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Understanding Young Adults' E-cigarette Use through the Theory of Planned Behavior

Emily Scheinfeld, PhD, **Brittani Crook, PhD**, **Cheryl L. Perry, PhD**

Emily Scheinfeld, Assistant Professor, Department of Communication, The University of Texas at Tyler. Brittani Crook, Affiliated Fellow with the Center for Health Communication, The University of Texas at Austin. Cheryl L. Perry, The Rockwell Distinguished Chair in Society and Health, Department of Health Promotion and Behavioral Sciences, The University of Texas Health Science Center at Houston.

Abstract

Objective: The use of e-cigarettes among college undergraduates is a prevalent problem across the United States. Guided by the Theory of Planned Behavior (TPB), we examined the relationship between memorable messages and early adulthood e-cigarette use.

Methods: We recruited 159 students to complete a survey at Time 1 and 126 of those students completed the second survey.

Results: Structural equation modeling demonstrated that attitudes and norms are significantly associated with intentions to use e-cigarettes, whereas efficacy is negatively associated with intentions to use. Intentions were positively associated with actual use of e-cigarettes at Time 2.

Conclusions: Our findings contribute to understanding young adults' experiences with alternative tobacco products, and demonstrate a need to create health education and promotion campaigns based on TPB constructs.

Keywords

young adults; Theory of Planned Behavior; e-cigarettes; tobacco use; smoking and health; college student health

In 2014, e-cigarettes were the most commonly used tobacco product among youth and young adults.[1] This is cause for concern because the use of e-cigarettes has been strongly associated with use of other tobacco products, and one-third of young adults have tried an e-cigarette at least once in their life.[1,2] These numbers have doubled since 2014. Among adults who have never smoked cigarettes, nearly 10% had tried an e-cigarette at least once.[1] Although from 2005 to 2014 the prevalence of cigarette smokers declined from 20.9% to 16.8%, research suggests that use of alternative tobacco products such as hookah and e-

Correspondence Dr Scheinfeld; escheinfeld@uttyler.edu.

Human Subject Approval Statement

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Conflict of Interest Disclosure Statement

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cigarettes have become more common among young adults.[3,4] The consequences of the use of these alternative tobacco products, such as long-term nicotine addiction, are of concern.[1]

Theory of Planned Behavior

The Theory of Planned Behavior (TPB)[5] uses components from a variety of behavioral theories (eg, theory of reasoned action (TRA);[6] social cognitive theory[7]) to explain a wide range of volitional behaviors. As with the TRA, the TPB argues that attitudes, subjective norms, and perceived behavioral control influence intentions to enact a particular behavior.[5,6] Attitude is defined as a person's perception of the behavior (eg, smoking e-cigarettes is bad for me) and is shaped by the evaluation of the likely outcome of engaging in the behavior.[6] Subjective norm is characterized by what an individual perceives influential others think or do concerning the behavior (eg, my peers think smoking e-cigarettes is bad for me). Lastly, perceived behavioral control is defined by Ajzen[8] as the judgments an individual holds about the ease or difficulty of executing the actions to engage in said behavior. Perceived behavioral control is often analogous to Bandura's concept of self-efficacy.[7] Each of these components of TPB is considered a strong "psychosocial variable"[9] that determines behavioral intentions and enactment. In the domain of health behaviors, these components have been well supported for their ability to predict tobacco use in young adults.[10] For example, young adults are more likely to quit smoking if they have positive attitudes and strong perceived control of the steps required to cease the behavior.[10] This study applies the TPB to examine how attitudes, norms, and behavioral control (or efficacy) towards e-cigarette use is associated with intentions and actual use of e-cigarettes over time. Therefore, we propose the following hypotheses:

H1: Favorable attitudes, perceived norms that others are engaging in e-cigarette use, and greater efficacy to use, are positively associated with behavioral intentions to use e-cigarettes.

H2: Intentions are positively associated with behavior use.

METHODS

Primary Study

Participants and procedures.—Overall, 157 persons 18 years of age or older responded to the call for the study examining messages about e-cigarettes. The call was posted on a university-wide listserv asking for participants. After completing a telephone interview to determine eligibility, participants completed an online questionnaire during spring 2016 and were compensated with a $20 Amazon.com gift card.

Participants averaged 20.33 (SD = 1.55) years of age and ranged from 18 to 26 years of age. Etnicities of the sample included: 54 (35.3%) white/Caucasian, 28 (18.3%) Latino/a or Hispanic, 44 (28.8%) Asian or Pacific Islander, 7 (4.6%) black/African-American, 12 (7.9%) other or biracial and/or multiple ethnicities, and 7 (4.6%) declined to respond. When asked to describe their year in school, 27 reported they were of freshman status (17.5%), 32 (20.8%) were sophomores, 50 juniors (32.5%), and 43 seniors (27.9%). Two (1.3%) individuals indicated they were of graduate status.

When asked if they had ever used e-cigarettes, 76 (49.4%) reported that they had not, and 78 (50.6%) reported they had used e-cigarettes. For those 78 students who said they had used e-cigarettes, most reported having not used an e-cigarette in the past 30 days (N = 61, 78.2%). Another 12.8% (N = 10) reported using an e-cigarette on 1–2 days, 4 (5.1%) reported use on 3–5 days, one (1.3%) on 6–9 days, and 2 (2.6%) on all 30 days.

When asked if they had ever used conventional cigarettes, 90 (58.4%) reported that they had not, and 64 (41.6%) reported they had used conventional cigarettes. For those 64 students who said they had used conventional cigarettes, most (N = 50, 78.1%) reported having not used tobacco in the past 30 days. Additionally, 11 (17.2%) reported smoking cigarettes on 1–2 days, 2 smoked (3.1%) on 20–29 days, and one smoked (1.6%) every day of the past 30 days.

Follow-up Study

Participants and procedures.—Approximately 4 months after the initial survey, in summer 2016, the follow-up study took place. Participants who had completed the primary study were sent an email with the link for the follow-up study. Participants were instructed they could only complete the second survey if they completed the first survey. After participants granted consent via the online survey, they entered the unique identifier that they had created for the primary study. Participants then repeated the main questionnaire to assess if their use and/or intentions to use, attitudes, normative beliefs and efficacy had changed from the initial survey. Of the original 157 participants, 39 males, 86 females completed the follow-up questionnaire. Participants were offered an additional $20 amazon.com gift card for their completion of the follow-up study.

Quantitative Measures for the Primary and Follow-up Studies

Unless otherwise noted, all measures were rated on 7-point scale with the anchors *strongly disagree* (1) and *strongly agree* (7). Larger values for a measure indicate a greater magnitude of the variable. For each scale, composite variables were created by averaging the individual items on each respective scale. Reliability for each measure was assessed at both baseline (Time 1 primary survey) and follow up (Time 2 follow-up survey), but only the reliability coefficients at Time 1 are reported below and are based upon the full sample for the main study (N = 159).

Theory of Planned Behavior Prediction Variables

To assess variables pertaining to the TPB in regard to attitudes, subjective norms, and efficacy towards e-cigarette use, items were adapted following the recommendations of Ajzen.[8] A 7-item measure assessed attitudes, and responses were solicited on a 7-point semantic differential scale. Each item had the antecedent statement: “For me to take e-cigarettes while I am enrolled in school is:” The statement was followed by 9 semantic differential word pairs: “Harmful – Beneficial,” “Pleasant – Unpleasant,” “Good – Bad,” “Worthless – Valuable,” “Enjoyable – Unenjoyable,” “Healthy–Unhealthy,” and “Boring – Exciting.” These items were reverse coded if applicable. The 7-item attitude scale yielded good reliability: $\alpha = .91$, ($M = 2.29$, $SD = 1.15$), where *α stands for Cronbach’s alpha and is used to assess reliability, M is the mean of the measure, and SD is standard deviation*.

A Likert-type measure was created based upon the recommendations of Ajzen[8] to measure norms. Norms was comprised of subjective norms, injunctive norms, and descriptive norms. Subjective norms were measured using 3 items on a 7-point scale ranging from 1 (*strongly agree*) to 7 (*strongly disagree*). The measure was moderately reliable (α = .75; M = 3.75, SD = 1.51). Items included: "It is socially acceptable at this university for students to use e-cigarettes," "It is socially acceptable for students at this university to use e-cigarettes in excess," and "My friends believe that it is ok for students to use e-cigarettes." Injunctive norms were measured similarly using 3 items as well. The measure was also moderately reliable (α = .78; M = 6.32, SD = .97). Items included: "Most people who are important to me think that I should use e-cigarettes," "It is expected of me that I use e-cigarettes while I am enrolled at UT," and "The people in my life whose opinions I value would approve of my use of e-cigarettes." Lastly, descriptive norms were assessed using 7 items using the same 7-point scale. Similarly, the descriptive norms measure was moderately reliable (α = .86; M = 2.21, SD = 1.18). Sample items include: "Most people who are important to me at UT use e-cigarettes," and "The people in my life whose opinions I value use e-cigarettes."

A 9-item measure was created based upon the recommendations of Ajzen[8] to measure efficacy. Six items were rated on a 7-point scale ranging from 1 (*strongly agree*) to 7 (*strongly disagree*). Sample items include: "I am capable of getting e-cigarettes," "I am capable of resisting taking e-cigarettes if it was offered to me from a friend," and "If I wanted to, I could take e-cigarettes while I am enrolled in school." Five of these items were reverse coded so that higher values indicated higher control. The last was already in the right direction. Additionally, 3 items were solicited on a 7-point semantic differential scale. Sample items include: "For me to use e-cigarettes while I am enrolled in school would be: Impossible – Possible," "If I wanted to, I could take e-cigarettes while I am enrolled in school: Definitely true – Definitely not true," and "How much control do you believe you have over taking e-cigarettes while enrolled at UT: Complete Control – No Control." Two items were reverse coded so that higher values indicated more control. Together, the reliability for the 9-item scale was adequate (α=.72, M=6.27,SD=.97).

Behavioral intentions were assessed with 2 items adapted from Norman et al[11] who examined binge drinking intentions in their application of the TPB, as well as one item adapted from Ajzen's[8] guide for constructing a TPB questionnaire. The items modified for the current behavior are as follows: "I would use e-cigarettes," "I intend to use e-cigarettes while I am in in school," and "I will try e-cigarettes while I am in school." The item responses included 7-point scales (1 = *strongly disagree*; 7 = *strongly agree*) and demonstrated good reliability (α =.93, M = 2.22, SD = 1.62).

Each of the items in the above mentioned measures was tested using an exploratory factor analysis (EFA) to ensure consistency across the items. This procedure also was performed to ensure that items that needed to be reverse-coded were, in fact, reverse-coded. Following these tests, a reliability test was conducted, and each item was assessed to decide whether the item should remain within the measure. Lastly, to test using these measures, a composite score was developed by summing the items and taking the average, as recommended in prior studies.[8]

Control Variables

The control variables were only assessed at Time 1. We collected the potential control variables sex, age, prior use of conventional ("Have you ever tried tobacco "conventional" cigarette smoking, even one or 2 puffs?") and e-cigarette use ("Have you ever tried electronic cigarettes [e-cigarettes, e-hookah, vape pens, etc]?)," and susceptibility. Susceptibility towards both smoking conventional and e-cigarettes was assessed by having respondents use a 4-point scale (1 = *definitely not*; 4 = *definitely yes*) to respond to the following questions: "Would you try smoking a cigarette [e-cigarette] if one of your best friends offered it to you?" "Do you think you would smoke in the next 6 months?" "Are you curious about smoking?"

RESULTS

The purpose of this study was to examine how young adults' attitudes, normative beliefs and efficacy about e-cigarettes are associated with one's intentions to use e-cigarettes. Next, a description of the preliminary analyses is presented followed by a description of the quantitative analyses used to assess Hypotheses 1 and 2 and Research Question 1.

Missing Data

To utilize all available data, we used expectation maximization (EM).[12] EM is a maximum likelihood procedure in which the parameters are estimated, then missing values are estimated.[13] Additionally, EM infers values based on the likelihood under the normal distribution[14] and is advantageous as it produces nearly unbiased estimates of means, variances, and co-variances.[13]

Normality

Next, all variables were examined for normality, and statistics for skewness and kurtosis and graphs of data indicated that the main variables were normally distributed. Table 1 reports descriptive statistics, including means, standard deviations, and Pearson product-moment correlations for all variables included in the primary study. Table 2 reports the follow-up variables.

After completion of all preliminary data analysis procedures, including t-tests to explore potential control variables, the main quantitative analyses were conducted to assess Hypotheses 1 and 2. Due to the significance of sex, prior e-cigarette use, and prior conventional cigarette use, these were used as control variables throughout the analyses.

Testing the Theory of Planned Behavior

Plan of analysis.—Path analysis using structural equation modeling with maximum-likelihood estimation was used to analyze the direct influences of attitudes, norms, and efficacy on behavioral intentions to use e-cigarettes at Time 1, and e-cigarette use at Time 2. If the full model proposed did not have sufficient fit, the model was modified based on theory and modification indices. Finally, the model was inspected to reveal any non-significant paths. If non-significant paths appeared, we followed standard procedures for

model trimming and simplification;[15] all non-significant paths were iteratively removed beginning with the least significant path, until only significant paths remained.

Assessing the theory of planned behavior.—Hypothesis 1 suggested that favorable attitudes, perceived norms that others using e-cigarettes, and greater efficacy to use will positively predict behavioral intentions to use e-cigarettes. Path analysis using AMOS was utilized to assess Hypothesis 1 following the plan of previously described analysis. The TPB model was constructed, and the control variables of sex and prior use of both e-cigarettes and conventional cigarettes, with direct paths from each variable to the outcome variable (ie, behavioral intentions) were included.

The hypothesized model put forth in Hypothesis 1 was partially supported, and the data fit well according to traditional tools for fit goodness:[16] χ^2 (17) = 19.51, $p < .30$, CFI = .99, TLI = .98, NFI = .96, RMSEA = .03, CI = .00 < .09, and SRMR = .03. (χ^2= chi square test; CFI = comparative fit index, TLI = Tucker Lewis Index, NFI = Normed Fit Index, RMSEA = Root Mean Square Error of Approximation, CI = Confidence Interval, and SRMR = Standardized Root Mean Square Residual).

As predicted in H1 attitudes ($\beta = .53$, z = .11, $p < .001$) and norms ($\beta = .20$, z = .14, $p = .04$) were positively associated with behavioral intentions. Perceived behavioral control, or efficacy, was negatively associated with behavioral intentions ($\beta = -.14$, z = .08, $p < .009$). Hypothesis 1 was partially supported.

Hypothesis 2 posited that intentions at the beginning of the semester to use e-cigarettes will be positively associated with behavioral use at the end of the semester. Intentions were positively associated with the current use of e-cigarettes ($\beta = .47$, z = .22, $p < .001$). Having ever used an e-cigarette was significantly associated with intentions ($\beta = .20$, z = .20, $p < .002$). Therefore, hypothesis 2 was supported.

DISCUSSION

Primary Discussion

The purpose of this study was to examine how young adults' attitudes, normative beliefs, and efficacy towards e-cigarette use may predict their intentions to use e-cigarettes and their actual use of e-cigarettes. Results suggest norms and attitudes were positively associated with the intentions to use e-cigarettes, whereas efficacy was negatively associated with intentions. The intentions to use e-cigarettes were, in turn, positively associated with current behavior at Time 2.

Our results provide more evidence for the role of attitudes in young adults' e-cigarette use compared with other TPB behaviors. We can discuss this issue from a theoretical perspective. Fishbein and Cappella[16] argue that the success of TPB components depends on the population being studied, as well as the behavior. Hill et al[14] also discovered that attitudes were the strongest predictor of intentions to smoke tobacco products, followed by efficacy, and norms. During young adulthood, attitudes related to the social desirability of e-cigarettes may be what motivates young adults to use e-cigarettes – more than the efficacy to

use or norms related to e-cigarettes. Future health campaigns should start by targeting favorable attitudes about e-cigarettes. Campaigns can do this by challenging the common theme that they are a healthy alternative to cigarettes.

Efficacy was negatively associated with intentions to use e-cigarettes during young adulthood. That is, the higher the efficacy to be able to use e-cigarettes, the less likely they had the intention to use them. Efficacy was also negatively correlated with attitudes and norms; therefore, those with high efficacy have less favorable attitudes and norms about e-cigarettes. Although past research does not provide much insight into why these relationships may exist, we offer some speculation as to why efficacy would be negatively associated with intentions to use e-cigarettes. First, we surmise that young adults may not perceive e-cigarettes as harmful as other drugs and tobacco sources;[17]therefore, they may have more favorable attitudes, but less confidence to resist offers from friends. In turn, young adults could have more intentions to use e-cigarettes. This argument is supported by the data as perceived harm for e-cigarettes was second-to-least harmful of 13 substances (M = 11.20; SD = 3.12 on a scale of 1–13 where 13 is least harmful, followed only by marijuana. We also suspect that young adults may be curious, which outweighs their efficacy not to use e-cigarettes, and thus, influencing their intention to use. Although it was reported that far fewer (16%) used e-cigarettes out of curiosity among those already smoking tobacco products, research has shown that those who use both products are actually less likely to report a decrease in overall use of tobacco than those just using e-cigarettes.[18] Lastly, young adults may perceive e-cigarettes as non-addictive so they feel like if they tried an e-cigarette they would be able to stop at any point.

Limitations

This research contributes to both the theoretical and practical understanding about how young adults make decisions about e-cigarette use by examining the variables associated with the TPB. However, our findings need to be considered in light of limitations. First, data were collected through convenience sampling, utilizing an undergraduate student sample at one university. Therefore, our findings are only applicable to the undergraduate students at this university. Furthermore, the sample had higher than average prevalence rates of e-cigarette (50.6%) and conventional cigarette (41.6%) use compared to the general United States (US) young adult population as of 2015 (e-cigarettes: 13.6%;[1] conventional cigarettes: 13%[19]). Additionally, it is necessary to mention that there may be historical validity or maturation validity concerns between time 1 and time 2. Events like exams could have influenced the answers on the second portion of the study. Furthermore, the relatively low alphas for the various types of norms may limit the reliability of the scales. Future research can increase the number of items used to assess descriptive, injunctive, and subjective norms to increase the reliability.

IMPLICATIONS FOR HEALTH BEHAVIOR OR POLICY

We elected to use the TPB model as it both predicts and helps us understand health behaviors. First, the TPB has been successful at predicting various health behaviors, including physical activity,[20] healthy eating,[21,22] smoking cessation,[11] condom use,[23]

among other health behaviors. This study contributes to the TPB literature by examining not just tobacco use, but e-cigarette use specifically. The TPB lends itself to formative research into the underlying aspects that are key in behavior change and enactment. In the present study, the fit of the TPB was satisfying, with each of the TPB variables being significantly associated with intentions and current behavior. It may make sense to study the factors influencing e-cigarette use during alternatives stages of life to explore the generalizability of the TPB model for e-cigarette use.

Future scholars might consider the health belief model as an additional, useful tool to examine e-cigarette use. There are several modifying factors that affect tobacco use, and the health belief model takes into consideration several of these factors, including social pressure and peer impact, which may be more influential than the norms used in this study. Furthermore, the model encompasses the cue to action, or the use of media campaigns, advice, magazines, etc. The environmental factors and societal norms pertaining to e-cigarette use in young adults may fit the function of the cue to action within the model. Because the model incorporates these 3 modifying factors simultaneously, it may be a better fit for this type of study.

The results of this study provide an opportunity to develop stronger health interventions targeting e-cigarette use of a young adult population. This study also supports the role of peer influences, in addition to personal attitudes within health campaigns, something past health interventions did not necessarily include. Supplemented by future research, this study may allow health communicators to develop more persuasive, tailored, and resonating interventions aimed at young adults.

Conclusions

In summary, e-cigarette use among young adults on college campuses is a continued and sustained problem in the US. This study investigated the application of the TPB on e-cigarette use. Our study extends previous research by seeking to understand the role of the TPB variables in young adult e-cigarette intentions of use and actual use. This study shows that changing positive attitudes and norms pertaining to e-cigarettes may be critical in reducing future use of these products.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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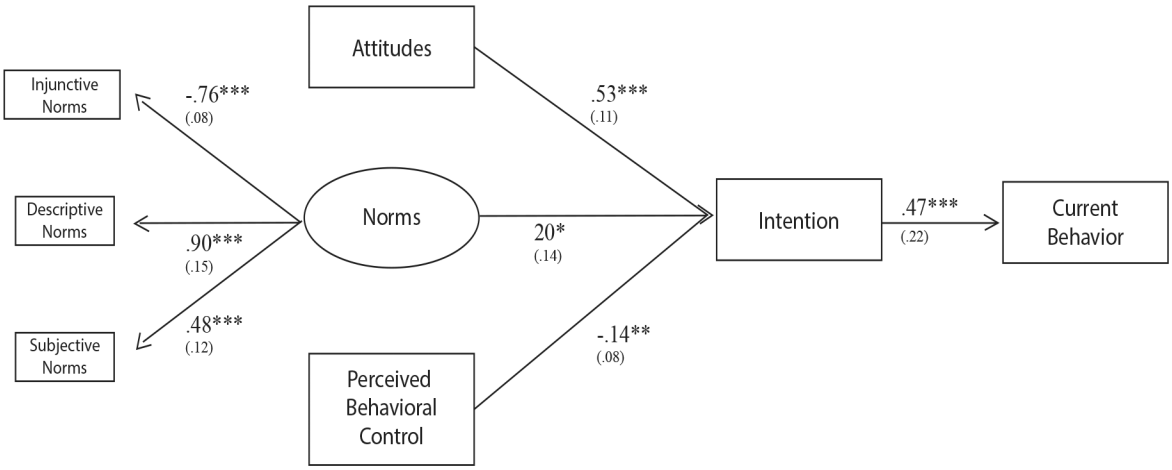

Figure 1.

Final TPB Model

$p < .05$*

Note.

a. The ß-values are presented through the path they represent.

b. Standard errors are presented in parentheses

Table 1

Bivariate Correlations among Primary Study Variables (N = 159)

Variable		1	2	3	4	5	6
1	Attitudes	2.29[a](L15)[b]					
2	Subjective Norms	.32***	3.75(1.51)				
3	Injunctive Norms	−.51***	−.34***	6.31(.97)			
4	Descriptive Norms	.64***	.43***	−.65***	2.22(1.18)		
5	Efficacy	−.31***	−.122	.38***	−.29***	6.27(1.62)	
6	Behavioral Intention	.78***	.33***	−.45***	.63***	−.39***	2.21(.97)

* p ≤ .05,

** p ≤ .01,

*** p ≤ .001

Note.

a. Means are on the diagonal

b. SD in the parentheses

Table 2

Bivariate Correlations among Follow-up Study Variables (N = 126)

Variable		1	2	3	4	5	6
1	Attitudes	2.21[a](1.09)[b]					
2	Subjective Norms	.21*	3.52(1.39)				
3	Injunctive Norms	.61***	.35***	1.63(.90)			
4	Descriptive Norms	.66***	.43***	.76***	2.04(1.13)		
5	Efficacy	−.30***	.01	−.51***	−.43***	5.85(.74)	
6	Behavioral Intention	.75***	.31***	.61***	.72***	−.31***	2.08(1.42)

* p ≤ .05,

** p ≤ .01,

*** p ≤ .001

Note.

a. Means are on the diagonal

b. SD in the parentheses