft.

Dr. Lopez contributed to the conceptualization of the study, analyzed the participant statements, provided critical review of the concept mapping model, and provided critical review of the manuscript drafts.

Dr. Guy contributed to the conceptualization of the study, analyzed the participant statements, provided critical review of the concept mapping model, and provided critical review of the manuscript drafts.

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Conflict of Interest

No conflict declared.

Feel/Taste than Cigarettes clusters were rated significantly higher than statements from other clusters ($ps<.05$). Some statements indicated flavors were perceived as masking agents for nicotine or other bad tastes associated with cigarette smoking making ECIG use more palatable.

Conclusions—Flavored ECIGs are used for many reasons. Some statements suggested flavors may increase the risk of ECIG addiction. These results support continued examination of the role of flavors and ECIG use behaviors.

Keywords

electronic cigarettes; flavors; mixed methods; concept mapping

1. INTRODUCTION

While combustible cigarette smoking prevalence has reached an all-time low in the United States (U.S. Department of Health and Human Services, 2014), there has been a rise in popularity of a new alternative tobacco product among all age groups in the U.S.: electronic cigarettes (ECIGs; Centers for Disease Control and Prevention (CDC), 2013; King et al., 2015; McMillen et al., 2012, 2015; Shoenborn and Gindi, 2015). ECIGs are a class of products/devices that use an electrically-powered heating element to aerosolize a liquid solution that often contains a combination of propylene glycol, vegetable glycerin, nicotine, and chemical flavorings. The vast majority of adult ECIG users are either current or former combustible cigarette smokers (Shoenborn and Gindi, 2015), however, a small percentage of adult never-tobacco users also use ECIGs (e.g., Barnett et al., 2015; CDC, 2013; Dockrell et al., 2013; Hamilton et al., 2014; King et al., 2013, 2015; Krishnan-Sarin et al., 2015; Loukas et al., 2015; McMillen et al., 2012, 2014; Porter et al., 2015; Saddleson et al., 2015; Sutfin et al., 2013; Wang et al., 2014). One product characteristic of ECIGs that is unique from combustible cigarettes is the availability of a wide variety of flavors. Recent estimates put the number of ECIG flavors at nearly 8,000 (Zhu et al., 2014). Available flavors include those common to combustible cigarettes (e.g., tobacco or menthol) and other categories such as fruit, candy, dessert, drink, and spices.

Limited research has examined which flavors are the most popular among ECIG users (Dawkins et al., 2013), however, the availability of flavors has been reported as a reason for using ECIGs (Berg et al., 2014; Farsalinos et al., 2013b; Kong et al., 2015; Soule et al., 2016b). No study has provided an in-depth examination of the role flavorings play in ECIG use initiation or continued use. Assuming that ECIG users report using flavors in their devices solely because of the taste may ignore other important roles that flavors may play in ECIG use. For instance, a review summarizing characteristics of use and perceptions of flavored tobacco products (Feirman et al., 2016) reported that individuals perceive flavored tobacco products are more favorable than non-flavored products (Soldz and Dorsey, 2005; Manning et al., 2009; Ashare et al., 2007), are attractive or appealing (Richter et al., 2002; Choi et al., 2012; Griffiths et al., 2011; Liu et al., 2014; Sifaneck et al., 2005), can disguise the risks of tobacco use (Griffiths et al., 2011), and can hide the smell of marijuana use (Sifaneck et al., 2005). Research is needed to understand how the use of flavorings in ECIGs impact ECIG users' perceptions and behaviors. The first step in this process is to identify and describe user-identified reasons for using flavors in ECIG products.

Survey methods allow for estimating the prevalence of phenomena, however, they are limited in examining topics about which researchers do not have a vast understanding. Rather, when attempting to understand new or emerging behaviors, such as using ECIGs with flavorings, incorporating qualitative methods can help to identify fully the domains relevant to the behavior of interest. While qualitative methods have the advantage of gathering rich data, qualitative methods are associated with researcher biases that may impact interpretation and utilization of study results. Quantitative methods may be less likely to include this bias. One method that allows researchers to take advantage of the strengths of qualitative techniques to gather rich data while also using quantitative methods to transform empirically qualitative data into usable results is concept mapping (CM). CM is an innovative participatory approach that integrates qualitative and quantitative methods to develop a framework that describes phenomena, such as ECIG use. This method has been used previously to examine other health issues (DeRidder et al., 1997; Stillman et al., 2012; Trochim et al., 2004) including ECIG use (Soule et al., 2016a, 2016b). The purpose of this study was to use CM to identify and describe the reasons experienced ECIG users report using flavorings in their ECIG products.

2. MATERIAL AND METHODS

2.1 Overview

This study was approved by the Virginia Commonwealth University Institutional Review Board. CM, an integrative mixed method participatory approach that uses multidimensional scaling and hierarchical cluster analyses to identify latent constructs, was used to identify and describe reasons for using flavors in ECIG devices among experienced ECIG users. This process included generation of statements through a brainstorming task, sorting and rating a final list of statements, using sorting and rating data to generate a concept “map”, and analyses allowing for interpretation of themes and examination of group differences.

2.2 Participants and procedures

For the preparation phase of the concept mapping procedure, researchers developed the focus prompt of “A specific reason I use flavored e-liquid in my electronic cigarette product is…” The term “e-liquid” was used in the prompt (as opposed to the term “liquid” used throughout the text) as this term is colloquial among ECIG users. Experienced ECIG users were recruited via internet advertisements in electronic cigarette forums and at vape conferences and participated in the study during 2014–2015. Potential participants contacted study personnel and were screened to confirm they were over the age of 18 and had been using an ECIG device for at least one month. Eligible participants were directed to a website (The Concept System® Global MAX™) to complete CM tasks. These tasks including a brainstorming task, a sorting task, and a rating task. Prior to completing the CM tasks, participants answered questions related to demographics, ECIG use, and other tobacco product use. Participants received $10 online gift cards for completing the brainstorming task, $15 for the sorting task, and $10 for the rating task. After completing the CM tasks, participants were contacted and asked to identify their top three favorite flavors they use in the ECIG device in an online survey.

Forty-eight participants were assigned to the brainstorming task and 46 participants completed the brainstorming task (response rate = 95.8%). Most participants identified as White (87.0%) and were non-Hispanic (97.8%). Just over half (58.7%) were male and the mean age was 38.5 years (SD = 10.52). In the brainstorming task, participants completed demographic and tobacco and ECIG use questions and were asked to provide five to eight statements that completed the focus prompt. For example, a participant might enter the statement “because it tastes good” or “I enjoy the experience better” to complete the focus prompt regarding why they used flavored ECIG liquid. Each participant could see the statements generated by previous participants and were asked to review the previous statements to prevent repeating the same ideas. Researchers reviewed the list of statements continuously until content saturation was reached. When content saturation was reached, the brainstorming section of the online program was closed, and researchers reviewed the list of statements to remove statements that did not relate to the focus prompt, nonsensical statements, and consolidated redundant statements resulting in a final list of 107 statements.

After developing the final list of statements, 44 of the participants from the brainstorming task were able to be contacted and invited to complete the sorting and rating tasks. Of these, 33 completed the sorting task correctly (response rate = 75%) and 37 completed the rating task correctly (response rate = 84.1%; see sorting and rating rules below). For the sorting task, (Rosenberg and Kim, 1975; Waller and Romney, 1988) each participant was asked to organize all of the statements into piles of statements. Individually, each participant dragged statements from a list of the 107 statements generated in the brainstorming task into piles of similar content. Each pile was required to be comprised of statements that related to a single topic or theme (e.g., “Tastes good” pile, “Smells nice” pile, etc.). The sorting task had three rules: participants could not have only one pile that contained all statements, participants could not have an “other” pile, and participants could not create piles based on priority or value such as “Important”, “Hard to do”, or “Random”. Participants also assigned names to each of the categories they created based on the content of the statements in each pile. After sorting all statements into piles, participants rated all 107 statements based on the prompt, “This is a specific reason why I used flavored e-liquid in my electronic cigarette product in the past month,” with response options ranging from 1 (Definitely not a reason) to 7 (Definitely a reason).

2.3 Data Analysis

Using CM software, a 107 × 107 matrix of similarities (Trochim, 1989) was created based on aggregated sort data from the participants who completed the sorting task. Each cell within the matrix represented the total number of times two statements were sorted into the same piles in all of the participants’ sorting of the 107 statements generated in the brainstorming task. Using multidimensional scaling, each statement was assigned a two-dimensional coordinate (x,y) resulting in a point map (see Figure 1; Kruskal and Wish, 1978) that displayed a representation of each statement in two-dimensional space. Points on the point map that were closer together represented statements that were more frequently sorted with one another in the sorting task, while points that were further apart represented statements that were sorted together less frequently with one another in the sorting task.

Using hierarchical clustering (Ward, 1963), statements were grouped empirically into non-overlapping clusters. Clusters were added by identifying groups of statements with smaller distances between each other on the point map. Additional clusters were added to the model until a final model was reached using parsimony and interpretability as indicators of best model fit. Average ratings of statements within each cluster were compared using *t*-tests using statistical software built into the CM software to determine which statements were identified as stronger reasons for using flavored liquid in participants' ECIG devices. Cluster ratings were compared between different demographic and ECIG use characteristic groups including sex, age, ECIG device type, and ECIG liquid nicotine concentration. Participants' identified favorite flavors were analyzed and categorized into flavor categories.

3. RESULTS

3.1 Participant ECIG use characteristics

Most participants (93.5%) reported lifetime combustible tobacco cigarette use (defined as using more than 100 lifetime cigarettes) and around a quarter (23.9%) reporting past-month combustible tobacco cigarettes smoking. Approximately three quarters (76.1%) reported using an ECIG all 30 days of the past month. Half (52.2%) of the participants reported using their ECIG 16 or more times per day (a use was defined as taking at least 12 to 15 puffs). In the absence of a standard measure of an ECIG "use", this definition of a "use" was used and based on the approximate number of puffs taken when smoking a single cigarette from previous laboratory studies (e.g., Breland et al., 2002; Vansickel et al., 2010; Lopez et al., 2016). Nearly all reported either using liquids with nicotine concentration of less than 8 mg/ml (43.5%) or 8–18 mg/ml (39.1%). The vast majority (69.6%) identified the ECIG they used as a tank system. Additional participant details are displayed in Table 1. Participants identified 114 favorite flavors. These flavors were organized into four categories: Food/Dessert/Spice (n = 42, 36.8%; e.g., vanilla, banana foster, peaches, coffee), Fruit (n = 41, 36.0%; e.g., watermelon, mango), Tobacco or Menthol (n = 17, 14.9%), and Other or a Combination of Flavors (n = 14, 12.3%; e.g., bubble gum, blueberry champagne, vanilla and tobacco).

3.2 Concept mapping results

Based on participants' sorting and rating of statements, a final concept map with five clusters of statements related to reasons for using flavorings in ECIG products was created (Figure 1). These clusters included Increased Satisfaction and Enjoyment, Variety and Customization, Better Feel and Taste than Cigarettes, Food Craving Suppression, and Social Impacts. A summary of these clusters including cluster ratings is described below (presented in order of highest average rating). Average statement ratings for each statement within each cluster are displayed in Table 2.

3.2.1 Increased Satisfaction and Enjoyment—The 29 statements in this cluster describe how flavors make ECIG use more enjoyable and more satisfying. The mean cluster rating was 5.55 (SD = 0.83) which was calculated by taking the average of all of the ratings of each statement in this cluster. Some of these statements represented general positive beliefs about how flavors modify the ECIG experience such as "Because it enhances the

enjoyment of vaping" or "I like the smooth taste." Others indicated that flavors make the physical effects of ECIG use stronger including "The flavors make it more satisfying than just using tobacco flavor alone" or "Because they allow me to feel satisfied faster than unflavored liquids." Some of the statements in this cluster appeared to address the ability of flavor to decrease the aversive stimuli of tobacco use or vaping such as "Flavors make it a pleasant experience rather than something to get through for the nicotine" or "I don't like just pure nicotine and vg/pg [vegetable glycerin/propylene glycol] without flavoring." While relating to different domains, all of these statements centered on improving the enjoyment of the ECIG use experience.

3.2.2 Variety and Customization—The 19 statements in this cluster (M = 4.80, SD = 0.97) described enjoyment associated with the ability to choose one's own unique flavors from many available options. Some statements indicated that the novelty of some of the flavors was appealing to ECIG users such as "You can get flavor combinations that don't exist in any other consumable product" or "Just for a change of pace, to try something different." Other statements suggested using flavors provided ECIG users with versatility to keep their ECIG use interesting including "The variety can keep me interested when one flavor or another becomes bland" and "I like to change flavors throughout the day." The statements in this cluster also indicated ECIG users enjoy customizing their flavors by mixing liquids to make their own flavors.

3.2.3 Better Feel and Taste than Cigarettes—The 28 statements in this cluster (M = 5.33, SD = 0.74) indicated that some ECIG users perceive that flavorings make ECIG aerosol taste and feel better than combustible tobacco cigarettes. Some of the statements were explicit in indicating that flavored ECIGs helped former smokers avoid cigarette smoking: "Because vaping a flavor that I enjoy helps me stay away from tobacco" or "It prevents me from smoking the amount of cigarettes I used to." Others implied that ECIG use with flavored liquids represented an experience that mimicked cigarette smoking but was perceived as more enjoyable than cigarette smoking: "It's a much more pleasurable alternative to smoking" or "It satisfies more of my senses than smoking did." Still other statements in this cluster indicated that ECIG users perceive flavored ECIG use as a healthier/safer alternative to combustible tobacco cigarettes such as "It's safer than cigarettes" or "Since using the ECIG, I feel much healthier." There were also some statements in this cluster that suggested ECIGs have a therapeutic-like effect: "Feels good on my throat" or "It's so relaxing". One statement also indicated flavors in ECIGs can "mask any unpleasant taste from the nicotine."

3.2.4 Food Craving Suppression—With the fewest number of statements (n = 15), the statements in this cluster (M = 4.39, SD = 0.68) indicated that some ECIG users perceive that using flavoring in their ECIGs allows them to get the satisfaction of eating desired foods without actually having to eat the foods. Some statements indicated that the flavorings allowed participants to experience desired tastes without ingesting calories: "While vaping, I can taste the drinks and foods I like without adding weight" or "Because it's a way to taste sweet things without the intake of extra calories." Others suggested flavored ECIGs were almost like candy: "Some flavors are almost like a treat" and "Allows me to have 'candy'

without the sugar and calories." Some statements even went so far as to suggest flavored ECIGs could be part of a diet/weight loss strategy: "I use e-liquid to curb my eating habits" and "Helps me lose weight."

3.2.5 Social Impacts—The 16 statements in this cluster (M = 4.88, SD = 1.00) described how the use of flavored ECIGs can affect the perceptions of those around the ECIG users as well as interactions with others. For example, some statements described the perceived direct positive impacts of the flavored ECIG aerosol on the physical environment: "It smells good," "Does not make my clothes, hair, and body smell like [combustible tobacco cigarette] smoke," and "Others around me enjoy the smell." Some statements also indicated that ECIGs can promote interactions with others including especially when it came to talking about smoking cessation: "I like sharing new flavors with friends who vape," "I can give friends who smoke a taste to help them quit smoking," and "Because it helps me start conversations with smokers about using ECIGs which often results in them quitting smoking." There were several other statements in this cluster that indicated that flavored ECIGs may be used for other purposes such as concealment ("Can vape indoors without people noticing") or medicinal purposes ("Because liquids with a high menthol concentration provide relief to me when I have a cold/congestion").

3.3 Cluster Rating Comparisons

Among all participants who completed the rating task, the mean statement rating for the Increased Satisfaction and Enjoyment cluster was rated significantly higher (more of a reason for using flavoring in participants' ECIGs) compared to mean statement ratings in the Variety and Customization ($t(46) = 2.77$, $p < 0.01$), Food Craving Suppression ($t(29) = 4.94$, $p < 0.001$), and Social Impacts ($t(43) = 2.28$, $p < 0.05$) clusters, but not the Better Feel and Taste than Cigarettes cluster. Subgroup analyses indicated cluster ratings were associated with certain participant characteristics. For age, compared to participants over the age of 30, participants under the age of 30 rated statements in the Increased Satisfaction and Enjoyment ($t(56) = 2.17$, $p < 0.05$), the Variety and Customization ($t(36) = 2.79$, $p < 0.01$), and Food Craving Suppression ($t(28) = 4.76$, $p < 0.001$) clusters significantly higher. Compared to participants who used ECIGs with tank systems, participants who reported "dripping" their ECIG liquid rated the Increased Satisfaction and Enjoyment ($t(29) = 2.75$, $p < .01$) and the Variety and Customization ($t(19) = 2.13$, $p < 0.05$) clusters as significantly more important reasons they used flavored liquid in their ECIG devices. Those who reported using liquid with less than 8 mg/mL nicotine concentration rated all of the clusters higher than those who used reported using liquid with 8 mg/mL or greater nicotine concentration (ps < 0.05). There were no differences in cluster ratings between men and women.

4. DISCUSSION

This study identified five broad thematic clusters of statements that ECIG users reported as reasons for using flavored liquid in their ECIG devices. Many of the flavors identified by ECIG users, such as strawberry cream, banana foster, mango, or root beer, presumably provide ECIG users with pleasant tastes and smells that mimic the appeals of sweet fruits, desserts, and candies. Flavored ECIG liquids appear to improve the experience of using

ECIGs by increasing the satisfaction and enjoyment associated with use, contributing to the variety and customizability of ECIGs, allowing ECIG users to experience the tastes of desirable foods without eating them, making ECIGs taste and feel better than combustible tobacco cigarettes, and impacting ECIG users' social lives positively.

This study expands on the growing literature on reasons for ECIG use in general. Studies have identified that ECIG users report using ECIGs for a variety of reasons including smoking cessation or reduction (Adikson et al., 2013; Berg et al., 2015; Brown et al., 2014b; Goniewicz et al., 2013; Hummel et al., 2015; Kadimpati et al., 2015; Kralikova et al., 2013; Li et al., 2015; Mark et al., 2015; Pepper et al., 2014; Peters et al., 2015; Richardson et al., 2015; Soule et al., 2016b), reducing health risks or perceiving ECIGs as less harmful than combustible cigarettes (Adikson et al., 2013; Berg et al., 2015; Brown et al., 2014b; Farsalinos et al., 2014; Goniewicz et al., 2013; Kadimpati et al., 2015; Kong et al., 2015; Mark et al., 2015; Soule et al., 2016b), utility for use where cigarette smoking is prohibited (Berg et al., 2015; Kadimpati et al., 2015; Kong et al., 2015; Kralikova et al., 2013; Richardson et al., 2014; Soule et al., 2016b), curiosity (Berg et al., 2015; Kong et al., 2015; Li et al., 2015; Pepper et al., 2014; Peters et al., 2015; Stein et al., 2015), and perceived lower costs compared to cigarettes (Kadimpati et al., 2015; Soule et al., 2016b). However, as demonstrated by the statements and clusters generated in this study, flavors may modify the perceived utility of or reasons for using ECIGs. For example, this study was the first to report food craving suppression as a reason for ECIG use with flavored liquid. While many studies report that ECIGs are perceived as smoking cessation aids, for some, flavored liquids are perceived as a tool to help avoid eating high caloric foods. Our study indicated that younger adults may be more likely to perceive that flavored ECIGs can aid in weight loss/control efforts, however, little is known about this subset of the ECIG use population or whether ECIGs with flavored liquid actually affect weight loss or users' eating habits. Research that conducts a more in-depth analysis of this phenomenon as well as other themes identified in the other clusters of the current study would help shed light on the diverse appeal of ECIG use.

The statements generated in this study indicate that flavorings make ECIGs an appealing product for reasons beyond tasting pleasant. Many of the statements suggest that the availability of flavors is a perceived advantage of ECIGs compared to combustible tobacco cigarettes. If ECIGs are viewed as a combustible cigarette cessation tool, these data could support the idea that combustible cigarette smokers (especially those who are interested in combustible cigarette smoking cessation) may be interested in trying and may experiment with ECIGs in part because of the flavor options that are available to ECIG users. However, a review of the literature (Breland et al., 2016) indicates that while some studies have found that ECIG use is associated with combustible cigarette smoking cessation (Beiner and Hargraves, 2014; Brown et al., 2014a; Dawkins et al., 2013; Etter et al., 2014; Farsalinos et al., 2013c, 2014; Hitchman et al., 2015; Polosa et al., 2014, 2015; Tacket et al., 2015), others have reported no association between ECIG use and combustible cigarette smoking cessation (Al-Delaimy et al., 2015; Berg et al., 2014; Borderud et al., 2014; Christensen et al., 2014; Grana et al., 2014; Harrington et al., 2015; Kasza et al., 2014; Popova and Ling, 2013; Vickerman et al., 2013). Future work utilizing randomized control trial methods to examine the influence of ECIGs on conventional tobacco use behaviors (as in Bullen et al.

2013; Caponnetto et al, 2013; Adriaens et al., 2015) that allow for ECIG liquid flavor choice and the ability to use multiple flavors may be better equipped to address this issue. Additionally, while the vast majority of adult ECIG users are current or former combustible cigarette smokers, a small percentage of non-tobacco users do report ever and current ECIG use (Barnett et al., 2015; CDC, 2013; Dockrell et al., 2013; Hamilton et al., 2014; King et al., 2013, 2015; Krishnan-Sarin et al., 2015; Loukas et al., 2015; McMillen et al., 2012, 2014; Porter et al., 2015; Saddleson et al., 2015; Sutfin et al., 2013; Wang et al., 2014) and some studies have found between 30–50% of adolescent ECIG users have never smoked combustible cigarettes (e.g., Krishnan-Sarin et al., 2015; Porter et al., 2015). Regulators should consider the potential for ECIG flavorings to appeal to combustible cigarette smokers as well as youth and non-tobacco users when determining how to regulate ECIG flavors.

Some statements generated in this study indicate flavors may impact ECIG abuse liability. First, flavors may make ECIG use more satisfying and may increase abuse potential, product appeal, and/or reinforcing effects (e.g., “Because [ECIGs] allow me to feel satisfied faster than unflavored liquids.”). Second, the ability to use many different flavors throughout the day may inhibit taste habituation (e.g., “The variety can keep me interested when one flavor or another becomes bland.”). Finally, flavors may mask unpleasant tastes or sensations (e.g., “Flavors make [ECIG use] a pleasant experience rather than something to get through for the nicotine.”). These statements alone do not provide the justification to claim ECIGs with flavored liquids are more addictive than ECIGs without flavored liquids, but they provide justification to examine whether flavorings affect the abuse liability of ECIGs in future studies (Henningfield, et al., 2011).

This study had several limitations. While participants were collected from a national sample of ECIG users, the sample was predominantly White, non-Hispanic males. The current study is consistent with previous research indicating that ECIG users are more likely to be White (Baumann et al., 2014; Harrington et al., 2014; Little et al., 2015a; Pearson et al., 2012; Richardson et al., 2014; Saddleson et al., 2015) and male (Choi et al., 2012; Goniewicz and Zielinska-Danch, 2012; Little et al., 2015a; Lotrean, 2015; McMillen et al., 2012; Ramo et al., 2015; Richardson et al., 2014; Saddleson et al., 2015; Sutfin et al., 2013). However, certain populations, such as American Indian/Alaskan Native populations, have higher prevalence rates of ECIG use (Schoenborn and Gindi, 2015). Additionally, the sample was recruited from an online vape forums with a large membership (>200,000 members) and national vape conferences attended by several hundreds of ECIG users. While this sampling frame allowed for enrollment of participants from across the U.S., individuals who visit these websites and venues may differ from the general ECIG user population. Thus, a more diverse sample may have improved the generalizability of these results. While the small sample does not allow us to assess prevalence of the attitudes and beliefs identified in the current study, by using a mixed method approach, we were able to reach saturation in generating statements related to ECIG users’ reasons for using flavors in their ECIGs and empirically derive a framework of thematic clusters. These statements and cluster themes can provide policy makers with useful information on how the availability of flavors in ECIGs may impact ECIG use.

As ECIGs continue to grow in popularity, regulators will need to determine how to regulate ECIGs appropriately and effectively. While most flavors were banned in combustible tobacco cigarettes as a result of the Family Smoking Prevention and Tobacco Control Act, flavorings currently are not banned for use in ECIGs among other tobacco products. This study shows that ECIG users perceive that flavors make otherwise unflavored ECIGs more satisfying, enjoyable, and also appealing for a variety of other reasons beyond changing the taste of the aerosol inhaled during ECIG use. However, flavorings may represent additional public health concerns including the effect of flavorings on the toxicant content of ECIG aerosol (see Bahl et al., 2012; Farsalinos et al., 2013a), ECIG abuse liability, the likelihood of adolescents experimenting and continued use of ECIGs, and the likelihood of non-tobacco users of experimenting and continued use of ECIGs. CM is a valuable method for examining ECIG use behaviors and can be used to address regulatory questions (Soule et al., 2016a, 2016b) and future studies may be able to apply the CM to answer these other important regulatory questions. These areas must be given due attention to allow policy makers to make informed decisions when developing ECIG regulations.

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Highlights

- ECIG users report using flavored liquids in their ECIGs for many reasons.
- Reasons describe flavors increasing satisfaction and enjoyment of ECIG use.
- Flavored ECIG products may be appealing to cigarette smokers looking to quit.
- Flavorings may increase the abuse potential of ECIGs.

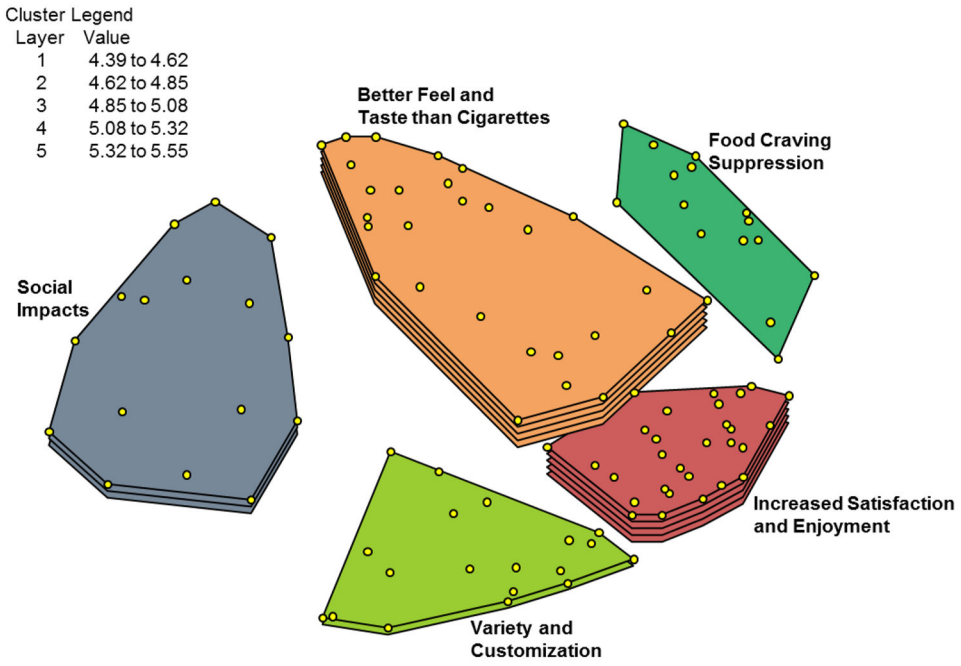

Figure 1.

Combined point map and cluster rating map. Each point represents a statement generated in the brainstorming task. Points closer to one another represent statements that were sorted together by more participants while statements that are further apart represent statements that were sorted together by fewer participants (or not at all). Clusters with greater number of layers represent clusters with greater mean statement ratings regarding the importance the statements for using flavored liquid in participants' electronic cigarette devices.

Table 1

Sample demographics and ECIG/cigarette use characteristics (n = 46)

Characteristic	N	%
Age (M, SD)		38.5, 10.5
Sex		
Female	19	41.3
Male	27	58.7
Ethnicity		
Not Hispanic/Latino	45	97.8
Race		
Asian	1	2.2
Black/African American	3	6.5
White/European American	40	87.0
More than one race	2	4.4
ECIG Use in Past 30 Days		
1 – 5 days	2	4.4
6 – 10 days	2	4.4
11 – 20 days	3	6.5
21 – 29 days	4	8.7
All 30 days	35	76.1
ECIG Use Times per Day[a]		
Less than 5 times a day	6	13.0
Between 6 and 15 times a day	16	34.8
Between 16 and 25 times a day	12	26.1
More than 25 times a day	12	26.1
Nicotine Concentration		
0 mg/ml	5	10.9
Less than 8 mg/ml	20	43.5
Between 8 mg/ml and 18 mg/ml	18	39.1
19 mg/ml to 35 mg/ml	3	6.5
36 mg/ml or more	0	0
ECIG Type		
Disposable/Cig-a-like product	4	8.7
Tank system	32	69.6
Drip liquid/Use drip tip	10	21.7
Lifetime Cigarette Use >100 Cigarettes		
Yes	43	93.5

[a]ECIG use was defined as taking at least 12 to 15 puffs.

Table 2

List of clusters and statements with mean statement ratings.

Cluster	Statement	Average Rating
Increased Satisfaction and Enjoyment (n=29)		5.55
	Makes the vaping experience enjoyable.	6.65
	They taste good.	6.62
	Because it enhances the enjoyment of vaping.	6.57
	I prefer something flavored over a bland, stale taste.	6.54
	The taste is satisfying.	6.41
	Flavors make it a pleasant experience rather than something to get through for the nicotine.	6.24
	I love the taste of the vape.	6.16
	The flavors are much more satisfying than just using tobacco flavor alone.	5.97
	The flavors are incredible.	5.95
	Because unflavored e-liquid is very bland.	5.95
	Satisfies my craving for nicotine with different flavors.	5.89
	I like the smooth taste.	5.86
	It would be boring without taste.	5.84
	It's a soothing taste.	5.78
	The more complex flavors are very enjoyable.	5.78
	I don't like just pure nicotine and vg/pg without flavoring.	5.65
	The taste is becoming more important than the nicotine.	5.54
	The variety of flavors goes beyond those that can be put in cigarettes.	5.43
	Because it wouldn't provide the same effect if I couldn't taste what I was vaping.	5.41
	Because they allow me to feel satisfied faster than unflavored liquids.	5.32
	I don't like tobacco flavored e-liquid.	5.14
	Tobacco flavors are generic, where the food flavors are really close if not perfect.	5.08
	There are only a few tobacco flavors versus limitless combinations of food/fruit flavors.	5.03
	It has a delicate taste to it.	4.95
Variety and Customization (n=19)		4.80
	The variety can keep me interested when one flavor or another becomes bland.	6.14
	I can choose some flavors that I really enjoy from the variety of e-liquids that	6.03
	I look forward to trying new products.	5.95
	I can customize flavors to suit me.	5.54
	I am not trying to simulate the flavor of smoking a cigarette.	5.49
	You can get flavor combinations that don't exist in any other consumable product.	5.49
	The availability of several flavors allows one to avoid getting vapor's tongue.	5.27
	I am able to experiment with new flavor combinations.	5.27
	There's a connoisseur side to flavors.	5.24
	Just for a change of pace, to try something different.	5.00
	I like to change flavors throughout the day.	4.76
	I did not stop liking flavors when I turned 18.	4.68
	I love to mix my own flavors based on the things that I like.	4.51

Cluster	Statement	Average Rating
	Because it helps promote competition between businesses to offer a better, more flavor-accurate product.	4.27
	I can make my own mixes.	4.24
	I enjoy mixing flavors that stores may not sell.	3.95
	Because mentholated liquids without any additional flavor can overwhelm my taste buds.	3.70
	Tobacco flavors give me the smoking feel.	3.32
	I save tobacco flavors for special occasions and seek out complex notes when I do choose to use a tobacco flavor.	2.32
Better Feel and Taste than Cigarettes (n=28)		5.33
	Because vaping a flavor that I enjoy helps me stay away from tobacco.	6.38
	Because it helps to keep me smoke free and from returning to tobacco.	6.27
	It's a much more pleasurable alternative to smoking.	6.24
	It prevents me from smoking the amount of cigarettes I used to.	6.22
	It's safer than cigarettes.	6.08
	The taste is more pleasant than tasting cigarettes.	6.05
	Since using the ECIG, I feel much healthier.	6.00
	It gives me a choice I didn't have with cigarettes.	5.89
	There's no bad aftertaste as when I smoked.	5.78
	I can breathe better.	5.68
	I can still taste food unlike when I smoked.	5.62
	It's so relaxing.	5.46
	It doesn't make my lungs hurt.	5.38
	It keeps me satisfied longer.	5.38
	There is no "burning product" taste as there is with a cig-like device.	5.35
	The flavors while vaping do no give me bad breath.	5.32
	Better quality way to puff.	5.32
	The low nicotine levels found in e-juices.	5.24
	It satisfies more of my senses than smoking did.	5.22
	There are more options of tobacco and other flavors to choose from so I can have more variety than traditional cigarettes.	5.22
	Transitioning from a tobacco flavor to other flavors have helped me to stay off cigarettes.	5.03
	After smoking cigarettes for so long I was ready for a different taste.	4.86
	Feels good on my throat.	4.84
	I have discovered different taste buds.	4.43
	It masks any unpleasant taste from the nicotine.	4.35
	I no longer enjoy the flavor of tobacco or menthol.	4.32
	It helps with the transition from other flavored tobacco products (e.g., clove cigars).	3.81
	It brings out the tobacco flavors you typically wouldn't taste after lighting a traditional cigarette.	3.43
Food Craving Suppression (n=15)		4.39
	Some flavors are almost like a treat.	5.57
	It satiates.	5.32
	While vaping, I can taste the drinks and foods I like without adding weight.	4.84
	Because it's a way to taste sweet things without the intake of extra calories.	4.84
	Helps with cravings of my sweet tooth.	4.81
	It satisfies my craving for nicotine while satisfying my craving for sweets/food.	4.57

Cluster	Statement	Average Rating
	Allows me to have 'candy' without the sugar and calories.	4.54
	Satisfies my need for eating as well as smoking.	4.54
	I can have the taste of a snack without having to eat a snack.	4.51
	Now that my senses of taste and smell have improved, using sweet flavors helps me to not overeat.	4.35
	Presents a balance to eating and drinking.	4.14
	I am able to taste flavors of food that I can't eat.	3.89
	I use e-liquid to curb my eating habits.	3.62
	Because it allows diabetics to satisfy their sweet tooth without causing a negative effect on their blood sugar.	3.46
	Helps me lose weight.	2.89
Social Impacts (n=16)		4.88
	It smells good.	6.30
	Does not make my clothes, hair, and body smell like smoke.	6.22
	It smells a lot better than cigarettes.	6.22
	The e-liquid smell doesn't attach to clothing and my hair like traditional cigarettes,	6.19
	It's fun.	5.32
	I like sharing new flavors with friends who vape.	5.19
	I like the way the smoke smells, once I blow it out from my mouth.	4.97
	Can vape indoors without people noticing.	4.86
	I can give friends who smoke a taste to help them quit smoking.	4.73
	Others around me enjoy the smell.	4.70
	Because having different liquid choices encourages the social aspect of vaping.	4.70
	The smell actually piques the interests of others.	4.57
	Because it helps me to start conversations with smokers about using e-cigarettes which often result in them quitting smoking.	4.14
	I like the look of the e-juice in the electronic cigarette device.	3.73
	The variety of colors it comes in.	3.08
	Because liquids with a high menthol concentration provide relief to me when I have a cold/congestion.	3.08