Identifying Promising Campaign Themes to Prevent Youth Initiation of Electronic Cigarette Use

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Objective

Our aim was to identify promising campaign themes for a campaign aimed at preventing youth (i.e., 13-17 year olds) initiation of electronic cigarette use. In order to identify promising (and unpromising) target beliefs, we have followed a methodological approach that uses cross-sectional quantitative data to assess the association between beliefs about the consequences of smoking and intentions to use electronic cigarettes in the future. (Hornik & Woolf, 1999).

Once media campaigns choose a focus behavior and a target audience, a next task is the choice of belief themes to serve as the basis for message development. The approach we will use is parallel to work we undertook supporting the FDA's Real Cost campaign focused on combustible cigarettes (Brennan et al., 2012; Brennan et al., 2013a,b,c). We used the Hornik and Woolf method (hereafter H&W) to choose among potential beliefs (Hornik & Woolf, 1999, Parvanta et al., 2013) and we propose to use it again for the current work. H&W uses survey data to rank potential themes combining three criteria: 1) the extent to which a potential target belief is related to the behavior (or intention to engage in the behavior); 2) the size of the target audience available to change on (not already accepting) the belief; 3) a more subjective criterion: the judged likelihood that a message addressing that belief will be persuasive.

Phase I: Generating Candidate Beliefs

Prior to testing the campaign themes, it was first imperative to generate an exhaustive list of potential, testable themes. We employed three strategies to generate candidate beliefs: an extensive literature review, an online elicitation survey, and a topic-model-based machine learning exercise exploiting our TCORS developed content database.

a) **Literature review/other TCORS Centers:** We reviewed the available literature relating to e-cigarettes and beliefs that might be related to their use. This included convention abstracts (particularly SRNT 2015 and 2016), full searches of current journals, and descriptions of current research at TCORS sites and other FDA-funded research programs. We used these searches to look for evidence that particular beliefs are related or are hypothesized to be related to e-cigarette use. We also looked for wording used by researchers to assess such beliefs. Through the TCORS Measurement Committee, we also aggregated all existing and proposed measurements from the TCORS centers currently examining e-cigarette related beliefs. This provided us with 328 items from six TCORS centers (Penn, GSU, Texas, UCSF, VCU, and Yale).

b) **The elicitation survey:** Fishbein and Ajzen (2011) describe a specific set of procedures for obtaining a list of candidate beliefs that might influence a particular behavior. Typically, they recommend using open-ended questions to avoid biasing results and to make it more likely that researchers will obtain answers that they may not expect (e.g., "Please list the [advantages/disadvantages] of using electronic cigarettes [everyday/once or twice a month]."). Because the elicitation survey is not used to estimate the distribution of beliefs in the population but only to generate candidate beliefs, the representativeness of the sample is less important than assuring that the sample represents a range of different population subgroups that might generate different beliefs. We

recruited participants from Toluna, online sample supplier. A total of 176 13-17 year olds completed the elicitation survey. Of these youth, 40 had used an electronic cigarette in the past, while 136 were never users. Two independent coders examined the open-ended responses and identified 54 belief theme categories, which were then converted into belief statements. Whenever possible, wording from participants was used to create statements relevant to the population of interest.

c) **Unsupervised topic modeling:** To supplement our comprehensive literature review and elicitation surveys, we also employed a computerized content analysis technique, specifically unsupervised topic modeling, to detect e-cigarette themes that are being discussed in our comprehensive existing TCORS database of media content. Rather than imposing categories of interest beforehand, the unsupervised topic modeling approach uses modeling assumptions and properties of the texts to learn and detect underlying topic clusters of the corpus under investigation. It automatically produces a set of topic clusters, available for interpretation, in the form of groups of terms that are associated together, and assesses the strength with which each document exhibits those topics (DiMaggio, Nag, & Blei, 2013; Grimmer & Stewart, 2013). The database employed in the analysis consisted of 4,441 texts culled from the Associated Press, major U.S. newspapers, broadcast television transcripts, and websites from April 2014 – November 2015.[1] Human coders worked to interpret the topic clusters based on the most frequent words identified in those clusters. The analytical procedure then identifies the top articles that represent each topic cluster. Three independent human coders coded these articles for belief themes. This process generated 60 belief themes, which were then crafted into belief statements.

Finalizing the Candidate Beliefs

The three methods of belief generation produced 507 eligible beliefs for inclusion in the survey. A master belief spreadsheet was aggregated from the three generation methods by sorting each statement into crude general theme and specific theme categories (e.g., "Addiction" as general theme, with "General Addiction" and "Comparative Addiction (to Cigarettes)"). Whenever possible, it was indicated when similar belief statements appeared across multiple methods.

From this master belief spreadsheet, a second spreadsheet was prepared listing only the themes and the methods they appeared within. From this spreadsheet, we were able to identify the prevalence of themes across the assorted methods. We selected candidate beliefs by prioritizing beliefs that appeared in all three methods (literature, elicitation survey, and topic modeling), followed by beliefs that appeared in the elicitation survey and topic modeling, then followed by whether appeared in elicitation survey or topic modeling and the literature. Finally, members from each arm of belief generation advocated for beliefs that were prevalent within the specific method, but may not have appeared in other methods. This strategy allowed us to prioritize beliefs that were prevalent across and within sources, creating a comprehensive picture of the diverse beliefs that are available. The final set of belief statements (n = 116) was then sorted into a final list of themes (n = 23).

[1] Each text mentioned tobacco-relevant words (based on our exhaustive keyword list) at least three times. This gave us greater certainty the text was tobacco-relevant.

Phase II: Identifying Promising Campaign Themes

Sample

Participants were recruited from Toluna, an opt-in online panel provider. Toluna provides both a youth panel and an adult panel. We recruited 13-17-year-old participants directly from the youth panel and through their parents in the adult panel. The clean and complete data included 1,014 13-17-year-old participants.

The purpose of the study was to identify promising belief themes to prevent initiation. Therefore, the analyses conducted in this study was focused specifically on youth participants who had both never used an electronic cigarette and never smoked a cigarette in their lifetime. We dropped participants who answered yes to either the item "Have you ever tried vaping or using electronic cigarettes, even one or two puffs?" or "Have you ever tried smoking cigarettes, even one or two puffs?" This yielded a final sample of 702 13-17-year-old participants.

The majority of the participants were girls (n = 464, 66.1%), while a little over one-third were boys (n = 238, 33.9%). Approximately half of the participants reported their race as Non-Hispanic White (52.1%), followed by Hispanic (17.4%), Black or African-American (10.3%), or Other/More than one race/ethnicity (20.2%).

E-Cigarette Users

Though all subsequent analyses focus on never e-cigarette and never cigarette users, we did explore a number of attributes about the e-cigarette users in our sample. In total, there were 255 youth (22.4% of the sample) who had used an e-cigarette at least once in their life time. Of these participants, 170 (66.7%) had also ever used a cigarette. Approximately half identified as Non-Hispanic White (n = 139, 54.5%), followed by Hispanic (n = 65, 25.5%), Black/African-American (n = 19, 7.45%), and Other/More than one race (n = 32, 12.6%). Approximately half were girls (n = 137, 53.94%) and half were boys (n = 117, 46.06%). The majority of these youth were 16-year-olds (n = 75, 29.4%) or 17-year-olds (n = 70, 27.5%), followed by 15-year-olds (n = 66, 25.9%), 14-year-olds (n = 27, 10.6%), and 13-year-olds (n = 17, 6.7%).

The e-cigarette users identified the e-cigarette device they "typically" used (i.e., cig-a-likes, vape pens, and/or mods), which was primarily vape pens (n = 65, 39.63%). A large portion of participants also reported they had used more than one type of device (n = 63; 38.42%), followed by cig-a-likes (n = 22, 13.4%) and mods (n = 14, 8.5%). A little over half of the participants owned their own e-cigarette (n = 145, 56.9%).

When asked about their last e-cigarette use, participants reported receiving their e-cigarette from someone who gave it to them (40.8%), as opposed to purchasing it themselves (26.7%), someone purchasing it for them (18.0%), or none of the above (14.51%). The majority of e-cigarette users reported using their last e-cigarette with a friend (72.2%), rather than alone (19.6%), with a sibling (3.9%), with a parent (3.1%), or none of the above (1.2%). E-cigarette users reported last using an e-cigarette device at their home (30.6%) or at a friend's home (24.31%), followed by at a party (21.2%), at school (9.4%), in a car/parking lot (8.2%), or none of the above (6.3%).

Procedure

All participants completed the questionnaire online, which took approximately 15 minutes to complete. The study was approved by the Institutional Review Board at the University of Pennsylvania.

Measures

Dependent Variable: No Intention to Use E-Cigarettes

We measured intentions to use electronic cigarettes over the next year using three or four intention questions (dependent on skip patterns). Three items were Likert-type scales with five response options (Very unlikely, unlikely, Neither likely nor unlikely, Likely, Very likely): 1) "How likely is it that you will vape or use an electronic cigarette, even one or two puffs, within the next year?" (asked of all respondents), 2) "How likely is that you will vape or use an electronic cigarette without nicotine within the next year?" (asked of all respondents), and 3) "How likely is that you will vape or use an electronic cigarette with nicotine in the next year?" (asked only of those participants who selected "Very unlikely" to both the general item and no nicotine item). A final item asked respondents, "How frequently are you likely to vape or use an e-cigarette in the next year?" with the response options of Never, Just to try it once or twice, 3-10 times during the year, more than 10 times during the year. We created a composite measure of no intention to use e-cigarettes, grouping together participants who indicated "very unlikely" to intention to use e-cigarettes (general) and "very unlikely" to intention to use e-cigarettes (no nicotine). In total, 55% of 13-17 year olds had no intention to vape over the next year.

Independent Variables: Smoking-Related Beliefs

Individual Beliefs. In total, we measured 116 beliefs across 23 themes. This included beliefs/themes that emphasized both benefits and negative consequences of using electronic cigarettes. There were two stems that preceded each belief question: "If I vape or use e-cigarettes every day" or "If I start vaping or using e-cigarettes," followed by the benefit (e.g., "I will look cool") or negative consequence (e.g. "I will look immature"). Each participant was randomly assigned to one of those stems for all of the belief statements. In the analyses the responses from both stems were collapsed.[2] Participants viewed at least three items for each of the 23 themes. For themes that had more than 23 items, participants were randomly assigned to view four of the items within the theme. All belief items were measured with 5-point Likert-type scales (Strongly Disagree, Disagree, Neither Agree nor Disagree, Agree, Strongly Agree). For these analyses, the beliefs were dichotomized, where the strongest anti-smoking belief was compared to all others (e.g., Strongly Disagree vs. Disagree, Neither Agree nor Disagree, Agree, and Strongly Agree).

Themes. The individual beliefs were also constructed into scale variables that represented each of the 23 themes. Cronbach's alpha was calculated for each theme to ensure each set of beliefs appeared to represent the same underlying theme (see Table 1). For each theme, we then averaged the set of individual belief items to develop a scale. Similar to the

[2] Preliminary analyses indicated that the two stem conditions produced results that were largely similar to one another, and by combining the data, we were able to increase the sample size and hence the stability of our results.

individual beliefs, the themes were dichotomized in analysis. Respondents who had an average score greater than 4.0 on the continuous scales were compared to respondents who had an average score of 4.0 or less on the scale.

Table 1. Belief Scales: Number of Items per Scale and Scale Reliability

	Number of Individual Belief Items in Scale	Scale α
Consequences		
Harm to Others	7	.97
Social Perceptions - Anti	3	.94
Health Effects – Short Term	7	.96
Chemicals	11	.98
E-Cigarette Specific Risk	4	.92
Health Effects – Long Term	6	.95
Tobacco Industry	3	.88
Policy – Public Restrictions	3	.85
Gateway and Polyuse	4	.94
Addiction	4	.95
Policy – Purchase Restrictions	3	.75
Cost (Financial)	4	.90
Benefits		
Relaxation and Mental Health	6	.98
Flavors	3	.89
Cosmetic Effects	6	.93
Comparison to Cigarettes	11	.96
Modification	4	.91
Ease of Use	3	.92
Opportunities for Social Interaction	7	.96
Technology	3	.94
Enjoyment and Mood	7	.96
Cessation	3	.94
Social Perceptions – Pro	3	.95

Data Analysis

All analyses were conducted using Stata 13.0/14.0. For each individual belief and message theme, we calculated three quantitative indicators of how promising the theme/belief would be as a campaign target.

First, an odds ratio (OR) was calculated to examine the association between each belief/theme and intentions to vape using logistic regression analyses. An OR greater than 1.0 indicated that respondents who held the desired belief/s were *more* likely to have no intention to vape or use an e-cigarette than were those who did not hold the desired belief/s, whereas an OR less than 1.0 indicated that respondents who held the desired belief/s were *less* likely to have no intention to vape or use an e-cigarette.

Second, potential percentage to move was calculated, which indicated the proportion of the population not currently holding the desired belief(s) and available to be influenced by campaign messaging. Low percentages to move indicated that a large portion of the population already held these particular beliefs, while higher percentages to move indicated the belief would present relatively new information for the population.

Finally, potential percentage to gain was calculated, which indicated the potential promise of a campaign theme. Percentage to gain represents the additional proportion of the population who would have the desired intention (i.e., no intention to vape or use e-cigarettes in the next year) if 100% of the population endorsed this particular belief (Hornik & Woolf, 1999). This percentage to gain score indicates the maximum promise of any given belief theme.

Results

The individual beliefs had an average percentage to gain of 12.28% (*SD* = 3.0%; Range of 5.5% to 20.1%). The themes (scales) had an average percentage to gain of 11.5% (*SD* = 2.2%; Range of 6.8% to 15.2%). We have decided to divide the results into beliefs that emphasize the negative consequences of vaping or using e-cigarettes and the beliefs that emphasize the benefits of vaping or using e-cigarettes. The full percentages to gain for beliefs for never e-cigarette users and never cigarette users can be found in Appendix A. The percentage to move is also reported in the table.

Highlighted Findings: Consequences of Vaping or Using E-Cigarettes

Here we highlight two themes that are particularly promising: Harm to Others and Health Effects – Short Term.

Harm to Others. The theme "Harm to Others" encompasses several belief statements that describe consequences to entities other than the individual vaping or using e-cigarettes. This theme had the highest percentage to gain for themes that emphasize consequences (percentage to gain = 13.2%) and the sixth highest theme over all. Within the theme, there was some variation of percentage to gain between individual belief items. The items with higher percentages to gain discussed harm to others more generally, while items within the theme with lower percentages to gain were those that targeted specific people such as family and friends. The three highest items were:

- "It will be harmful to the environment." (Percentage to gain: 15.5%)
- "It will expose others to chemicals absorbed through the skin." (Percentage to gain: 14.6%)
- "It will produce secondhand smoke (Percentage to gain: 14.5%)

Health Effects – Short Term. The theme "Health Effects – Short Term" is also noteworthy. The average percentage to gain was 12.2%, though there was also variation among the individual belief items. The beliefs with higher percentages to gain were those targeted at health effects such as headaches, sinus issues, and dehydration, while those that targeted health beliefs such as throat issues, cough, and breathing were less promising. The three highest items were:

- "I will feel dizzy or have headaches." (Percentage to gain: 17.4%)
- "I will have sinus issues." (Percentage to gain: 16.4%)
- "I will be dehydrated." (Percentage to gain: 13.9%)

Highlighted Findings: Benefits of Vaping or Using E-Cigarettes

Though potentially more difficult to develop a prevention campaign, it should be noted that benefits had overall higher percentages to gain. A few themes will be highlighted here.

Relaxation and Mental Health. The theme "Relaxation and Mental Health" had the highest overall percentage to gain (15.19%). Within this theme, the belief statements that focused more on stress relief were more promising, while those that targeted relaxation more generally had lower percentages to gain. The three highest items were:

- "It will calm my nerves." (Percentage to gain: 19.2%)
- "It will reduce my stress." (Percentage to gain: 17.6%)
- "It will clear my mind." (Percentage to gain: 15.5%)

Flavors. The theme "flavors" included three belief statements regarding the variety and risks related to flavor options. The theme had the second highest percentage to gain overall (14.7%). The items included:

- "I will be able to use a variety of flavors I like." (Percentage to gain: 15.4%)
- "I will enjoy trying different e-cigarette products and flavors with friends." (Percentage to gain: 14.9%)
- "The flavor additives will not harm me." (14.4%)

Conclusions

All of the belief statements (n = 116) and themes (n =23) had some promise, though some were particularly promising and others were not. Additionally, there was some variation of the individual beliefs within each theme.

Follow-Up Analyses for U.S. FDA CTP
Update Date: December 8, 2016

The research team at the Annenberg School for Communication at the University of Pennsylvania has completed several follow up analyses for the priority beliefs and non-priority beliefs at the request of the Center for Tobacco Products. Our findings and comments can be found below and in the attached tables. In our initial report, we presented the approach we took overall, and offered evidence about which beliefs were most promising for all prior non-users of e-cigarettes. This summary assumes that the prior report is a foundation and then focuses on new information garnered from the additional requested follow-up analyses. Our approach is to focus attention on beliefs which show evidence of difference in responses by subgroups. For example, we begin by comparing the responses of ever users to never users. We do not report about beliefs where the percentage to gain was not different for the ever users from the never users.

1. *Assess beliefs for those who have used e-cigarettes*

Regression analyses were performed to determine if there were differences in the impact of beliefs on intentions to use electronic cigarettes between never users (i.e., those who have never tried an e-cigarette nor a cigarette) and ever users (i.e., participants that reported trying an e-cigarette even just once, including one or two puffs). For each belief, a logistic regression was conducted examining the predictive ability of the belief, ever user status (1 = yes, 0 = no), and the interaction of belief and ever user status on intentions to use e-cigarettes. A significant interaction indicates differences between ever users and never users on the association with the respective beliefs. The beliefs with significant differences between ever users and never users can be found below in Table 2, though the full listing of percentages to gain for priority beliefs among ever users can be found in Appendix B; this can be compared with the analyses for all never users in Appendix A. To summarize: there were 33 priority beliefs and 54 non-priority beliefs; of these only four priority beliefs and six non-priority beliefs showed a significantly different patterns between the two groups.

Table 2. Beliefs with Significant Differences between Never Users and Ever Users

Belief Statements	OR (interaction)	sig (interaction)	CI (low)	CI (high)	Direction (belief stronger for)
Priority Beliefs					
It will produce secondhand smoke	7.17	.018	1.397	36.820	Never users
I will be exposed to harmful vapor	3.62	.009	1.372	9.548	Never users
It will change my brain	11.40	.024	1.385	93.672	Never users
I will be able to control my level of nicotine exposure	.27	.011	.097	.738	Ever users
Non-Priority Beliefs					
I will feel dizzy or have headaches	3.72	.040	1.065	12.956	Never users
I will have sinus issues	11.50	.026	1.331	99.336	Never users
I will be exposed to propylene glycol, which can lead to skin irritation	6.17	.038	1.108	34.393	Never users

I will develop sexual and/or fertility problems	7.54	.014	1.509	37.700	Never users
I will not be exposed to the tar found in tobacco cigarettes	.12	.026	.019	.778	Ever users
I will have fun	.30	.050	.091	1.001	Ever users

2. *Assess beliefs among non-users with those who are at high risk for using separated from those who are at low risk for using*

In order to develop a measure for e-cigarette risk, we calculated a predicted susceptibility score for each respondent. We initially conducted a regression analysis exploring the factors that predicted intention to use e-cigarettes (general). The predictors entered into the model are as follows: identifying as Hispanic, identifying as Black/African-American, a four-item composite score for sensation-seeing, sex, the number of friends who are currently e-cigarette users (0-4), cigarette ever use, and age. Results from the regression analysis can be found in Table 3. The prediction equation accounted for 42% of the variance explained. Hispanic and African-American respondents were less susceptible; high sensation-seekers, tobacco cigarette users, and those with more e-cig using friends were more susceptible

Table 3. Predictors of E-Cigarette Intention

Number of obs	1,005
***F* (10,994)**	72.93
p	< .001
R^2	.42
Root MSE	1.00

Predictor	Coefficient	SE	*t*	*p*	95% CI Lower	95%CI Upper
Race – Hispanic	.22	.08	2.73	.01	.06	.39
Race – Black	.28	.11	2.52	.01	.06	.49
Sensation-Seeking	.13	.03	3.80	<.001	.06	.20
Sex	-.13	.07	-1.94	.05	-.26	.00
Cig. Ever Use	.94	.09	10.22	<.001	.76	1.12
Descriptive Norms	.36	.03	12.51	<.001	.31	.42
14 year old	-.09	.14	-.62	.53	-.36	.19
15 year old	-.15	.13	-1.15	.25	-.42	.11
16 year old	-.07	.13	-.52	.60	-.33	.19
17 year old	-.14	.13	-1.09	.28	-.40	.12

The predicted scores of the susceptibility measure were saved for each participant. Regression analyses were conducted for each priority belief, entering the belief, the predicted susceptibility score, and the interaction between belief and predicted susceptibility. If the interaction term for any given belief is significant, this indicates a difference between low and high risk individuals. The full tables are available upon request, but only the following interaction terms were significant. For all of the following beliefs, the beliefs were more promising for *high* susceptibility participants (see Table 4). Thus six beliefs were different between high and low susceptibles, but 27 beliefs were not different.

Table 4. Belief Items with Differences Between High and Low Susceptibility Respondents

Belief Statements	b (interaction)	sig (interaction)	CI (low)	CI (high)
I will look ridiculous	0.187	0.038	0.061	0.572
I will be exposed to toxic metals…	0.012	0.041	0.001	0.24
It will change my brain	0.015	0.011	0.002	0.146
It will be hard for me to put down	0.051	0.019	0.009	0.293
I will not be able to stop if I wanted to	0.033	0.015	0.005	0.229
I will be able to control my level of nicotine exposure	5.918	0.008	2.329	15.041

3. *Belief rankings separated out by ethnicity, in particular, rankings for African American, Hispanic, and multi-race youth*

Similar to the ever user analyses, a series of logistic regressions were conducted for each of the sub-groups: African-American, Hispanic, and Multi-Race never-using youth.[3] In these regressions, the belief, identifying as a member of the minority group (1 = yes, 0 = no), and interaction between belief and racial identification were used to predict intention to use e-cigarettes. Only the 33 priority beliefs were tested. Significant interactions are highlighted below, which indicate meaningful differences between the specific minority group (vs. all others). It should be noted that there were few differences between the groups overall, except for the beliefs highlighted below. A "+" indicates that belief is more promising for the particular minority group, a "-" indicates the belief is less promising for the minority group. The full listing of percentages-to-gain for each group are compared is available upon request.

African American Youth (N = 77)

Only a small number of never-using African American youth were present in the sample, so it is difficult to make strong claims about the beliefs that might be more or less promising for this sub-population. There were no beliefs among African Americans for which the percentage to gain was both different from those for others, and different from 0. We do not present those results here.

Hispanic Youth (N = 122)

For four of the 33 priority beliefs never-using Hispanic youth were significantly different from other never using groups. These beliefs had significantly *more* promise, though they were not from any consistent theme. For the remaining 29 beliefs the Hispanic respondents were not different from others.

[3] Due to sample size constraints, multi-race youth includes both youth who identified as more than one race/ethnicity AND youth who identified as a race or ethnicity other than Non-Hispanic White, Hispanic, or Black/African-American.

Table 5. Promising Beliefs for Hispanic Youth

Belief Statements	% to Gain (Hispanic Youth)	% to Gain (All Never Users)	% to Move (Hispanic Youth)	Direction (+ or -)
I will look immature	26.99	12.68	42.62	+
It will harm my lungs	17.04	8.96	50.53	+
I will be more likely to use tobacco cigarettes	38.52	9.00	18.03	+
It will be a waste of my money	15.99	9.05	58.20	+

Multi-Racial and Other Race Youth (N = 142)

Among multi-racial and other race youth, no beliefs had percentages to gain that were both significantly different from all other groups and different from 0.

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Appendix A. Individual Belief Analyses for Never E-Cigarette, Never Cigarette Users

Theme Rank	Belief Rank	Theme/Belief Statement	% to Gain	Lower 83% CI % to Gain	Upper 83% CI % to Gain	OR	% to Move	N
1		**Relaxation & Mental Health**	**15.19**	**12.83**	**17.63**	**4.99**	**53.06**	**703**
	2	**It will calm my nerves**	19.19	15.96	22.48	7.09	55.82	378
	6	**It will reduce my stress**	17.57	14.19	21.01	6.03	56.11	360
	14	**It will clear my mind**	15.52	12.51	19.35	5.52	52.99	334
	17	It will help when I am upset or angry about something	15.40	12.07	19.03	5.51	51.58	349
	19	It will relax me	15.17	11.83	18.97	4.83	58.65	341
	33	It will be better for reducing stress than medications	14.28	11.02	17.83	4.52	52.74	347
2		**Flavors**	**14.68**	**12.17**	**17.27**	**4.12**	**59.46**	**703**
	18	**I will be able to use a variety of flavors I like**	15.36	12.63	18.15	4.12	64.30	703
	21	**I will enjoy trying different e-cigarette products and flavors with friends**	14.89	12.59	17.52	4.57	55.33	703
	29	**The flavor additives will not harm me**	14.39	12.07	17.07	4.07	58.18	703
3		**Cosmetic Effects**	**13.48**	**10.88**	**16.18**	**3.56**	**59.89**	**703**
	9	I will be able to keep my weight down	17.18	13.13	21.23	5.08	66.20	358
	20	My teeth won't be discolored	15.05	11.48	18.87	3.72	60.16	374
	39	I won't stain my fingers or clothes	13.90	9.70	18.14	3.13	66.76	373
	64	I won't smell like smoke	11.97	7.81	15.91	3.03	61.47	340
	68	I will like the way I looked using them	11.87	8.38	15.00	3.97	46.30	324
	94	I won't have bad breath	9.80	6.49	13.20	3.01	51.76	340
4		**Comparison to Cigarettes**	**13.42**	**10.35**	**16.26**	**3.09**	**69.27**	**703**
	5	It will not bother people around me as much as tobacco cigarettes do	17.82	13.79	22.94	4.82	68.22	265
	69	I will avoid chemicals found in tobacco cigarettes	11.79	6.45	17.14	2.58	74.32	263
	70	It will be cleaner than smoking tobacco cigarettes	11.72	6.35	16.94	2.58	64.34	260
	3	I will be able to get them more easily than tobacco cigarettes	18.84	14.29	23.49	7.10	63.40	257

	16	They will be cheaper than smoking tobacco cigarettes	15.43	8.69	20.50	3.57	71.88	224
	104	It will be less harmful than smoking tobacco cigarettes	8.31	4.47	12.62	2.58	73.98	267
	36	It will taste better than smoking tobacco cigarettes	14.05	7.58	19.48	2.86	70.72	246
	75	It will be less harmful to others than smoking tobacco cigarettes	11.25	5.68	16.55	2.35	70.38	246
	1	I will be able to use e-cigarettes where tobacco cigarette smoking is not allowed	20.15	15.51	25.11	6.59	69.11	258
	111	I will not be exposed to the tar found in tobacco cigarettes	6.14	0.94	11.40	1.62	61.05	282
	4	It will be less addictive than tobacco cigarettes	18.34	13.44	22.66	5.51	68.79	244
5		**Modification**	**13.35**	**10.67**	**16.36**	**3.27**		**702**
	23	I will be able to modify all parts of the vaping experience	14.70	11.80	17.55	3.75	65.10	702
	27	I will be able to get an e-cigarette without nicotine	14.49	11.30	17.48	3.42	70.09	702
	43	I will enjoy the fun of being able to DIY (do-it-yourself) my own e-cigarette device	13.51	11.09	16.01	3.91	54.70	702
	78	I will be able to control my level of nicotine exposure	11.16	8.21	14.03	2.60	64.81	702
6		**Harm to Others**	**13.20**	**10.69**	**15.57**	**3.85**	**53.63**	**703**
	15	**It will be harmful to the environment**	15.51	11.58	18.89	3.95	62.41	407
	25	**It will expose others to chemicals absorbed through the skin**	14.63	10.68	18.35	3.66	60.89	381
	26	**It will produce secondhand smoke**	14.54	10.97	17.76	4.02	60.45	402
	54	It will be harmful to my family's health	12.18	9.00	15.14	3.34	55.12	430
	58	It will bother people around me	12.06	9.17	14.95	4.37	43.59	390
	76	It will be harmful to my friends' health	11.22	7.89	14.95	2.93	57.68	397
	85	It will harm others around me	10.42	6.99	13.67	2.79	57.46	402
7		**Ease of Use**	**13.08**	**10.42**	**16.07**	**3.24**	**63.02**	**703**
	30	It will be easy for me to use them	14.34	11.59	17.30	3.57	66.00	703

	34	It will be convenient to carry them with me	14.10	11.50	16.92	3.67	62.30	703
	42	It will be easy for me to hide them	13.64	11.06	16.47	3.42	63.58	703
8		**Opportunities for Social Interaction**	**12.57**	**10.57**	**14.96**	**4.10**	**46.94**	**703**
	28	I will be able to share my e-cigarette with friends	14.47	11.31	17.80	4.49	54.31	418
	32	I will fit in with my peers	14.29	11.27	17.57	5.53	45.48	387
	47	It will help me make friends	12.73	9.93	15.78	4.83	41.93	384
	56	I will be accepted by others	12.11	9.20	15.33	3.48	47.17	407
	61	It will be a good conversation starter	12.00	8.69	14.94	3.97	45.98	398
	67	I will feel like less of an outcast	11.92	9.04	14.91	4.17	45.83	408
	90	I will be able to socialize with other people who vape	10.20	6.94	13.82	2.69	55.26	409
9		**Technology**	**12.55**	**10.44**	**15.02**	**3.91**	**48.93**	**703**
	37	I will feel like I am part of tech culture	13.96	11.81	16.32	4.81	47.80	703
	49	I will feel like I am using a cutting-edge product	12.66	10.42	15.16	3.84	50.50	703
	55	I will be using a futuristic device	12.13	9.56	14.57	3.49	52.20	703
10		**Enjoyment & Mood**	**12.49**	**10.13**	**14.76**	**3.72**	**51.07**	**703**
	8	I will have something to do with my hands	17.32	14.35	20.97	5.86	58.25	400
	13	I will enjoy the taste	15.59	12.64	18.68	5.57	48.89	405
	40	I will have fun	13.70	10.76	16.76	4.93	48.78	410
	41	I will have something to do when I am bored	13.67	10.37	16.51	4.06	53.35	418
	51	I will enjoy making vape clouds	12.41	9.36	15.50	3.40	53.03	396
	71	It will help me concentrate	11.66	8.55	14.53	4.00	44.47	389
	80	I will get a nice buzz	11.05	8.04	14.72	2.97	53.71	391
11		**Social Perceptions - Anti**	**12.19**	**9.98**	**14.53**	**3.72**	**49.22**	**703**
	48	I will look immature	12.68	10.47	15.21	3.64	53.34	703
	66	I will look stupid	11.95	9.63	14.38	3.63	49.08	703
	72	I will look ridiculous	11.64	9.53	14.00	3.43	50.07	703
12		**Health Effects - Short Term**	**12.15**	**9.47**	**14.89**	**3.04**	**60.60**	**703**
	7	**I will feel dizzy or have headaches**	17.35	13.21	20.85	4.87	66.75	397
	10	**I will have sinus issues**	16.43	12.29	21.03	3.89	67.36	383
	38	**I will be dehydrated**	13.94	10.32	17.90	3.70	65.92	402
	50	It will decrease my sports performance	12.48	8.69	16.10	3.08	61.36	427

	52	I will have a dry, itchy throat	12.32	8.30	16.36	2.71	66.06	383
	60	I will get a bad cough	12.01	8.73	15.55	3.32	61.17	412
	74	I will have a hard time breathing	11.57	8.05	14.86	3.00	58.97	407
13		**Cessation**	**11.95**	**9.31**	**14.93**	**2.93**	**61.77**	**701**
	44	smoking tobacco cigarettes - e-cigs will help me reduce the number of cigarettes I smoke	13.35	10.67	16.35	3.35	63.05	701
	46	smoking tobacco cigarettes - e-cigs will work better than other quitting aids in helping me quit	13.07	10.24	15.96	3.31	61.77	701
	73	smoking tobacco cigarettes - e-cigs will help me quit	11.59	8.91	14.42	2.85	61.43	700
14		**Chemicals**	**11.64**	**9.01**	**14.63**	**2.79**	**62.82**	**702**
	11	I will inhale poisons	16.04	11.89	20.55	4.64	59.59	245
	22	I will be exposed to tar	14.77	9.89	19.96	3.43	70.72	263
	24	I will be exposed to diacetyl, which can lead to "popcorn lung" (lung scarring)	14.68	11.08	19.62	3.86	60.57	279
	31	I will be exposed to propylene glycol, which can lead to skin irritation	14.30	9.15	19.21	3.31	64.45	256
	63	I will be exposed to toxic metals such as chromium, nickel, and lead	12.00	7.04	16.42	2.84	62.99	254
	77	I will be exposed to hormones	11.16	5.55	17.16	2.27	72.73	242
	81	I will be exposed to formaldehyde, which can lead to eye, nose, and throat irritation	10.99	5.58	15.00	2.81	65.25	259
	83	I will be exposed to toxic chemicals	10.69	5.99	14.87	2.59	57.09	247
	96	I will inhale nicotine	9.58	4.38	13.90	2.38	63.67	245
	102	I will be exposed to aerosol, which may contain harmful particles	8.56	4.55	12.62	2.46	62.03	266
	113	I will be exposed to charcoal	5.68	-0.43	11.42	1.50	69.84	252
15		**E-Cigarette Specific Risk**	**11.25**	**8.70**	**13.73**	**2.93**	**56.61**	**703**
	53	I will be exposed to harmful vapor	12.25	9.84	14.72	3.32	55.62	703
	59	I will have to worry about an e-cigarette catching fire or exploding	12.02	9.21	14.88	2.81	65.58	703

	62	I will be exposed to dangerous ingredients	12.00	9.67	14.40	3.30	54.48	703
	93	I will worry about liquid chemicals from refills leaking on clothes or furniture	9.98	7.29	13.06	2.40	61.97	702
16		**Health Effects - Long Term**	**9.83**	**7.51**	**12.68**	**2.44**	**59.32**	**703**
	12	I will get sick because it will weaken my immune system	15.76	12.42	18.79	4.83	60.79	454
	35	I will develop sexual and/or fertility problems	14.10	9.84	17.95	3.10	73.57	473
	45	I will get lung cancer	13.25	9.73	16.63	3.24	63.17	486
	79	It will change my brain	11.07	7.65	14.23	2.84	60.17	467
	97	I will get oral (mouth) cancer	9.53	5.81	13.04	2.32	65.10	467
	101	It will harm my lungs	8.96	5.69	11.94	2.29	52.69	465
17		**Tobacco Industry**	**9.44**	**6.07**	**12.87**	**2.07**	**71.37**	**702**
	65	I will feel manipulated by the tobacco companies	11.97	8.66	15.53	2.58	72.22	702
	89	I will be supporting the tobacco industry	10.28	6.81	13.29	2.24	70.80	702
	103	I will be purchasing products from the same people that make tobacco products	8.49	4.62	12.30	1.86	75.07	702
18		**Social Perceptions - Pro**	**9.43**	**7.84**	**11.57**	**4.20**	**31.58**	**703**
	82	I will look cool	10.93	9.15	13.09	4.81	34.00	703
	91	I will look confident	10.10	8.33	12.21	4.15	34.71	703
	95	I will look attractive	9.58	7.80	11.46	4.39	31.01	703
19		**Policy - Public Restrictions**	**9.34**	**6.21**	**11.92**	**2.27**	**61.25**	**702**
	91	I will be able to use them in outdoor spaces such as parks	10.37	6.84	13.56	2.28	3.04	702
	113	I will be able to use them in indoor spaces such as restaurants and theaters	7.29	4.84	9.69	2.11	2.68	702
	119	I will be able to carry them on airplanes	5.48	2.71	7.91	1.68	2.13	702
20		**Gateway & Polyuse**	**9.19**	**5.17**	**13.00**	**1.92**	**78.81**	**703**
	84	I will be more likely to use other drugs	10.52	6.30	14.65	2.10	81.37	703
	99	I will be more likely to use tobacco cigarettes	9.00	4.97	13.08	1.87	79.80	703
	106	I will be more likely to use marijuana	7.76	3.84	12.19	1.69	81.08	703
	108	I will be more likely to use other tobacco products, such as cigarillos and hookah	7.63	3.22	11.98	1.69	79.63	702

21		**Addiction**	**9.02**	**6.02**	**11.81**	**2.12**	**65.01**	**703**
	86	It will be hard for me to put down	10.42	7.50	13.72	2.32	68.85	703
	87	I will become addicted	10.37	7.52	13.31	2.39	65.58	703
	92	I will become addicted to nicotine	10.08	6.75	13.31	2.21	69.15	658
	100	I will not be able to stop if I wanted to	8.98	5.69	12.15	2.00	71.08	702
22		**Policy - Purchase Restrictions**	**7.98**	**4.70**	**10.94**	**1.91**	**66.19**	**701**
	57	I will have to pay tobacco taxes on them	12.10	8.70	15.91	2.52	75.75	701
	105	I will not be able to purchase them in places near my school or home	8.02	4.88	11.10	1.88	68.33	701
	107	I will not be allowed to purchase them because I'm too young	7.65	5.15	10.10	2.03	56.63	701
23		**Cost (Financial)**	**6.84**	**5.11**	**9.04**	**2.41**	**38.46**	**702**
	98	It will be a waste of my money	9.05	7.23	11.10	3.55	34.90	702
	110	I will have to spend a lot of money buying more refills/juice	6.86	4.57	9.24	2.00	51.00	702
	112	I will have to spend a lot of money buying the device	6.06	3.73	8.66	1.80	52.85	702
	114	It will be more expensive for me	5.49	3.40	7.70	1.81	46.87	702

Appendix B. Individual Belief Analyses for E-Cigarette Ever Users

Theme/Belief Statement	% to Gain	Lower 83% CI % to Gain	Upper 83% CI % to Gain	OR	Lower 83% CI OR	Upper 83% CI OR	% to Move	N
Harm to Others								
It will expose others to chemicals absorbed through the skin	9.50	0.33	20.77	2.50	1.11	5.64	16.00	150
It will produce secondhand smoke	-4.10	-10.76	2.58	0.56	0.19	1.67	19.42	139
It will bother people around me	7.35	1.36	14.66	2.51	1.22	5.20	28.48	151
Social Perceptions – Anti								
I will look immature	6.59	0.91	14.87	1.94	1.07	3.54	18.82	255
I will look stupid	3.80	-1.61	10.71	1.50	0.81	2.78	19.69	254
I will look ridiculous	6.36	0.62	13.08	1.95	1.09	3.48	21.18	255
Chemicals								
I will inhale poisons	14.56	4.03	28.53	5.95	1.90	18.60	21.79	78
I will be exposed to diacetyl, which can lead to "popcorn lung" (lung scarring)	2.39	-7.29	13.54	1.37	0.42	4.45	17.71	96
I will be exposed to toxic metals such as chromium, nickel, and lead	2.98	-7.59	14.06	1.34	0.50	3.62	18.95	95
I will be exposed to formaldehyde, which can lead to eye, nose, and throat irritation	7.17	-2.69	20.95	2.14	0.77	5.94	16.19	105
I will be exposed to toxic chemicals	13.96	-0.15	29.37	2.93	1.13	7.63	15.73	89
I will be exposed to aerosol, which may contain harmful particles	6.58	-1.55	16.84	2.47	0.84	7.27	21.05	95
E-cigarette Specific Risk								
I will be exposed to harmful vapor	-0.68	-5.00	4.45	0.92	0.49	1.73	23.92	255
I will have to worry about an e-cigarette catching fire or exploding	6.59	0.00	13.42	1.94	1.07	3.54	18.82	255
I will be exposed to dangerous ingredients	3.10	-1.86	9.02	1.42	0.79	2.57	23.14	255
Health Effects – Long Term								
It will change my brain	-7.34	-11.48	-1.75	0.25	0.06	1.06	16.85	178
It will harm my lungs	11.06	2.90	20.24	2.74	1.41	5.31	21.82	165
Gateway & Polyuse								
I will be more likely to use tobacco cigarettes	3.63	-2.77	12.53	1.44	0.73	2.85	14.90	255
I will be more likely to use other tobacco products, such as cigarillos and hookah	4.51	-1.89	13.17	1.58	0.82	3.01	16.47	255
Addiction								
It will be hard for me to put down	-1.34	-7.51	4.14	0.85	0.42	1.75	18.11	254
I will become addicted	-0.20	-5.54	5.97	0.98	0.50	1.91	19.69	254
I will become addicted to nicotine	-3.30	-9.48	4.12	0.67	0.28	1.64	14.60	226

I will not be able to stop if I wanted to	-3.87	-10.05	2.11	0.62	0.26	1.49	14.17	254
Cost								
It will be a waste of my money	10.63	6.63	15.66	3.70	2.14	6.38	30.98	255
I will have to spend a lot of money buying more refills/juice	1.95	-2.37	6.31	1.29	0.74	2.25	30.59	255
I will have to spend a lot of money buying the device	4.06	-0.61	8.92	1.65	0.95	2.86	29.02	255
Comparisons to Cigarettes								
It will be less addictive than tobacco cigarettes	61.27	18.63	87.25	23.73	4.51	124.76	3.92	102
I will avoid chemicals found in tobacco cigarettes	-1.11	-10.20	13.88	0.87	0.19	4.01	11.22	98
Modification								
I will be able to get an e-cigarette without nicotine	34.90	19.79	53.73	8.31	3.97	17.39	6.67	255
I will be able to control my level of nicotine exposure	35.67	22.35	51.66	9.72	5.01	18.85	9.02	255
Flavors								
I will be able to use a variety of flavors I like	33.30	20.24	47.60	8.41	4.29	16.48	8.63	255
I will enjoy trying different e-cigarette products and flavors with friends	29.22	18.28	40.66	7.69	4.14	14.28	11.37	255
The flavor additives will not harm me	30.15	18.65	43.17	7.66	4.05	14.51	10.20	255