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Angeline Sangalang

Allyson Volinsky

Qinghua Yang

Jiaying Liu

Stella Lee

See next page for additional authors

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Author(s)

Angeline Sangalang, Allyson Volinsky, Qinghua Yang, Jiaying Liu, Stella Lee, Laura A. Gibson, and Robert Hornik

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

Angeline Sangalang, Allyson C. Volinsky, Qinghua Yang, Jiaying Liu, Stella Lee,
Laura A. Gibson, and Robert C. Hornik

Penn's Tobacco Center of Regulatory Science
Annenberg School for Communication
University of Pennsylvania
Philadelphia, Pennsylvania

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Corresponding Author:
Professor Robert C. Hornik
Annenberg School for Communication
University of Pennsylvania
3620 Walnut St
Philadelphia, PA 19104
rhornik@asc.upenn.edu

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., 2013a,b,c,d). 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 or negative consequence (e.g. xxx). 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.

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 can be found in [Table 2](#) and for themes in [Table 3](#).

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%)

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.

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