Published in final edited form as:

Addict Behav. 2016 May ; 56: 41–50. doi:10.1016/j.addbeh.2016.01.008.

REASONS FOR ELECTRONIC CIGARETTE USE BEYOND CIGARETTE SMOKING CESSATION: A CONCEPT MAPPING APPROACH

Eric K. Soule, Ph.D., M.P.H.,

Virginia Commonwealth University, Department of Psychology and Center for the Study of Tobacco Products, P.O. Box 980205, Richmond, VA 23298-0205

Scott R. Rosas, Ph.D. and

Concept Systems, Incorporated, 136 East State St., Ithaca, NY 14850

Aashir Nasim, Ph.D

Virginia Commonwealth University, Department of African American Studies, Department of Psychology and Center for the Study of Tobacco Products, P.O. Box 842509, Richmond, VA 23284-2509

Abstract

Introduction—Electronic cigarettes (ECIGs) continue to grow in popularity, however, limited research has examined reasons for ECIG use.

Methods—This study used an integrated, mixed-method participatory research approach called concept mapping (CM) to characterize and describe adults' reasons for using ECIGs. A total of 108 adults completed a multi-module online CM study that consisted of brainstorming statements about their reasons for ECIG use, sorting each statement into conceptually similar categories, and then rating each statement based on whether it represented a reason why they have used an ECIG in the past month.

Results—Participants brainstormed a total of 125 unique statements related to their reasons for ECIG use. Multivariate analyses generated a map revealing 11, interrelated components or domains that characterized their reasons for use. Importantly, reasons related to Cessation Methods, Perceived Health Benefits, Private Regard, Convenience and Conscientiousness were rated significantly higher than other categories/types of reasons related to ECIG use ($p < .05$). There

Corresponding author: Eric K Soule, Ph.D., MPH, Virginia Commonwealth University, Department of Psychology, P.O. Box 980205, Richmond, VA 23284-0205, eksoule@vcu.edu.

Contributors

Aashir Nasim recruited and enrolled participants into the study and managed the project. Aashir Nasim and Eric Soule conducted the analyses and wrote the manuscript. Scott Rosas provided guidance with concept mapping software, design, and analyses and also assisted with the writing of the concept mapping methods and the results. All authors have approved the final manuscript.

Conflict of Interest

Dr. Scott Rosas is a senior consultant at Concept Systems Incorporated. Dr. Rosas provides consultations on concept mapping methods and concept mapping software.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

also were significant model differences in participants' endorsement of reasons based on their demography and ECIG behaviors.

Conclusions—This study shows that ECIG users are motivated to use ECIGs for many reasons. ECIG regulations should address these reasons for ECIG use in addition to smoking cessation.

Keywords

Electronic cigarettes; reasons for use; mixed methods; concept mapping

1. Introduction

Tobacco use accounts for nearly 500,000 annual deaths in the US.¹ Cigarette smoking rates are at an all-time low, however, nearly one fifth of American adults smoke.¹ Nicotine replacement therapy (NRT) is commonly used to help smokers quit, but smoking abstinence rates associated with nicotine patches, nicotine gum, or other pharmaceuticals range from 0.6% to 35.5%.^{2–13} The challenges associated with smoking cessation may lead some smokers to explore other options as a means to quit smoking.

One option may be electronic cigarettes (ECIGs). ECIGs are devices that use an electrically-powered heating element to heat a liquid solution so that an aerosol is produced for the user to inhale. ECIGs typically contain a liquid with varying concentrations of nicotine, propylene glycol, vegetable glycerin, and flavorants. ECIG products vary considerably with some products storing the liquid in prefilled disposable cartridges, refillable tanks, or others that do not use a liquid storage device, but rather users “drip” liquid directly onto the ECIG heating element for inhalation. Though not approved by the FDA as smoking cessation aids, some tobacco cigarette smokers have used ECIGs in attempts to quit or reduce cigarette smoking.^{14–21} Some may perceive that ECIGs are more efficacious for smoking cessation, more desirable, have fewer negative side effects, and are more effective at preventing relapse than NRT products.²² Smoking cessation may represent a major reason for initiation of ECIG use.

Little research has examined the broad range of reasons for ECIG use. Most studies that have examined reasons for ECIG use among adults report smoking cessation as a common reason for ECIG use.^{23–34} While marketing efforts promote ECIGs for smoking cessation,³⁵ some individuals may initiate and maintain ECIG use for other purposes. Studies have reported increases in ECIG use among youth and adults who have never used any tobacco product.^{36,37} Given that some ECIG users have never used tobacco before, it can be assumed that there are other reasons for using ECIGs beyond smoking cessation. Additionally, even though many ECIG users who are current or former tobacco users identify smoking cessation as a reason for ECIG use, there are likely other reasons for ECIG use especially considering the differences between conventional cigarettes and ECIGs (e.g., social acceptability, product characteristics, availability of flavors, perceived health benefits, etc.). A greater understanding of the reasons for ECIG use will provide valuable perspective that can inform policies and regulations addressing ECIG use. Understanding reasons for ECIG use may allow for the development of policies that decrease the appeal of ECIGs among youth or would-be never tobacco users.

1.1 Current Study

The purpose of this study was to conceptualize the broad range of reasons for ECIG use among adults. The study used concept mapping (CM)^{38,39} to characterize, describe, and explain reasons for ECIG use. CM is a mixed-method, participatory research approach that combines qualitative and quantitative research methods. We additionally sought to determine which reasons for ECIG use were perceived to be the most important among ECIG users and whether reasons varied by age, gender, and frequency of ECIG use.

2. Method

2.1 Overview

CM was used to characterize and describe factors related to adults' reasons for using ECIGs. CM involves six steps: (1) preparation, (2) generation (i.e., brainstorming), (3) structuring (i.e., sorting and rating), (4) data analysis and representation, (5) interpretation, and (6) utilization. Each step is described below.

2.2 Participant Recruitment

We employed a two-stage participant recruitment strategy. The first recruitment stage involved the enlistment of ECIG users from national and regional ECIG user conferences and conventions to participate in online studies about their attitudes, beliefs, and perceptions related to ECIGs. With approval from conference/convention organizers, a study registration booth was set up in these venues. Conference attendees who visited the booth were shown recruitment cards that provided a description of the study and an email address and phone number to inquire about study procedures. Conference attendees were also given 5–10 recruitment cards to distribute to others. Overall, approximately 700 recruitment cards were disseminated across three conferences/conventions held in Washington, DC and Las Vegas, NV. Prospective study participants completed an online screening survey to determine eligibility. Individuals who were over the age of 18 and reported ECIG use in the past month were considered eligible to participate. The screening survey also collected contact, demographic, and past 30-day ECIG use information. Eligible individuals who contacted study personnel via email were provided a link to a screening survey.

2.3 Preparation, Generation and Structuring

In the preparation step, the investigators developed, pretested, and revised a focus prompt based on information gathered through computerized structured interviews with 20 ECIG users. Specifically, 20 ECIG users over the age of 18 who responded to posted advertisements provided responses to an initial focus prompt related to reasons for ECIG use. These pilot participants then provided feedback through 15–20 minute structured interviews to make the prompt easier to understand. In these free-text interviews, participants indicated if they understood the prompt and if they would change anything in the prompt. This pilot testing resulted in the final focus prompt: "A specific reason why I have used ECIGs in the past month is...". Following the focus prompt refinement, research personnel invited the 287 screened individuals who met eligibility criteria to enroll in the study (over the age of 18 and ECIG use in the past 30 days). Of the 287, 108 enrolled in the IRB-approved, online study. Using online CM software (Concept System® Global MAXTM),

invited participants selected tasks from three, integrated online modules: brainstorming (n=76) and sorting (n=31) and rating (n=65). Participants first completed the brainstorming task and later completed the sorting and rating tasks at a second time point. Participants who completed the brainstorming task were invited to complete the sorting and rating tasks as well as other who did not complete the brainstorming task. During screening, participants provided demographic information (age, race, ethnicity, sex) and then answered questions related to their ECIG and tobacco use prior to completing the online CM tasks.

Generation involved participants responding to the finalized focus prompt during an asynchronous, online brainstorming session. For brainstorming, participants typed statements that completed the focus prompt. Each participant was asked to add five to eight statements. Collected statements were saved and, in real time, added to the list of statements, where all participants could view them. Participants completed this task individually, however, once statements were submitted by a participant, participants who completed the brainstorming task afterwards were able to see the previously submitted statements. Participants were instructed to review the previously submitted statements before submitting their own statements to reduce the likelihood of submitting redundant statements. Upon completion of the brainstorming session, researchers synthesized the list using a four-step review process: deleting irrelevant or nonsensical responses (e.g., I now earn \$1000/day while not leaving my house), eliminating duplicative responses, and consolidating and revising responses. Through this systematic process, the initial list of 482 brainstormed statements was reduced to 125 representative statements.

The structuring step involved participants completing a sorting and rating task. For the sorting task,^{40,41} each participant was instructed to sort each statement into groups or piles “in a way that makes sense to you.” The only restrictions in this sorting task were that there could not be as many piles as there were statements, one pile consisting of all statements; or a “miscellaneous” pile. The task was an “unstructured sort” in that there was no pre-determined number of groups or piles that participants were expected to meet. Participants were asked to provide a name/label for each of the piles that best reflected the content of the group. In the second part of the structuring task, participants were asked to rate each of the statements according to whether each statement identified “a reason why I have used ECIGs” in the past month. A seven-point Likert-type response scale, with only the anchor categories visible was used that ranged from 1=Definitely do not agree to 7=Definitely agree. The ratings data were used to explore variation in participant values across the content, both at an individual statement and cluster level.

2.4 Representation

Representation involved quantitative data analysis. As described previously,³⁸ analysis began with the creation of a binary square similarity matrix (rows and columns represent statements) for each sorting participant. All individual sort matrices were then aggregated to form a total similarity matrix and analyzed using non-metric multi-dimensional scale (MDS) analysis with a two-dimensional solution to create a point map (Figure 1).⁴² The MDS analysis yielded a two dimensional (x, y) configuration of the set of ideas based on the criterion that statements piled together most often are located more proximally in two-

dimensional space, while those piled together less frequently are further apart (see Figure 1). The solution was limited to two dimensions.⁴² A goodness of fit statistic called the stress measure was computed to assess the degree to which the distances on the point map vary from the values in the similarity matrix and judge the model's internal representational validity. The stress value equaled .22, well within the range reported previously.⁴³

After generating the point map from the MDS analysis, x, y coordinates were used as input for the hierarchical cluster analysis utilizing an algorithm⁴⁴ to define a non-overlapping cluster arrangement. A "cluster map" (see Figure 2) was generated that displayed the original statement points enclosed by polygon-shaped boundaries for the clusters. The cluster map and the point map were created based on the sorting data from the 36 participants who completed the sorting task, consistent with the recommended number of sorters to achieve a stable stress value.³¹ The result was a conceptual model of multiple statements nested within interrelated clusters of meaning. As the final cluster solution was based on interpretative judgement, the suitability of different cluster solutions was examined so that the final number of clusters selected preserved the most detail and yields substantively interpretable clusters of statements. This model was based on parsimony and interpretability as indicators of good model fit. Therefore, the final model was achieved by selecting a model with the least amount of clusters present (parsimony) that adequately described the unique concepts present in the list of statements (interpretability) as identified by the investigators.

2.5 Interpretation and Planned Comparisons

The goal of this step was to define and interpret the final concept map. This step involved determining the final number of clusters to retain, and coming to consensus on the meaning/labels of each cluster included in the final concept map. The research team presented a short list of possible cluster arrangements to professional colleagues and at scientific conferences.⁴⁵ With feedback from these groups, the research team formed consensus on the final cluster solution and labels.

Given the exploratory nature of this study, several planned comparisons were conducted to examine rating differences across all of the clusters. To compute cluster averages, we first averaged across all participants, then each item average was averaged across the items within a cluster, constituting a double average. We reviewed the cluster averages across demographic, ECIG, or tobacco use characteristics to determine if patterns of variation existed that would suggest the need to statistically examine subgroup differences. Thus, comparisons of mean ratings of individual clusters were made among subsets of the population to determine if demographic, ECIG, or tobacco use characteristics were associated with different mean cluster ratings for specific clusters. The use of independent samples t-tests to examine the cluster averages of subgroups is common among group concept mapping studies, with a number of recently published studies employing the technique.^{46–48} Consistent with these studies, we used a Welch's t-test, which assumes unequal variances and unequal sample sizes, to test the differences in cluster means between identified subgroups. For example, male and female mean cluster ratings were compared for each of the individual clusters generated in the model.

2.6 Utilization

The concept map and associated data are currently used to disseminate the findings of our analysis. Specifically, our findings represent an in-depth description of reasons for ECIG use that can be used by a wide variety of stakeholders to gain a better understanding of reasons for ECIG use. These data may additionally be useful to guide item development for future research.

3. Results

3.1 Demographics and tobacco behaviors

Responses to demographic, ECIG use, and tobacco use items are displayed in Table 1. The average age of the 108 participants was 35 (SD=10.6). About two-thirds were male and a little more than three-fourths of the participants identified as Non-Hispanic white. About one-half of participants reported using ECIGs for one or more years. Most participants reported daily ECIG use. More than half reported ECIG use 16 or more times per day with most reporting 7 or more puffs of their ECIG per use. The most commonly used liquid nicotine concentration was 8 mg/ml. Tank systems were more commonly reported by participants than drip feed and prefilled products. More than three-fourths of current ECIG users reported not smoking cigarettes in the past 30 days.

3.2 Reasons for ECIG use clusters

The final map included 11 clusters of reasons for ECIG use statements (Figure 2). A summary of the clusters is provided below in decreasing order of mean participant ratings and a complete list of statements within each cluster is displayed in Appendix A.

3.2.1 Cessation Methods—The Cessation Methods cluster had the highest mean statement rating among the overall sample ($M=5.54$, $SD=0.30$). There were 12 statements in this cluster that generally described reasons to use ECIGs as a means to quit using other tobacco products (mainly combustible cigarettes). The statements in this cluster described the perception that ECIGs could help “curb the craving for smoking cigarettes,” “cut down or reduce the number of cigarettes smoked.” Other statements in the Cessation Methods cluster indicated that participants perceived ECIGs as smoking cessation aids that were controllable, allowed one to take control of addiction to cigarettes, allowed users to taper down nicotine doses, and gave users the perception of knowing the ingredients inhaled from an ECIG.

3.2.2 Perceived Health Benefits—With 17 statements ($M=5.36$, $SD=1.36$), the Perceived Health Benefits cluster had the greatest number of statements and they described the positive outcomes related to improved health, mainly as a result of combustible cigarette smoking cessation. Statements described perceptions that ECIGs helped to reduce the harmful effects on the lungs, improved breathing, alleviated coughing and hacking in the morning, reduced frequency of getting sick or congested, and allowed users to live an overall healthier lifestyle.

3.2.3 Private Regard—The Private Regard cluster had the fewest statements (6) and the third highest mean statement rating ($M=5.25$, $SD=0.75$). Statements in this cluster focused on participants' perception that using ECIGs (instead of combustible cigarettes) would reduce negative effects on others. For example, statements in this cluster identified living longer for family, not having to worry about second or third-hand smoke, and not harming others (e.g., non-smokers).

3.2.4 Convenience—The 13 statements in this cluster ($M=5.05$, $SD=0.93$) described ways in which ECIG use was convenient, often compared to combustible cigarette use. Participants identified ECIGs as a product that they could use in locations where smoking combustible cigarettes was prohibited. For example, statements described being able to use an ECIG in one's house, non-smoking hotel rooms, work vehicles, or dorm rooms. Other statements included being able to use an ECIG in rainy or windy conditions, not having to worry about ashes, and not needing to have lighters or matches.

3.2.5 Conscientiousness—This cluster contained eight statements that described how being an ECIG user could benefit others ($M=4.75$, $SD=0.86$). The statements in this cluster differed from those in the Private Regard cluster because its statements were more focused on setting a good example and being a leader for others. Examples of Conscientiousness cluster statements include no longer supporting the tobacco industry, being more environmentally friendly when using ECIGs compared to combustible cigarettes, setting a good example to help others quit smoking cigarettes, and being a better role model in general.

3.2.6 Pleasurable Effects—This cluster had 9 statements ($M=4.54$, $SD=1.42$). Some compared the satisfaction of an ECIG to that of a combustible cigarette including descriptions of the satisfying hand-to-mouth habit that is involved in both ECIG use and cigarette smoking or tasting better than a cigarette. Other statements described enjoyment that ECIG use provided because of the feeling of inhaling and exhaling as well as being a "constant" in life.

3.2.7 Unanticipated Benefits—The Unanticipated Benefits cluster had nine statements ($M=4.32$, $SD=1.22$). These statements described positive outcomes associated with using ECIGs (often after switching from or decreasing combustible cigarette use) including regaining a sense of taste and smell, perceiving ECIG "vapor" to not stain teeth like combustible cigarettes, appetite and sweet craving suppression, and feeling energized in the morning.

3.2.8 Perceived Agency—The 10 statements in this cluster ($M=4.29$, $SD=1.03$) described reasons for ECIG use that related to the numerous options available with ECIG use as well as the ability to choose an ECIG product. These statements included enjoying the variety of flavors, being in control of the "vaping process" such as liquid nicotine concentration, and the "cathartic" effects of maintaining an ECIG routine. Other statements in this cluster identified the newness or novelty of ECIGs. Examples of these statements included wanting to try something new, ECIGs providing something to do when bored, and being curious about how ECIGs work.

3.2.9 Therapeutic—This cluster's 14 statements had the third lowest mean statement cluster rating ($M=4.05$, $SD=1.19$). Statements described affect regulating, stress relieving, and other similar ECIG use reasons. Some represented calming effects including promoting relaxation, nerve calming, stress reduction, or helping to clear the mind. Other statements seemed to represent the opposite effect. For example, some statements in this cluster described how ECIG use could make one happy, provide a "lift", or provide a "pick me up" when feeling blue or down.

3.2.10 Hobby/Interests—The 11 statements in the Hobby/Interests cluster described the ability to tinker, modify, and customize ECIG devices ($M=3.89$, $SD=0.87$). These statements were related to various aspects of ECIG use including the liquid used in the device. For example, some statements described enjoyment associated with being able to try different flavors with friends as well as being able to mix one's own liquid with different amounts of flavorings, vegetable glycerin, propylene glycol, and nicotine. Other Hobby/Interests statements were related to the device components such as being able to buy accessories, new versions of ECIGs, interchanging device components, and rebuilding "mods and atomizers."

3.2.11 Networking/Social Impacts—This cluster's 16 statements had the lowest mean statement rating ($M=3.79$, $SD=0.97$) that described a broad range of topics that related how ECIG use may impact social interactions. Some statements described how participants felt that ECIG use could help them meet new people at conferences/conventions or other social events. Many statements related to how using ECIGs was not associated with the stigma that is attached to combustible cigarette smoking. Additionally, being able to remain in social situations and locations such as clubs or restaurants were reasons for ECIG use in this cluster.

3.3 Cluster Comparisons

The mean cluster ratings for the overall sample ($n=65$) are displayed graphically in a cluster rating map (Figure 2). Among the entire sample, the Cessation Methods cluster was mostly highly rated as a reason for using ECIGs, followed by the Perceived Health Benefits, Private Regard, and Conscientiousness clusters, with the cluster averages represented in Figure 2 in the fifth quintile (i.e., layer 5). The Therapeutic, Hobby/Interests, and Networking/Social Impacts clusters were the lowest rated as a reason for using ECIGs, with the cluster averages in the first quintile (i.e., layer 1). Table 2 displays the mean cluster ratings across demographic, ECIG, or tobacco use characteristics. Observation of the patterns of mean cluster ratings across subgroups indicated some variation and suggested specific comparisons were warranted.

Comparisons of ratings within individual clusters revealed differences between certain sample subgroups. Participants between the ages of 26 and 35 had higher ratings for the Cessation Methods cluster ($M=5.84$, $SD=0.36$) compared to participants between the ages of 18 and 25 ($M=5.25$, $SD=0.59$) ($t=2.97$, $p<.01$) and participants between the ages of 36 and 45 ($M=5.19$, $SD=0.26$) ($t=5.09$, $p<.001$). Participants between the ages of 18 and 25 rated the Convenience, Perceived Agency, Therapeutic, and Networking/Social Impacts clusters

significantly higher than participants between the ages of 36 and 45 ($t_s = 2.84, p < .02$). The younger age groups (18–25 and 26–35) rated the Hobby/Interests cluster higher ($M=4.40, SD=0.89$ and $M=4.34, SD=1.14$ respectively) than participants over the age of 45 ($M=3.40, SD=0.69$) ($t_s = 2.35, p < .05$). Males rated the Hobby/Interests cluster higher ($M=4.32, SD=0.92$) than females ($M=3.43, SD=0.91$) ($t=2.3, p < .05$). Non-Hispanic whites rated the Hobby/Interest and Networking/Social Impacts clusters significantly lower than those who did not identify as non-Hispanic whites ($t_s = 2.36, p < .05$).

Cluster ratings also differed based on ECIG use characteristics. Participants who reported using 8 mg/ml nicotine liquid concentration or less rated the Cessation Methods ($M=5.79, SD=0.33$) and Hobby/Interest ($M=4.24, SD=0.87$) clusters higher than participants who reported using more than 8 mg/ml nicotine liquid concentration or more ($M=5.33, SD=0.56; M=3.35, SD=0.82$ respectively) ($t_s = 2.47, p < .05$). Participants who reported use drip feed systems rated the Hobby/Interest cluster ($M=4.65, SD=1.04$) compared to participants who used tank systems ($M=3.57, SD=0.96$) ($t=2.5, p < .02$).

4. Discussion

ECIG use prevalence has increased rapidly among U.S. adults,^{49–52} and a commonly cited reason for this trend is perceived effectiveness of ECIGs as a smoking cessation aid^{29,53–55} or as an overall tobacco harm reduction strategy.^{56–59} While this study found support for the rationale related to cessation, it also revealed an additional 10, empirically-derived, ECIG use reason categories. There were also individual differences in ECIG users' endorsement of reasons based on their tobacco use history and type of electronic cigarette device used.

While many ECIG users report that a main reason for ECIG use is for tobacco cessation, participants in this study identified many other reasons for ECIG use. Some of these reasons related to reduced harm perceptions and potential positive health impacts associated with ECIG use, but other reasons represented drastically different domains such as viewing ECIGs as a hobby or networking/socializing opportunity. Cluster ratings differed based on certain demographic and ECIG use characteristics. These findings are logical in that certain ECIG users may want to use ECIGs for different reasons. For example, a 40-year-old ECIG user who has smoked cigarettes for 20 years may initiate ECIG use for different reasons than a 20-year-old who has never used any tobacco product. Similarly, certain ECIG products may be designed or marketed to appeal to different types of users or be used in different ways. For example, some users may see ECIGs as a fun and entertaining hobby and may purchase ECIG devices with product features that are more flashy and entertainment-oriented rather than products that are more functional. This may explain why participants who reported using drip feed systems (a technique that requires more user-device interaction) rated the Hobby/Interest cluster higher than participants who did not use drip feed systems. As devices continue to evolve, it is possible that ECIGs may be designed to appeal to unique users who are attracted to ECIG use for reasons beyond smoking cessation. While further research is needed to determine whether recruiting cigarette smokers to ECIG use represents a harm reduction strategy, most can agree that ECIG users that initiate ECIG use for other reasons beyond smoking cessation may represent a public health threat.

The study did have several limitations. Given the small sample size and convenience sample of ECIG users with many recruited from ECIG forums and conferences/conventions which may be result in a sample of strong ECIG proponents, caution must be used when generalizing these findings to the national population of ECIG users. Additionally, while there is currently not a definition of a “typical” ECIG user, the majority of the sample were white males many of whom used e-liquids with nicotine concentration of 8 mg/ml or less. However, this study included ECIG users from 31 U.S. states and while a more diverse sample may have yielded additional statements related to reasons for ECIG use, previous research indicates that ECIG users are more likely to be white^{28,60–64} and male^{28,51,54,62,64–68} indicating this sample was consistent with previous findings. A future study with a large nationally representative sample examining the reasons for ECIG use in this study could extend the implications of the current study (e.g., identify the prevalence of ECIG users who use ECIGs for various reasons). The reason clusters identified are subject to interpretability that may differ depending on personal biases, but this study employed a mixed-method approach that used empirical quantitative methods to generate the broad reason clusters for ECIG use. Finally, the comparisons conducted in this study were exploratory in nature and therefore a correction was not applied. These comparisons could be examined in future studies to determine if significant associations can be reproduced in other samples.

While there is some degree of subjective judgment that is used to determine the appropriate number of clusters in this CM approach, this is similar to other methods such as factor analysis or latent class analysis. However, the CM approach offers unique advantages over other analyses, such as exploratory factor analysis. These advantages include (1) using experts (e.g. ECIG users) to provide sort data to establish clusters of similar themes rather than relying solely on extracted variance of items, (2) CM creates a two-dimensional physical representation of empirically-identified clusters that cannot be obtained from an exploratory factor analysis (e.g., unique clusters in a cluster map are more related to one another than clusters that are further apart), and (3) CM does not require large sample sizes whereas a properly conducted factor analysis requires items and responses that are formatted in a manner that allows for analysis and best practices indicate a ratio of 20 to 1 participants to items be employed⁶⁹ (i.e. 2500 participants would be required for the current study if using an exploratory factor analysis rather than CM). A future study using an exploratory factor analysis could be conducted in the future to see if a similar factor structure can be obtained.

5. Conclusions

These findings suggest that reasons for ECIG use are not solely based on perceived efficacy as a cessation aid, but rather ECIGs are devices that are used for a variety of reasons. If ECIGs are to be regulated, regulatory agencies will need to consider that ECIG users may use these products for other reasons beyond smoking cessation. These findings could guide regulatory action in many ways. One such way would be to potentially require ECIG manufacturers to include disclosures on packaging indicating that ECIGs may be associated with negative health effects or addiction. Additionally, these findings may suggest the use of labels that explicitly inform potential users that there is currently no evidence to support

common beliefs that ECIG use is safe or at least safer than other tobacco products. The results from this study also can inform future research. The statements and clusters identified in this analysis can inform the development of an instrument to be administered to larger populations and assess population level reasons for ECIG use.⁷⁰ These types of studies will be imperative as ECIG use in the U.S. continues to increase rapidly with many questions still unanswered.

Acknowledgments

Funding

This research was supported by the National Institute on Drug Abuse of the National Institutes of Health under Award Number P50DA036105 and the Center for Tobacco Products of the U.S. Food and Drug Administration. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health or the Food and Drug Administration.

We would like to thank Dr. Thomas Eissenberg for assisting with reviewing and preparing the manuscript and Ms. McKayla Stokes and Ms. McKenzie Stokes for their contributions to the study.

References

1. U. S. Department of Health and Human Services. The health consequences of smoking – 50 years of progress: a report of the Surgeon General. Atlanta: 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; 2014. [Accessed February 21, 2014]
2. Shiffman S, Gorsline J, Gorodetzky CW. Efficacy of over-the-counter nicotine patch. *Nicotine Tob Res.* 2002; 4(4):477–483.10.1080/1462220021000018416 [PubMed: 12521407]
3. Davidson M, Epstein M, Burt R, Schaefer C, Whitworth G, McDonald A. Efficacy and safety of an over-the-counter transdermal nicotine patch as an aid for smoking cessation. *Arch Family Med.* 1998; 7(6):569–574.
4. Sonderskov J, Olsen J, Sabroe S, Meillier L, Overvad K. Nicotine patches in smoking cessation: a randomized trial among over-the-counter customers in Denmark. *Am J Epidemiol.* 1997; 145(4): 309–318. [PubMed: 9054234]
5. Hays JT, Croghan IT, Schroeder DR, et al. Over-the-counter nicotine patch therapy for smoking cessation: Results from randomized, double-blind, placebo-controlled, and open label trials. *Am J Public Health.* 1999; 89(11):1701–1707. [PubMed: 10553392]
6. Shiffman S, Rolf CN, Gorsline J, et al. Real-world efficacy of prescription and over-the-counter nicotine replacement therapy. *Addiction.* 2002; 97(5):505–516.10.1046/j.1360-0443.2002.00141.x [PubMed: 12033652]
7. Leischow SJ, Muramoto ML, Cook GN, Merikle EP, Castellini SM, Otte PS. OTC nicotine patch: effectiveness alone and with brief physician intervention. *Am J Health Behavior.* 1999; 23(1):61–69.
8. Bauld L, Chesterman J, Ferguson J, Judge K. A comparison of the effectiveness of group-based and pharmacy-led smoking cessation treatment in Glasgow. *Addiction.* 2009; 104(2):308–316.10.1111/j.1360-0443.2008.02446.x [PubMed: 19149828]
9. Costello MJ, Sproule B, Victor JC, Leatherdale ST, Zawertailo L, Selby P. Effectiveness of pharmacist counseling combined with nicotine replacement therapy: a pragmatic randomized trial with 6,987 smokers. *Cancer Causes Control.* 2011; 22(2):167–180.10.1007/s10552-010-9672-9 [PubMed: 21153694]
10. Dent LA, Harris J, Noonan WC. Randomized trial assessing the effectiveness of a pharmacist-delivered program for smoking cessation. *Ann Pharmacother.* 2009; 43(2):194–201.10.1345/aph.1L556 [PubMed: 19193572]

11. Maguire TA, McElnay JC, Drummond A. A randomized controlled trial of a smoking cessation intervention based in community pharmacies. *Addiction*. 2001; 96(2):325–331.10.1046/j.1360-0443.2001.96232516.x [PubMed: 11182878]
12. Bock BC, Hudmon KS, Christian J, Graham AL, Bock FR. A tailored intervention to support pharmacy-based counselling for smoking cessation. *Nicotine Tob Res*. 2010; 12(3):217–220.10.1093/ntr/ntp197 [PubMed: 20100808]
13. Vial RJ, Jones TE, Ruffin RE, Gilbert AL. Smoking cessation program using nicotine patches: linking hospital to the community. *J Pharm Pract Res*. 2002; 32(1):57–62.
14. Ayers JW, Ribisl KM, Brownstein JS. Tracking the rise in popularity of electronic nicotine delivery systems (electronic cigarettes) using search query surveillance. *Am J Prev Med*. 2011; 40(4):448–453.10.1016/j.amepre.2010.12.007 [PubMed: 21406279]
15. Etter JF. Electronic cigarettes: A survey of users. *BMC Public Health*. 2010; 10:231.10.1186/1471-2458-10-231 [PubMed: 20441579]
16. Etter JF, Bullen C. Electronic cigarette: Users profile, utilization, satisfaction and perceived efficacy. *Addiction*. 2011; 106(11):2017–2028.10.1111/j.1360-0443.2011.03505.x [PubMed: 21592253]
17. McQueen A, Tower S, Sumner W. Interviews with “vapers” :implications for future research with electronic cigarettes. *Nicotine Tob Res*. 2011; 13(9):860–867.10.1093/ntr/ntp088 [PubMed: 21571692]
18. Polosa R, Paquale C, Morjaria JB, Papale G, Campagna D, Russo C. Effect of an electronic nicotine delivery device (e-cigarette) on smoking reduction and cessation: a prospective 6-month pilot study. *BMC Public Health*. 2011; 11:786.10.1186/1471-2458-11-786 [PubMed: 21989407]
19. Brose LS, Hitchman SC, Brown J, West R, McNeill A. Is the use of electronic cigarettes while smoking associated with smoking cessation attempts, cessation and reduced cigarette consumption? A survey with a 1-year follow-up. *Addiction*. 2015 epub ahead of print. 10.1111/add.12917
20. Hitchman SC, Brose LS, Brown J, Robson D, McNeill A. Associations between e-cigarette type, frequency of use, and quitting smoking: findings from a longitudinal online panel survey in Great Britain. *Nicotine Tob Res*. 2015 epub ahead of print. 10.1093/ntr/ntv078
21. Biener L, Hargraves JL. A longitudinal study of electronic cigarette use among a population-based sample of adult smokers: association with smoking cessation and motivation to quit. *Nicotine Tob Res*. 2015; 17(2):127–133.10.1093/ntr/ntu200 [PubMed: 25301815]
22. Barbeau AM, Burda J, Siegel M. Perceived efficacy of e-cigarettes versus nicotine replacement therapy among successful e-cigarette users: a qualitative approach. *Addict Sci Clin Pract*. 2013; 8:5.10.1186/1940-0640-8-5 [PubMed: 23497603]
23. Pepper JK, Brewer NT. Electronic nicotine delivery system (electronic cigarette) awareness, use, reactions and beliefs: a systematic review. *Tob Control*. 2013; 23(5):375–384.10.1136/tobaccocontrol-2013-051122 [PubMed: 24259045]
24. Adikson SE, O’Connor RJ, Bansal-Travers M, et al. Electronic nicotine delivery systems: international tobacco control four-country survey. *Am J Prev Med*. 2013; 44(3):207–215.10.1016/j.amepre.2012.10.018 [PubMed: 23415116]
25. Berg CJ, Haardoefer R, Escoffery C, Zheng P, Kegler M. Cigarette users’ interest in using or switching to electronic nicotine delivery systems for smokeless tobacco for harm reduction, cessation, or novelty: a cross-sectional survey of US adults. *Nicotine Tob Res*. 2015; 17(2):245–255.10.1093/ntr/ntu103 [PubMed: 24951496]
26. Kralikova E, Novak J, West O, Kmetova A, Hajek P. Do e-cigarettes have the potential to compete with conventional cigarettes?: a survey of conventional cigarette smokers’ experiences with e-cigarettes. *Chest*. 2013; 144(5):1609–1614.10.1378/chest.12-2842 [PubMed: 23868661]
27. Mark KS, Farquhar B, Chisolm MS, Coleman-Cowger VH, Terplan M. Knowledge, Attitudes, and Practice of Electronic Cigarette Use Among Pregnant Women. *J Addict Med*. 2015; 9(4):266–272.10.1097/ADM.0000000000000128 [PubMed: 25974378]
28. Richardson A, Pearson J, Xiao H, Stalgaitis C, Vallone D. Prevalence, harm perceptions, and reasons for using noncombustible tobacco products among current and former smokers. *Am J Public Health*. 2014; 104(8):1437–1444.10.2105/AJPH.2013.301804 [PubMed: 24922154]

29. Brown J, West R, Beard E, Michie S, Shahab L, McNeill A. Prevalence and characteristics of e-cigarette users in Great Britain: findings from a general population survey of smokers. *Addict Behav.* 2014; 39(6):1120–1125.10.1016/j.addbeh.2014.03.009 [PubMed: 24679611]
30. Goniewicz ML, Lingas EO, Hajek P. Patterns of electronic cigarette use and user beliefs about their safety and benefits: an internet survey. *Drug Alcohol Rev.* 2013; 32(2):133–140.10.1111/j.1465-3362.2012.00512.x [PubMed: 22994631]
31. Hummel K, Hoving C, Nagelhout GE, et al. Prevalence and reasons for use of electronic cigarettes among smokers: Findings from the International Tobacco Control (ITC) Netherlands Survey. *Int J Drug Policy.* 2015; 26(6):601–608.10.1016/j.drugpo.2014.12.009 [PubMed: 25582280]
32. Kadimpati S, Nolan M, Warner DO. Attitudes, beliefs, and practices regarding electronic nicotine delivery systems in patients scheduled for elective surgery. *Mayo Clin Proc.* 2015; 90(1):71–76. [PubMed: 25572195]
33. Pepper JK, Ribisl KM, Emery SL, Brewer NT. Reasons for starting and stopping electronic cigarette use. *Int J Environ Res Public Health.* 2014; 11(10):10345–10361.10.3390/ijerph111010345 [PubMed: 25286168]
34. Peters EN, Harrell PT, Hendricks PS, et al. Electronic cigarettes in adults in outpatient substance use treatment: Awareness, perceptions, use, and reasons for use. *Am J Addict.* 2015; 24(3):233–9. [PubMed: 25809200]
35. Huang J, Kornfield R, Szczypka G, Emery SL. A cross-sectional examination of marketing of electronic cigarettes on Twitter. *Tob Control.* 2014; 23(Suppl 3):iii26–iii30.10.1136/tobaccocontrol-2014-051551 [PubMed: 24935894]
36. Bunnell RE, Agaku IT, Arrozola RA, et al. Intentions to smoke cigarettes among never-smoking U.S. middle and high school electronic cigarette users, National Youth Tobacco Survey, 2011–2013. *Nicotine Tob Res.* 2014 epub ahead of print. 10.1093/ntr/ntu166
37. McMillen RC, Gottlieb MA, Shaefer RM, Winickoff JP, Klein JD. Trends in electronic cigarette use among U. S. adults: use is increasing in both smokers and nonsmokers. *Nicotine Tob Res.* 2014 epub ahead of print. 10.1093/ntr/ntu213
38. Trochim WMK. An introduction to concept mapping for planning and evaluation. *Eval Program Plann.* 1989; 12(1):1–16.
39. Kane, M.; Trochim, WMK. *Concept Mapping for Planning and Evaluation.* Thousand Oaks, CA: Sage Publications; 2007.
40. Rosenberg S, Kim MP. The method of sorting as a data gathering procedure in multivariate research. *Multivar Behav Res.* 1975; 10(4):489–502.10.1207/s15327906mbr1004_7
41. Weller, SC.; Romney, AK. *Systematic data collection.* Newbury Park, CA: Sage; 1988.
42. Kruskal, JB.; Wish, M. *Multidimensional scaling.* Beverly Hills, CA: Sage Publications; 1978.
43. Rosas SR, Kane M. Quality and rigor of the concept mapping methodology: A pooled study analysis. *Eval Program Plann.* 2013; 35(2):236–245.10.1016/j.evalprogplan.2011.10.003 [PubMed: 22221889]
44. Ward JH. Hierarchical grouping to optimize an objective function. *J Am Stat Assoc.* 1963; 58(301):236–244.
45. Nasim, A.; Soule, EK.; Eissenberg, T. Motivations for electronic cigarette use: a concept mapping approach. Poster presented at: TCORS Grantee Meeting; November 3rd–4th; Bethesda, MD.
46. Glenn M, Thorne K. Does the purpose for using a service dog make a difference in the perceptions of what it takes to create successful outcomes in the workplace? *JARC.* 2015; 46(2):13–19.
47. Ries AV, Voorhees CC, Gittelsohn J. Environmental barriers and facilitators of physical activity among urban African-American youth. *Child Youth Environ.* 2010; 20(1):26–51.
48. Frye V, Paul MM, Todd MJ, Lewis V, Cupid M, Coleman J, et al. Informal social control of intimate partner violence against women: Results from a concept mapping study of urban neighborhoods. *J of Comm Psych.* 2012; 40(7):828–844.
49. Hajek P, Etter JF, Benowitz N, Eissenberg T, McRobbie H. Electronic cigarettes: review of use, content safety, effects on smokers and potential for harm and benefit. *Addiction.* 2014; 109:1801–1810.10.1111/add.12659 [PubMed: 25078252]

50. Regan AK, Promoff G, Dube SR, Arrazola R. Electronic nicotine delivery systems: adult use and awareness of the 'e-cigarette' in the USA. *Tob Control*. 2013; 22:19–23.10.1136/tobaccocontrol-2011-050044 [PubMed: 22034071]
51. McMillen R, Maduka J, Winickoff J. Use of emerging tobacco products in the United States. *J Environ Public Health*. 2012; 201210.1155/2012/989474
52. King BA, Patel R, Nguyen KH, Dube SR. Trends in awareness and use of electronic cigarettes among US adults, 2010–2013. *Nicotine Tob Res*. 2015; 17(2):219–227. [PubMed: 25239961]
53. Li J, Newcombe R, Walton D. The prevalence, correlates and reasons for using electronic cigarettes among New Zealand adults. *Addict Behav*. 2015; 45:245–251.10.1016/j.addbeh.2015.02.006 [PubMed: 25744712]
54. Ramo DE, Young-Wolff KC, Prochaska JJ. Prevalence and correlates of electronic-cigarette use in young adults: findings from three studies over five years. *Addict Behav*. 2015; 41:142–147.10.1016/j.addbeh.2014.10.019 [PubMed: 25452058]
55. Schmidt L, Reidmohr A, Harwell TS, Helgeson SD. Prevalence and reasons for initiating use of electronic cigarettes among adults in Montana, 2013. *Prev Chronic Dis*. 2014; 11:E204.10.5888/pcd11.140283 [PubMed: 25412027]
56. Ambrose BK, Rostron BL, Johnson SE, et al. Perceptions of the relative harm of cigarettes and e-cigarettes among U.S. youth. *Am J Prev Med*. 2014; 47(2S1):S53–S60.10.1016/j.amepre.2014.04.016 [PubMed: 25044196]
57. Choi K, Forster JL. Beliefs and experimentation with electronic cigarettes: a prospective analysis among young adults. *Am J Prev Med*. 2014; 46(2):175–178.10.1016/j.amepre.2013.10.007 [PubMed: 24439352]
58. Kong G, Morean ME, Cavallo DA, Camenga DR, Krishnan-Sarin S. Reasons for electronic cigarette experimentation and discontinuation among adolescents and young adults. *Nicotine Tob Res*. 2014 epub ahead of print. 10.1093/ntr/ntu257
59. Tan ASL, Bigman CA. E-cigarette awareness and perceived harmfulness: prevalence and associations with smoking-cessation outcomes. *Am J Prev Med*. 2014; 47(2):141–149.10.1016/j.amepre.2014.02.011 [PubMed: 24794422]
60. Baumann AW, Kohler C, Kim YI, et al. Differences in electronic cigarette awareness, use history, and advertisement exposure between black and white hospitalized cigarette smokers. *J Cancer Educ*. 2015; 30(4):648–654.10.1007/s13187-014-0767-y [PubMed: 25503053]
61. Harrington KF, Hull NC, Akindoju O, et al. Electronic cigarette awareness, use history, and expected future use among hospitalized cigarette smokers. *Nicotine Tob Res*. 2014; 16(11):1512–1517.10.1093/ntr/ntu054 [PubMed: 24827786]
62. Little MA, Derefinko KJ, Bursac Z, et al. Prevalence and Correlates of Tobacco and Nicotine Containing Product Use in a Sample of United States Air Force Trainees. *Nicotine Tob Res*. 2015 Epub ahead of print.
63. Pearson JL, Richardson A, Niaura RS, Vallone DM, Abrams DB. e-Cigarette awareness, use, and harm perceptions in US adults. *Am J Public Health*. 2012; 102(9):1758–1766.10.2105/AJPH.2011.300526 [PubMed: 22813087]
64. Saddleson ML, Kozlowski LT, Giovino GA, et al. Risky behaviors, e-cigarette use and susceptibility of use among college students. *Drug Alcohol Depend*. 2015; 149:25–30.10.1016/j.drugalcdep.2015.01.001 [PubMed: 25666362]
65. Choi K, Fabian L, Mottey N, Corbett A, Forster J. Young adults' favorable perceptions of snus, dissolvable tobacco products, and electronic cigarettes: findings from a focus group study. *Am J Public Health*. 2012; 102(11):2088–2093.10.2105/AJPH.2011.300525 [PubMed: 22813086]
66. Goniewicz ML, Zielinska-Danch W. Electronic cigarette use among teenagers and young adults in Poland. *Pediatrics*. 2012; 130(4):e879–85.10.1542/peds.2011-3448 [PubMed: 22987874]
67. Lotrean LM. Use of electronic cigarettes among Romanian university students: a cross-sectional study. *BMC Public Health*. 2015; 15(1):358.10.1186/s12889-015-1713-6 [PubMed: 25888354]
68. Sutfin EL, McCoy TP, Morrell HE, Hoepfner BB, Wolfson M. Electronic cigarette use by college students. *Drug Alcohol Depend*. 2013; 131(3):214–221.10.1016/j.drugalcdep.2013.05.001 [PubMed: 23746429]

69. Costello AB, Osborne JW. Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. *Practical Assessment, Research & Evaluation*. 2005; 10(7) Available online: <http://pareonline.net/getvn.asp?v=10&n=7>.
70. Rosas SR, Ridings JW. The use of concept mapping in measurement development and evaluation: application and future direction. *Eval Program Plann*. In press.

Appendix A: Statements by cluster with mean averages

Cluster	Statement	Average Rating
Cessation Methods		5.54
	It is the only smoking cessation that has worked for me.	5.95
	I feel like I am taking control over my addiction to cigarettes.	5.80
	To curb the craving for smoking cigarettes.	5.77
	To get to the point where I can quit cigarettes forever.	5.71
	It is part of my overall smoking cessation plan.	5.65
	Because other nicotine replacement products (e.g., patch) haven't worked as well for me.	5.63
	To cut down or reduce the number of cigarettes smoked.	5.57
	Because the taste of smoking has become unpleasant since I have started vaping.	5.55
	I am able to taper down my nicotine dosage over time.	5.49
	I know the exact ingredients of what I am inhaling unlike cigarettes.	5.45
	Because the smell of tobacco cigarette smoke now makes me nauseous.	4.95
	Because I still am trying to reach my goal of 0% nicotine.	4.92
Perceived Health Benefits		5.36
	To reduce harmful health effects on my lungs.	6.58
	To purposefully avoid the thousands of chemicals produced from a burning cigarette.	6.54
	To avoid the carcinogens in cigarettes.	6.48
	Because I think it's safer than smoking cigarettes.	6.46
	To live (or get back to) a healthier lifestyle.	6.18
	My chest and lungs feel much better after a day or night of vaping rather than smoking.	6.11
	To improve my breathing.	6.02
	I'm no longer hacking (i.e., coughing) in the morning.	5.94
	I feel so much more healthier than when I smoked cigarettes.	5.92
	I don't have wheezing when breathing like with cigarettes.	5.75
	Doesn't make me out of breath like cigarettes.	5.72
	I no longer get sick or have congestion problems like I did when I smoked.	5.60
	So I can exercise and do physical activities without getting winded.	5.15
	Electronic cigarettes do not inflame my sinuses like traditional tobacco cigarettes do.	4.95
	Because it has stopped my chronic heartburn.	2.83
	My asthma no longer bothers me as it did with smoking cigarettes.	2.78
	My doctor suggested it.	2.14
Private Regard		5.25

Cluster	Statement	Average Rating
Convenience	To live longer for my family.	5.97
	It's a cleaner way of doing things.	5.85
	No more worries about secondhand and thirdhand smoke.	5.63
	To not harm the health of others around me.	5.52
	Vaping is better than smoking around my pets.	4.75
	It is safe to vape around my children.	3.80
		5.05
	I can vape in my house.	6.20
	It doesn't smell bad and linger around like cigarette smoke.	6.05
	You can take a "smoke break" without actually having to take a smoke break.	5.80
Conscientiousness	I enjoy not having to go outdoors to smoke.	5.78
	They're cheaper than regular cigarettes over the long run.	5.68
	Because you can use electronic cigarettes in most weather conditions (rainy, windy, etc.)	5.48
	Can use in non smoking hotel rooms.	5.37
	Because there are no ashes to worry about.	5.08
	To avoid ruining my clothing (e.g., burn holes or smell that won't washout).	4.92
	I can vape in work vehicle.	4.38
	Don't have to keep up with a lighter or matches.	4.25
	A e-cig is more portable than other tobacco products I use.	3.60
	I can use it in my dorm.	3.06
Pleasurable Effects		4.75
	My friends and family are not bothered by the smell.	6.03
	I no longer want to support the tobacco industry.	5.15
	I feel more environmentally friendly when I vape compared to when I used to smoke cigarettes.	5.14
	Because the vapor dissipates rapidly, unlike cigarette smoke.	5.03
	To be an example to help others to quit smoking cigarettes.	4.98
	To promote electronic cigarettes as an alternative to tobacco cigarettes.	4.91
	To be a better role model.	3.65
	To coax a family member off cigarettes.	3.14
	I like the taste better than a regular cigarette.	6.23
Unanticipated Benefits	It satisfies the hand to mouth habit that I'm accustomed to from being a regular smoker.	6.14
	I simply enjoy the feeling of inhaling and exhaling when I vape.	5.75
	It is an enjoyable constant in my life.	5.35
	I get more satisfaction from vaping than I do a regular cigarette.	5.05
	When I am driving it gives me something to do.	4.15
	It gives me confidence.	3.02
	The vapor is cool on a hot day.	2.89
	It gives me a nice buzz.	2.29
		4.32

Cluster	Statement	Average Rating
Perceived Agency	Because e-cigs don't stain my teeth the way that regular cigarettes do.	5.86
	My sense of smell has returned.	5.62
	Because my sense of taste has returned since I started vaping.	5.49
	Vapor doesn't sting my eyes like cigarette smoke.	4.68
	Some of the flavors of e-juice curb my appetite for sweets.	4.42
	I feel more energized when I wake up in the morning.	4.31
	It is a nice alternative to snacking.	3.65
	It keeps my weight down.	2.88
	It helps me combat pain.	1.97
		4.29
Hobby/Interests	I like the variety of available flavors.	6.31
	I like to be in control of all parts of the vaping process (e.g., nicotine levels, etc).	5.78
	I enjoy watching the exhaled vapor.	4.92
	Because I enjoy handling it.	4.65
	The act of maintaining an e-cig is cathartic.	3.91
	Something to do when I'm bored.	3.86
	I wanted to try something new.	3.58
	Vaping has become an obsession.	3.49
	I was curious about how it worked.	3.22
	I love using drippers to make clouds.	3.22
Therapeutic		3.89
	I enjoy sampling different e-cig products and flavors with friends.	5.14
	Vaping has become a hobby.	5.06
	I like trying new versions of electronic vaporizers.	4.60
	Because I like being able to buy accessories for my e-cig.	4.18
	I like playing or toying around with gadgets.	4.15
	I enjoy collecting the different gadgets (different mods, tanks, coils).	3.77
	I like to tinker with the mods and the atomizers.	3.68
	I love rebuildable drippers.	3.65
	Because I like interchanging device components.	3.65
	I enjoy mixing my own concentrations (e.g., flavors, VG, PG, nicotine).	2.86
	Because I bought a new expensive e-cig and feel obligated to use it.	2.03
		4.05
	It helps with my oral fixation.	5.88
	It is relaxing.	5.51
	For the calming effect.	5.25
	To reduce my stress level at times.	5.14
	To calm my nerves.	5.05
	It makes me feel happy.	4.74
	It helps to clear my mind.	4.23
	Because vaping gives me a lift.	3.86

Cluster	Statement	Average Rating
Networking/Social Impacts	It helps to improve my concentration.	3.85
	To pick me up when I have felt blue or somewhat down.	3.11
	Because I have felt upset or uncomfortable about something.	2.71
	Because I feel a gnawing hunger without it.	2.68
	Because I have felt angry about something.	2.52
	I feel bad when I try to stop.	2.23
		3.79
	I can vape almost anywhere that cigarettes are not usually allowed.	5.55
	Less of a stigma associated with vaping compared to cigarette smoking.	4.97
	To be able to smoke in clubs and restaurants.	4.80
	It is more accepted by society now to vape than it is to smoke.	4.49
	It keeps people off my back (i.e., hassling me) about smoking cigarettes.	4.48
	I feel a part of movement or something bigger than me.	4.43
	I like meeting new people at conventions and festivals centered around vaping.	4.12
	To socialize with other electronic cigarette users.	3.89
	Because vaping has changed my social interactions and status for the better.	3.88
	For the purpose of demonstrating to people how to vape.	3.52
	To not feel like an outcast anymore.	3.28
	Because my friends or significant others vape.	3.28
	It's a good conversation starter.	2.82
	It opens doors for business.	2.78
	To gain social acceptance.	2.43
	To keep my job.	1.91

Highlights

- Electronic cigarette users report using electronic cigarettes for many reasons
- Smoking cessation is one of many reported reasons for electronic cigarette use
- User characteristics were associated with different rating of reasons for use

Figure 1.

Point Map. Each point represents a participant generated statement. Locations of each point are established through multidimensional scaling where points that are closer to one another represent statements sorted together more often. Points that are further apart represent statements that were sorted together less frequently (or not at all).

Figure 2. Combined cluster map and cluster rating map. Points within each cluster boundary represent individual statements sorted by the participants. Clusters with greater number of layers represent clusters with greater mean statement ratings regarding motivations for ECIG use.

Table 1**Demographics**

Characteristic	N	%
<i>Age (M, SD)</i>		35.1, 10.6
<i>Sex</i>		
Female	35	32.4%
Male	69	63.9%
<i>Ethnicity</i>		
Hispanic/Latino	6	5.6%
Not Hispanic/Latino	93	86.1%
<i>Race</i>		
Asian	1	0.9%
Native Hawaiian/Pacific Islander	1	0.9%
Black/African American	6	5.6%
White/European American	89	82.4%
More than one race	6	5.6%
<i>Regular ECIG Use Duration</i>		
Less than a month	1	0.9%
1 – 5 months	23	21.3%
6 – 12 months	36	33.3%
Between 1 and 2 years	21	19.4%
More than 2 years	27	25.0%
<i>ECIG Use in Past 30 Days</i>		
1 – 5 days	2	1.9%
6 – 10 days	4	3.7%
11 – 20 days	6	5.6%
21 – 29 days	10	9.3%
All 30 days	86	79.6%
<i>ECIG Use Times per Day</i>		
Less than 5 times a day	9	8.3%
Between 6 and 15 times a day	39	36.1%
Between 16 and 25 times a day	24	22.2%
More than 25 times a day	36	33.3%
<i>Number of Puffs per Use</i>		
1 – 6 puffs	38	35.2%
7 – 15 puffs	54	50.0%
16 – 20 puffs	12	11.1%
More than 20 puffs	4	3.7%
<i>Nicotine Concentration</i>		
Zero (0mg/0ml)	3	2.8%
Low (less than 8mg/.08ml)	49	45.4%
Medium (between 8mg/.08ml and 16mg/1.6ml)	31	28.7%

Characteristic	N	%
High (more than 16mg/1.6ml)	18	16.7%
Not sure	7	6.5%
<i>ECIG Type</i>		
Prefilled	9	8.3%
Drip feed from bottle	41	38.0%
Tank feed	58	53.7%
<i>Lifetime Cigarette Use</i>		
No	5	4.6%
Yes	103	95.4%
<i>Cigarette Use Past 30 Days</i>		
None	84	77.8%
1 – 5 days	11	10.2%
6 – 10 days	2	1.9%
11 – 20 days	7	6.5%

Table 2

Mean cluster ratings across demographic variables.

Variables	n	Cessation Methods a.	Perceived Health Benefits b.	Private Regard c.	Convenience d.	Conscientiousness e.	Pleasurable Effects f.	Unanticipated Benefits g.	Perceived Agency h.	Therapeutic i.	Hobby/ Interests j.	Networking/ Social Impacts k.
All Participants	65	5.54 (0.30)	5.36 (1.36)	5.25 (0.75)	5.05 (0.93)	4.75 (0.86)	4.54 (1.42)	4.32 (1.22)	4.29 (1.03)	4.05 (1.19)	3.89 (0.87)	3.79 (0.97)
Age												
18–25	8	5.25 (0.59)	5.32 (1.38)	5.58 (1.00)	5.54 (0.92)	5.14 (0.67)	4.89 (0.97)	4.21 (1.38)	5.03 (0.92)	4.71 (1.20)	4.40 (0.89)	4.32 (1.02)
26–35	25	5.84 (0.36)	5.56 (1.54)	5.22 (0.97)	4.98 (0.94)	4.86 (0.98)	4.76 (1.48)	4.36 (1.49)	4.53 (1.10)	3.93 (1.40)	4.34 (1.14)	3.79 (1.06)
36–45	10	5.19 (0.26)	4.70 (1.48)	5.12 (0.49)	4.66 (1.08)	4.33 (0.93)	4.21 (1.71)	3.59 (1.27)	3.75 (1.22)	3.14 (1.24)	3.79 (0.95)	2.84 (1.01)
>45	17	5.50 (0.47)	5.32 (1.24)	5.40 (0.79)	5.13 (1.12)	4.72 (1.00)	4.43 (1.55)	4.69 (1.09)	4.22 (1.10)	4.45 (1.24)	3.40 (0.69)	4.01 (1.05)
Ethnicity/Race												
Non-Hispanic White	48	5.47 (0.41)	5.19 (1.49)	5.07 (0.81)	4.90 (0.96)	4.58 (0.89)	4.41 (1.52)	4.14 (1.20)	4.19 (1.10)	3.95 (1.25)	3.70 (0.94)	3.62 (0.99)
Other	14	5.84 (0.36)	5.85 (1.08)	5.96 (0.70)	5.55 (0.93)	5.40 (0.96)	5.10 (1.13)	4.93 (1.35)	4.96 (0.80)	4.46 (1.13)	4.84 (0.76)	4.44 (0.96)
Gender												
Female	25	5.53 (0.40)	5.21 (1.30)	5.53 (0.60)	4.87 (1.20)	4.82 (0.92)	4.49 (1.60)	4.16 (1.03)	4.05 (1.12)	4.13 (1.13)	3.43 (0.91)	3.56 (0.93)
Male	37	5.57 (0.36)	5.43 (1.46)	5.09 (0.91)	5.17 (0.82)	4.72 (0.84)	4.62 (1.32)	4.43 (1.39)	4.58 (1.02)	4.02 (1.32)	4.32 (0.92)	3.97 (0.99)
Regular use												
< 12 months	35	5.55 (0.44)	5.31 (1.39)	4.99 (0.81)	4.98 (0.92)	4.52 (0.95)	4.40 (1.35)	4.19 (1.22)	4.32 (0.98)	3.87 (1.13)	3.68 (0.87)	3.65 (0.93)
1–2 years	10	5.40 (0.47)	4.94 (1.18)	5.13 (0.59)	4.82 (0.90)	5.16 (0.24)	4.78 (1.25)	4.31 (1.06)	5.18 (0.97)	4.86 (1.26)	5.18 (1.18)	4.20 (0.87)
More than 2 years	20	5.58 (0.61)	5.66 (1.51)	5.77 (0.92)	5.29 (1.17)	4.96 (1.08)	4.67 (1.77)	4.54 (1.45)	3.81 (1.33)	3.96 (1.35)	3.61 (0.84)	3.82 (1.22)
Times per day using ECIG												
< 5 times per day	6	4.90 (0.41)	4.75 (1.17)	5.08 (0.73)	4.82 (0.50)	4.10 (1.11)	3.89 (0.98)	3.96 (1.01)	4.43 (1.19)	4.55 (0.98)	3.67 (0.79)	3.73 (0.95)
6–15 times per day	21	5.29 (0.40)	5.27 (1.27)	4.94 (1.02)	4.88 (0.81)	4.46 (0.70)	4.39 (1.22)	4.07 (1.31)	4.46 (0.97)	3.94 (1.09)	3.88 (0.95)	3.64 (0.88)
16 or more times per day	38	5.77 (0.37)	5.51 (1.48)	5.45 (0.75)	5.19 (1.12)	5.02 (0.94)	4.73 (1.66)	4.51 (1.27)	4.18 (1.10)	4.04 (1.33)	3.93 (0.93)	3.88 (1.08)
Nicotine level												
0 mg/ml	2	2.21 (0.85)	2.88 (0.74)	3.58 (1.77)	2.27 (0.89)	2.19 (0.90)	3.39 (1.02)	2.83 (1.45)	3.55 (1.52)	4.79 (1.72)	3.00 (1.66)	3.38 (1.82)
Low/Less than 8 mg/ml	30	6.03 (0.36)	5.61 (1.35)	5.71 (0.84)	5.17 (1.04)	5.22 (0.67)	4.71 (1.41)	4.66 (1.29)	4.62 (0.99)	4.20 (1.20)	4.32 (0.86)	3.98 (0.92)
Medium/8–16 mg/ml	15	5.28 (0.42)	5.28 (1.47)	5.15 (0.80)	5.23 (0.82)	4.51 (1.07)	4.32 (1.41)	4.21 (1.40)	3.75 (0.95)	3.80 (1.14)	3.22 (0.80)	3.55 (1.26)
High/More than 16mg/ml	14	5.38 (0.85)	5.65 (1.61)	5.24 (0.62)	5.34 (1.13)	4.54 (1.48)	4.54 (1.70)	4.21 (1.48)	4.02 (1.30)	3.91 (1.27)	3.48 (0.93)	3.75 (1.13)
Not sure	4	5.04 (1.01)	4.06 (1.45)	3.08 (0.84)	3.90 (1.24)	4.22 (1.32)	4.67 (1.68)	3.25 (1.14)	5.20 (1.47)	4.00 (1.96)	5.00 (1.55)	3.63 (1.35)
Type												

Variables	<i>n</i>	Cessation Methods a.	Perceived Health Benefits b.	Private Regard c.	Convenience d.	Conscientiousness e.	Pleasurable Effects f.	Unanticipated Benefits g.	Perceived Agency h.	Therapeutic i.	Hobby/ Interests j.	Networking/ Social Impacts k.
Prefilled	7	5.11 (0.77)	5.59 (0.87)	5.19 (0.47)	5.68 (0.65)	4.54 (1.10)	4.37 (0.82)	4.52 (1.36)	4.36 (0.95)	4.35 (0.88)	3.61 (0.40)	4.13 (1.09)
Tank	39	5.52 (0.30)	5.30 (1.41)	5.29 (0.93)	4.97 (1.05)	4.61 (0.91)	4.51 (1.52)	4.37 (1.22)	4.05 (1.17)	3.92 (1.24)	3.57 (0.96)	3.68 (0.95)
Drip	19	5.72 (0.40)	5.41 (1.49)	5.20 (0.66)	4.98 (0.91)	5.13 (0.80)	4.67 (1.57)	4.13 (1.32)	4.78 (0.98)	4.21 (1.31)	4.65 (1.04)	3.88 (1.17)
Past 30-day cigarette use												
Yes	16	5.56 (0.33)	5.38 (1.39)	5.28 (0.75)	5.00 (0.99)	4.89 (0.84)	4.66 (1.54)	4.32 (1.22)	4.29 (1.07)	4.02 (1.27)	4.04 (0.96)	3.77 (1.01)
No	49	5.46 (0.52)	5.30 (1.29)	5.16 (0.79)	5.21 (0.81)	4.34 (1.01)	4.19 (1.18)	4.31 (1.36)	4.31 (1.11)	4.16 (0.99)	3.41 (0.48)	3.84 (0.96)

Note. Mean cluster ratings are reported. Means were calculated based on responses from the 65 participants who completed the rating task.