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Orientation of US Young Adults toward E-cigarettes and their Use in Public

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Abstract

Objectives—We examined use of e-cigarettes and views toward their use in public.

Methods—An online survey of US adults aged 18-24 (N = 874) was used. Measures included tobacco/e-cigarette use, acceptability of public cigarette/e-cigarette use, intention to use e-cigarettes, attitudes and norms.

Results—There was greater acceptance of public e-cigarette use than cigarettes. A path model revealed that attitudes and norms concerning e-cigarettes predicted the use of e-cigarettes beyond the effect of smoking. Attitudes also were shown to predict intention for future e-cigarette use above the effect of current and past smoking, and to predict acceptability of public use of e-cigarettes.

Conclusions—Normative acceptance of e-smoking in public may contribute to the wider adoption of e-cigarettes.

Keywords

E-cigarettes; public use; attitudes toward e-cigarettes; norms

Several studies over the last 5 years have documented an increase in the level of awareness of e-cigarettes and their use. Tan and Bigman¹ reviewed results from 7 national surveys from 2009 to 2013 and found that awareness of e-cigarettes among US adults increased from 16.4% to 77.1%. Chapman and Wu² reviewed 21 studies published between 2008 and 2012 and concluded that in 2011 e-cigarette use among adults reached 6.2%, 7% among young adults age 20-28, and 3.3% among adolescents in grades 6-12. Further, they reported that ever-use among older adolescents in grades 9-12 reached 10% in 2012.²

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Human Subjects Approval Statement

All completed questionnaires were anonymous, and no personal identifiers were used. The study was reviewed and approved as exempt by the Colorado State University Institutional Review Board.

Conflict of Interest Declaration

Neither author reports a conflict of interest in this work.

As electronic cigarettes have become increasingly popular there have emerged proponents for allowing their use in areas where smoking is currently prohibited; others have advocated for banning their use along with traditional cigarettes.^{3,4} Opponents express the following concerns: (1) State and municipal clean indoor air laws may be compromised, or at least complicated by this development;⁵ (2) Research has clearly shown that youth uptake of tobacco is affected by the observed prevalence of tobacco use in the environment;⁶ and (3) An additional mode of public nicotine use will not serve the interests of smoking prevention.^{7,8}

Considering these concerns, this study was formulated with 3 goals: (1) To assess how young adults view public smoking versus e-smoking; (2) To evaluate the manner in which attitudes and perceived social norms contribute to the support for e-smoking in public places; and (3). To determine how attitudes and perceived social norms contribute to use of e-cigarettes.

The study was theoretically framed using the Theory of Reasoned Action (TRA). This theory has been used in a wide variety of contexts and has been especially prominent in health research.^{9,10} This includes one previous study showing attitudes and social norms being predictive of use and acceptability of e-cigarettes in a small convenience sample of college students.¹¹ Within the TRA, individual volitional behaviors begin with 2 closely related processes. First the formation of attitudes toward the behavior in question takes place as interplay between beliefs about the behavior and evaluations of the outcomes of the behavior. Second, individuals form a perception of social norms relative to the behavior, in which there is a consideration of the normative expectations of relevant others combined with the level of motivation to comply with those expectations. Researchers have employed a variety of measurement techniques, both direct and indirect, which have been summarized by Ajzen.¹² TRA studies have reported respectable effects by accounting for typically 40% of intention and 30% of behavior.¹¹

We included acceptability of the use of e-cigarettes in public places as a dependent variable. This variable was examined in contrast with acceptability of public cigarette use. Independent variables predicting acceptance of public e-cigarette use included past tobacco use, intention to use an e-cigarette in the near future, attitudes toward e-cigarettes, and perceived social norms concerning e-cigarettes. We examined one research question and 2 hypotheses:

RQ1: Are young adults more accepting of the use of e-cigarettes in public places as compared to cigarettes?

H1: Controlling for past tobacco use, intention to use an e-cigarette in the near future will be predicted by attitudes toward e-cigarettes and perceived social norms concerning their use.

H2: Controlling for past tobacco use, acceptance of e-cigarette use in public places will be predicted by intention to use an e-cigarette, attitudes toward e-cigarettes, and perceived social norms concerning their use.

METHODS

Participants and Data Collection

This study focused on the young adult population in the US within the 18-24 age range. According to the US Census Bureau, in October 2012, 48% of the nation's 18-24 year-olds were enrolled in a college or professional school.¹³ Therefore, the sample design provided for proportional representation of those currently enrolled and not currently enrolled in college. Data collection was executed by GfK Custom Research through their KnowledgePanel® online survey services. GfK provides a statistically accurate sample of the US population, including non-Internet households. The survey was presented to 2032 KnowledgePanel® participants between March 21 and April 2, 2013. Item order was randomized within question sets. There were 874 complete responses, a 43%; completion rate.

Measures

We measured acceptability of cigarette and e-cigarette use in public by replicating and adapting an item set from the Tobacco Use Supplement of the US Census Current Population Survey.¹⁴ In the original measure respondents state if smoking should be allowed in all areas, in some areas, or not at all in 5 locations: restaurants, indoor work areas, bars and cocktail lounges, indoor sporting events, and indoor shopping malls. We added 5 additional locations that seemed logical for this young adult population: airports, indoor concerts, outdoor sporting events, college dorms, and college student centers. We used this item set for both acceptance of smoking and e-smoking in public. Both measures were scored 1-3 on each of the 10 items (1 = allowed in all areas, 2 = allowed in designated areas, 3 = not allowed at all). We summed the items for a general acceptance of smoking/e-smoking, which resulted in a 10-30 scale (smoking $\alpha = .91$, e-smoking $\alpha = .98$).

We assessed current tobacco use using 2 items from the Behavioral Risk Factor Surveillance System.¹⁵ These included having smoked 100 cigarettes in a lifetime (*1 = yes, 0 = no*), and current use (*now smoking every day, some days, or not at all*). We then merged the items for 1 = never, 2 = former, 3 = occasional, and 4 = daily. Similarly, e-cigarette use status was assessed by asking respondents if they had ever tried an electronic cigarette (*1 = yes, 0 = no*), and if so, what their current use was (*now using every day, some days, or not at all*). These were also merged for 1 = never, 2 = former, 3 = occasional, and 4 = daily. We assessed use of alternate tobacco products by taking an inventory of 5 products: hookah, pipe, cigars, snuff, and chewing tobacco. Responses were on a 1-4 scale including *Never, Tried once or twice, Some days, Every Day*. We summed the items for overall use of alternate tobacco products ($\alpha = .69$).

We measured the TRA items using best practice recommendations provided by Ajzen.¹² The behavioral intention item asks: "How likely do you think it is that you would use an e-cigarette in the not-too distant future, say in the next six months?" Responses occur with a 7-point scale from absolutely not, very unlikely, unlikely, maybe yes maybe no, likely, very likely and to absolutely yes. Attitude toward the act included 3 items with 5-point responses (*strongly agree to strongly disagree*): "Use of e-cigarettes should be legal for adults; E-

cigarettes are a big step forward; E-cigarettes are a more modern way of using tobacco.” This measure is summed across the 3 items ($\alpha = .82$). Social norms consisted of 3 pairs of items, all with 5-point responses (*strongly agree to strongly disagree*): “It would be acceptable to my closest friends (most people I know, closest family members) if I used e-cigarettes; when it comes to things like e-cigarettes it is important for me to follow the wishes of my closest friends (most people I know, closest family members).” We computed this measure by summing the products of the paired statements ($\alpha = .92$), which is a common measurement technique for assessing social norms in TRA.

We also included demographic questions on the following variables: age, sex, student status as currently enrolled or not, educational attainment as 14 levels from no formal education to completed doctorate, state of residence, and residence in a metropolitan area or not.

Analysis

The dataset was 99.5% complete, so we replaced the 201 missing values prior to index construction with appropriate measures of central tendency. Demographic post-stratification weights provided by GfK provided weighting to match the Knowledge-Panel® sample to current US population estimates from the current population survey. We recoded variables as needed to make all measures consistent such that higher values might predict more positive orientations toward e-cigarettes and their use.

Our descriptive and exploratory analyses included measures of central tendency and dispersion, Cronbach’s alpha for index reliability, and Pearson correlations for association. We used principal components factor analysis for an oblique 2-factor solution to evaluate the dimensionality of the cigarette and e-cigarette public use items before index construction. We assessed the difference between acceptability of cigarette and e-cigarette use in public with a paired t-test. We were able to test our hypotheses through an exploratory multiple regression path analysis. The logic of the path model was to use tobacco use behavior along with attitudes and norms to predict intention, and then intention to predict public acceptability of e-cigarette use. In revising this model we trimmed non-significant paths and examined modification indices to consider any additional paths or covariances. We then calculated model- and equation-level goodness-of-fit statistics with χ^2 and R^2 , respectively. All analyses were conducted using Stata 13.

RESULTS

Table 1 presents descriptive statistics including ranges and reliabilities for the indices. Study participants were balanced on sex, with 49% being female. The average age was 21 years, 34% were full-time students, and 7% were part-time students. Of the students 34% were in a 1-to-2-year college, 66% in 2-to-4-year college, 83% in a public college and 17% in a private college. Of the non-students, 58% had completed high school, another 20% had attended some college, and 23% had completed college. Participants resided in every state except Delaware and 85% lived within a metropolitan area. Most (84%) of the participants had never smoked. Of those who had, 3% were former smokers, 8% smoked some days, and 5% smoked every day. A majority (81%) had heard of e-cigarettes, and 14% had tried e-cigarettes. Greater educational attainment was associated with lower scores on the smoking

index ($r = -.19$ $p < .001$), perception of norms against smoking ($r = -.10$ $p < .001$), and less acceptance of smoking in public ($r = -.15$ $p < .001$).

There was a strong association between smoking and e-cigarette use ($r = .53$ $p < .001$). It was seen that among never smokers, 4% had tried an e-cigarette; but among current or former smokers, 45% had tried an e-cigarette ($\chi^2(1, 874) = 233$ $p < .001$). Of the 11% daily smokers in the sample ($N = 96$), 2% indicated daily e-cigarette use, 20% indicated occasional use, and 33% indicated former use; of the 7% occasional smokers in the sample ($N = 58$), 2% indicated daily use, 9% indicated occasional use, and 31% indicated former use; of the 6% ($N = 51$) former smokers in the sample, none indicated daily use, 2% indicated occasional use, and 16% indicated former use ($\chi^2(9, 874) = 274$ $p < .001$).

We used principal components analysis to assess the measures for acceptability of public smoking and public use of e-cigarettes. We anticipated that analysis of the full set of 20 items would form 2 correlated factors, one for cigarettes and one for e-cigarettes. Table 2 presents the rotated solution that confirmed our expectations. Two factors were confirmed with well-differentiated loading and scree plots, and no strong cross-loadings. We computed additive indices for the 2 factors and they were used to see if respondents had a greater acceptance of e-cigarette versus cigarette use in public places. A paired samples t-test showed that there was a significantly greater acceptance level of e-cigarette use in public compared to cigarette use ($t(872) = 21.7$, $p < .001$, $d = 0.77$).

To evaluate intention to use an e-cigarette and acceptability of e-cigarette use in public places, we developed a regression path model as described above and shown in Figure 1. Goodness-of-fit was acceptable with a model $R^2 = .54$, $\chi^2(4) = 10.9$, $p = .03$. Omitted paths were non-significant. Educational attainment also was evaluated as a predictor of the outcome variables and dropped as non-significant. No other significant paths were indicated by modification indices. The model revealed that attitudes and perceived norms function to predict the use of e-cigarettes independently of the effect of smoking status and use of alternate tobacco products. Attitudes toward e-cigarettes also were shown to exert a more widespread effect, as they predicted intention for future e-cigarette use above the effect of past e-cigarette use, smoking status, and use of alternate tobacco products. Further, attitudes predicted acceptability of public e-cigarette use above the effect of intended future use and smoking status.

DISCUSSION

The research question comparing acceptability of public e-cigarette use to cigarette use strongly confirms that the generally accepted prohibition against cigarette smoking in public spaces has not been extended to the use of e-cigarettes. It is important to note that adoption of e-cigarettes has not reached a level at which their public use is comparable to that of cigarettes before smoking bans became widely implemented. But, for the people who do have first-hand experience with public e-cigarette use, there may be much greater tolerance, which might be based on the advertised premise of no second-hand smoke. Moreover, general acceptance of others smoking these devices may change attitudes and social norms about e-smoking, thereby possibly increasing overall use over time. Also, the expanded

item set for assessing acceptability of cigarette and e-cigarette use in public proved to be dimensionally acceptable and reliable, suggesting its future use is warranted.

The first hypothesis, that intention to use an e-cigarette in the near future is predicted by attitudes toward e-cigarettes and perceived social norms concerning their use, was only partially supported. Whereas both attitudes and social norms did predict current e-cigarette status, norms did so only at a relaxed alpha and only attitudes remained significant in the model to predict future intention. The second hypothesis extended the model to predict acceptability of e-cigarette use in public. This hypothesis also was supported only partially, again with the effect of social norms being rejected. The effect of attitudes was relatively strong, with a greater coefficient than either cigarette status or intention to use e-cigarettes. Whereas social norms did not predict future intention or acceptability of public e-cigarette use, it did predict past use of e-cigarettes as well as past use of alternate tobacco products. This suggests that social acceptance was a factor for non-cigarette nicotine use. However, the relative lack of a broader effect by norms may be an indication that the nature of e-cigarette use is to some degree resilient to perceived normative pressure. This could be the result of the relative lack of experience people have with e-cigarettes at this point in their introduction and/or the marketing claims being made that emphasize greater social acceptability of e-cigarettes over cigarettes.

It should be noted that the usage patterns we found in this study are consistent with those seen in other studies. The majority of individuals who use or have tried e-cigarettes are also smokers, and a good portion of those individuals tried e-cigarettes but did not continue use. There was a small segment of individuals who had tried e-cigarettes as their first exposure to nicotine, and some of these individuals had continued use. This is of some concern as it is not known if these individuals might have gone on to adopt tobacco smoking as well.

Limitations

This study has limitations to note. All measures consisted of self-report items that carry an inherent potential for bias. Whereas many of the question inventories were replicated from previous work, and thus, present a degree of validity, some were modifications of earlier measures. Although inclusive of young people attending and not attending college, the population for the study is limited to a narrow age range, thereby preventing a complete representation of e-cigarette use patterns, especially among long-term smokers. Moreover, the design was cross-sectional, thus eliminating the possibility of formal causal inference.

Finally, the results of this investigation also point to additional questions that are warranted for future study. The strong contrast between acceptance of public e-cigarette use over cigarette use argues for inclusion of these measures in other samples such that results might accumulate over time. Public orientation toward e-cigarettes is at an early stage of development and observing its trajectory is called for. Further elaboration of the reasons why individuals view public e-cigarette use as more acceptable also would enhance such work. Furthermore, an examination of the role of attitudes and perceived social norms relative to e-cigarette marketing appeals is needed.

IMPLICATIONS FOR HEALTH BEHAVIOR OR POLICY

In the area of health behavior this study presented evidence that use of e-cigarettes in public has the potential for growing social acceptability. This potential basis for attitudinal and normative acceptance of e-cigarette use is of concern because the opinion that e-cigarettes do not pose a second-hand exposure risk may become entrenched and later resistant to scientific evidence to the contrary.⁵ Certainly the science on second-hand exposure to e-cigarette vapor is incomplete. In addition, the broader question of how the observability of public e-cigarette use might contribute to the wider adoption of this nicotine delivery device is of central concern. This is especially so as it may contribute to the precipitation of future nicotine users, and potentially future tobacco smokers.¹⁶ Additionally, the functional effects of attitudes and norms provides a mechanism for persuasive marketing.¹⁷ Such findings should be used to develop countering public health communications.

With respect to policy, the central issue relative to this study's findings involves the application of existing clean air regulations to e-cigarettes. As the US Federal Drug Administration has sought a regulatory basis for e-cigarettes, many state and local governments have taken actions to ban the sale of e-cigarettes to minors and to prohibit their use indoors, as is done with cigarettes. Clean air advocate organizations have compiled lists of such laws. For example, The American Nonsmokers' Rights Foundation reported that in late 2014 North Dakota, New Jersey, and Utah were the 3 states banning the use of e-cigarettes in smoke-free venues. There were 11 other states with limited bans in places such as school grounds or correctional facilities, 225 local municipalities that had banned the use of e-cigarettes in smoke-free venues, and another 121 local municipalities that had enacted bans in a variety of other venues.¹⁸ What their report paints is a patchwork of approaches formulated with as yet relatively scant scientific evidence in terms of potential harm as well as social factors. The results of this study suggest that relatively high levels of acceptance for the use of e-cigarettes in public may need to be factored in to such regulations to ensure their best success.

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Figure 1. Path Model of E-cigarette Use and Acceptance of Public Use
Note.

Standardized coefficients (** $p < .01$, * $p < .05$, † $p < .10$).

Table 1

Descriptive Statistics

	1	2	3	4	5	6	7	8
1. Cigarette use. "Have you smoked at least 100 cigarettes in your entire life?" "Do you now smoke cigarettes every day, some days, or not at all?" Merged to never smoked (1) quit (2), some days (3) and every day (4).	1.52 (1.02)	.53**	.34**	.39**	.37**	.56**	.21**	.34**
2. E-cigarette Use. "Have you ever tried an electronic cigarette?" "Do you now smoke cigarettes every day, some days, or not at all?" Merged to never used an e-cigarette (1) quit (2), some days (3) and every day (4).	.27	1.18 (0.49)	.42**	.22**	.33**	.60**	.28**	.28**
3. Alternate tobacco use. "Have you ever or do you now use any of the following? hookah, pipe, cigars, snuff, chewing tobacco <i>Never (1), Tried once or twice (2), Some days (3), Every Day (4)</i> . Summed index 5-20, higher more frequent use, $\alpha = .69$	.286	.249	6.03 (1.74)	.25**	.24**	.41**	.19**	.19**
4. Acceptability of cigarette use in public. "Should smoking be allowed in all areas (3), in some areas (2), or not at all (1)" in ten locations. 10-30, higher more acceptable, $\alpha = .91$	1.64	.45	1.79	14.77 (4.17)	.53**	.26**	.30**	.31**
5. Acceptability of e-cigarettes use in public. "Should electronic cigarettes be allowed in all areas (3), in some areas (2), or not at all (1)" in ten locations. 10-30, higher more acceptable, $\alpha = .98$	2.75	1.19	3.04	16.01	19.37 (7.32)	.29**	.57**	.40**
6. Behavioral intention. "How likely do you think it is that you would use an e-cigarette in the not-too distant future, say in the next six months?" (1) absolutely not, won't happen, to (7) absolutely yes, certain to.	.81	.42	1.01	1.53	2.96	1.79 (1.42)	.23**	.30**
7. Attitude. "The use of e-cigarettes should be legal for adults; I think e-cigarettes are a big step forward; I believe using e-cigarettes is the more modern way of smoking now rather than using tobacco cigarettes." (5) strongly agree to (1) strongly disagree, 3-15 higher more positive $\alpha = .82$	.61	.40	.95	3.58	11.99	.94	8.05 (2.87)	.60**
8. Norms. "It would be acceptable to my very closest friends (most people I know, closest family members) if I used e-cigarettes," and "When it comes to things like using an e-cigarette, it is important to me to follow the wishes of my very closest friends (most people I know, closest family members)," (5) strongly agree to (1) strongly disagree, 3-75 higher less pressure $\alpha = .92$	6.52	2.58	6.42	24.32	55.09	8.05	32.64	33.58 (18.97)

** $p < .01$ Correlations above diagonal, covariances below, M(SD) on diagonal (N = 874). Cronbach's alpha reliability indicated for indices.

Table 2

Principal Components Analysis

	Component	
	1	2
E-cigarette Use		
Indoor sports	.958	-.039
Indoor shows	.952	-.013
Shopping malls	.935	-.040
Workplace	.929	-.022
Airports	.912	.016
Restaurants	.911	.007
College campus	.897	.018
Bars	.888	.033
Outdoor sports	.882	.036
Outdoor shows	.855	.072
Cigarette Use		
Indoor shows	-.096	.875
Indoor sports	-.088	.858
Workplace	-.108	.841
Shopping malls	-.082	.801
Restaurants	-.064	.800
Airports	.109	.683
Outdoor sports	.202	.628
Bars	.176	.618
Outdoor shows	.231	.595
College campus	.277	.519
% Variance	54	17
Cronbach's α	.98	.91