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Social media e-cigarette exposure and e-cigarette expectancies and use among young adults

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Abstract

A vast majority of U.S. young adults use social media such as Facebook and Instagram daily. Research suggests that young adults are commonly exposed to e-cigarette-related marketing or user-generated contents on the social media they use. Currently, however, there is limited empirical evidence as to how social media e-cigarette exposure is associated with e-cigarette use beliefs and behavior. In particular, limited evidence exists to support the proposition that social media e-cigarette exposure is uniquely associated with e-cigarette use, even after adjusting for the effects of e-cigarette use in young adults' in-person or 'offline' social networks. This study was conducted to test the hypotheses that 1) social media e-cigarette exposure is associated with e-

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Contributors

PP designed the study, conducted the data analysis and led the manuscript preparation. PF and TAH assisted with measure development, data interpretation, and manuscript preparation. LL provided feedback on data analysis and manuscript drafts with a focus on social media use patterns and policy implications. WB, HRL provided feedback on data analysis and manuscript drafts with a focus on theoretical implications. CTK assisted with data collection and was involved in manuscript preparation. JBU provided conceptual inputs at various stages of study design and manuscript preparation.

All authors declare that they have no conflicts of interest.

cigarette use outcome expectancies and current e-cigarette use; and 2) the association of social media and e-cigarette use is linked via outcome expectancies. We collected cross-sectional data from a sample of 470 young adult college students in Hawaii. Hypotheses were tested by fitting a structural equation model to the data. The model accounted for the associations of demographic variables, cigarette smoking history, as well as e-cigarette use in individuals' actual social networks with expectancies and behavior. Results indicated that social media e-cigarette exposure was associated with current e-cigarette use indirectly through two of the four positive outcome expectancies examined, namely, positive "smoking" experience and positive sensory experience. We discuss the implications of the findings in the context of tobacco control efforts.

Keywords

E-cigarettes; young adults; social media; expectancies

1. INTRODUCTION

Electronic or e-cigarette use prevalence is increasing rapidly across all age-groups but mainly among youth and young adults. Recent Monitoring the Future (MTF) survey data (Johnston et al., 2016) indicates that among 8th, 10th, and 12th graders past-30-day e-cigarette use prevalence has surpassed the prevalence of past-30-day cigarette use: for example, 4% vs. 9% of 8th graders and 7% vs. 16% of 10th graders tend to report past-month cigarette vs. e-cigarette use, respectively. Current e-cigarette use (24%) is highest among young adults (18–24 year olds) (Hu et al., 2016). At present, the long- and short-term health consequences of e-cigarette use are not clearly understood (Dinakar & O'Connor, 2016). In vitro studies (Misra et al., 2014; Wu et al., 2014; Willershausen et al., 2014; Bahl et al., 2012; Romagna et al., 2013; Rubenstein et al., 2015; Scheffler et al., 2015), animal in vivo studies (Schweitzer et al., 2015; Lerner et al., 2015;, Husari et al., 2016; Lim & Kim, 2014;) and studies with humans (Vardavas et al., 2012; Flouris et al., 2012; Flouris et al., 2013; Yan et al., 2015) suggest that various constituents of e-liquid or vapor may have adverse physiological or biological effects. Formaldehyde, a known carcinogen, has been associated with vaporization of e-liquids at a high temperature (Talih et al., 2016; Slieman et al., 2016). In addition, flavorings in e-liquid are likely to include compounds such as diacetyl, 2, 3-pentanedione, and acetoin, inhalation of which have been previously associated with serious lung diseases (Allen et al., 2016).

Consistent with the social learning theory (Bandura, 1977), which posits that new attitudes and behaviors are partly learned by observing others, research indicates that social influence is a robust predictor of young adults' e-cigarette use and susceptibility (Pokhrel et al., 2014; Barrington-Trimis et al., 2015). In today's world, social influence among young people occurs both through in-person ("offline") or internet ("online") social networks (Huang et al., 2014). Over 90% of U.S. young adults actively use one or more types of online social networking media ("social media") daily (Perrin, 2015). The social media platforms most commonly used by young adults are Facebook, Instagram, Twitter, and Reddit. For example, approximately 71% and 52% U.S. young adults regularly use Facebook and Instagram (52%), respectively (Perrin, 2015). Social media are interactive applications that enable

users to 1) create personal profiles—labeled with names/pseudo-names—that express their identities, textually and visually, in terms of, for example, demographics and lifestyle; 2) articulate a social ("friend or follower") network; and 3) interact with streams of user-generated content (Ellison & boyd, 2013). Network members can interact with each other by sharing, or reacting to, visual or textual posts.

Studies (Huang et al., 2014; D'Angelo, Kerr, & Moreno, 2014; Moreno & Whitehill, 2014; Carrotte et al., 2016; Hoffman et al., 2016) suggest that exposure to pro-substance use images and texts on social media may promote substance use among young people. There are two main types of such exposure (Salimian, Chunara, & Weitzman, 2014). The first is the exposure to pro-substance use contents originated from members of one's social media networks. The second is the exposure to product advertisement or promotion initiated by manufacturers/vendors. Exposure through both peers and marketers can exert normative and informational social influence. Normative influence occurs as individuals conform to the thoughts and behaviors that they perceive to be widely socially accepted, and, informational influence occurs when individuals use others' thoughts and behaviors to inform their own (Myers, 2013).

If and how exposure to e-cigarettes on social media promotes e-cigarette use among young adults have not been clearly understood. E-cigarettes are known to be marketed as safer and more socially acceptable alternatives to conventional cigarettes (Grana & Ling, 2014). A number of studies have shown the presence of e-cigarette-related content on Twitter (e.g., Allem et al., 2016; Dai & Hao, 2016; Chu, Sidhu, & Valente, 2015; Chu, Unger, Allem et al., 2015), Instagram (Laestadius, Wahl, & Cho, 2016; Chu, Allem, Cruz, & Unger, 2016), and Facebook (Chu, Sidhu, & Valente, 2015). This presence has been characterized mainly by vendors'/manufacturers' efforts to promote e-cigarettes and by comments and posts from e-cigarette users and enthusiasts (Dai & Hao, 2016; Chu, Sidhu, & Valente, 2015; Chu, Unger, Allem et al., 2015; Laestadius et al., 2016). As a result, the prevalence of pro-e-cigarette messages appears to be highly prevalent on social media (Dai & Hao, 2016; Laestadius et al., 2016).

Increased knowledge about the cognitive mediators of the effects of exposure to social media e-cigarette posts may help inform social media-based e-cigarette counter-marketing or prevention efforts. In general, there has been a lack of studies that have investigated the unique impact of social media e-cigarette exposure on e-cigarette use beliefs and behavior after accounting for the effects of demographics, cigarette smoking experience, and the presence of e-cigarette users in one's in-person social network. In regard to adolescent cigarette smoking and alcohol use, Huang et al. (2014) showed that social media substance use exposure uniquely influences adolescents' substance use above and beyond the effects of substance use in their in-person peer networks.

The present study examined the association between social media e-cigarette exposure and current e-cigarette use in a sample of young adults that included current cigarette smokers, cigarette experimenters, and never cigarette smokers. We tested the hypothesis that social media e-cigarette exposure will have unique impact on e-cigarette use beliefs (i.e., outcome expectancies) and behavior beyond the impact of demographics, cigarette smoking, and

presence of e-cigarette users in in-person social network. Outcome expectancies refer to beliefs that certain outcomes will be experienced if the individual engages in a behavior (Brandon, Juliano, & Copeland, 1999). Negative outcome expectancies, on the other hand, represent beliefs that certain negative outcomes will result if engaged in a behavior. Positive outcome expectancies often underlie the motivation to engage in a behavior.

Past research (Pokhrel et al., 2014) has linked positive e-cigarette outcome expectancies, including social enhancement, affect regulation, and positive sensory experience with e-cigarette use and use susceptibility among young adults. Also, negative outcome expectancies such as negative health consequences, addiction concern, and negative sensory experience have been concurrently associated with lower likelihood of e-cigarette use (Pokhrel et al., 2014). Social enhancement expectancies refer to the beliefs that e-cigarette use would result in being more popular, being liked by others, and appearing fashionable. Affect regulation expectancies include beliefs that use of e-cigarettes would result in feeling good and the relief of boredom and stress. Positive sensory experience expectancies represent beliefs that use of e-cigarettes would result in experiencing of good tastes and smells. Positive “smoking” experience expectancies tap beliefs that e-cigarettes provide a safer, more convenient, and socially acceptable alternative to smoking.

The negative outcome expectancies we consider include negative health consequences, negative social consequences, addiction concern, and negative sensory experience. Negative health consequences represent beliefs are e-cigarette use will cause harm to health or body. Negative social consequences refer to beliefs that use of e-cigarette will elicit social disapproval. Addiction concern represents beliefs that use of e-cigarette use will result in increased addiction to e-cigarettes and negative sensory experience includes beliefs that use of e-cigarettes will lead to experiencing bad taste and smelling bad.

Thus, in summary, we hypothesized that higher social media e-cigarette exposure would be associated with higher likelihood of current e-cigarette use and this relationship would be mediated by the following four positive outcome expectancies: social enhancement, affect regulation, positive “smoking” experience, and positive sensory experience. In addition, we expected that increased social media e-cigarette exposure would be associated with lower negative e-cigarette outcome expectancies, which in turn would be associated with lower current e-cigarette use. The support of our hypotheses would suggest that strategies countering the spread of e-cigarette use among young adults may need to address the beliefs represented by the expectancy variables considered here.

2. METHODS

2.1. Participants

Table 1 shows participants’ demographic characteristics. Participants were 18–25 year old, undergraduate college students. Approximately 14% of the participants attended 2-year or community colleges. As is common among samples recruited from college campuses (Pokhrel, Little, & Herzog, 2013), the majority of the participants were women. Participants represented the ethnic/racial diversity of Hawaii. A majority (53%) of the participants in the

"Other" ethnic category were Native Hawaiian/Pacific Islanders, the rest represented African Americans (10%), Hispanics (23%), and other (14%).

2.2. Procedures

Participants were recruited from two four-year and four two-year colleges belonging to a single university system and located on the island of Oahu in Hawaii, where 75% of Hawaii's population reside. E-mail addresses of all 18–25 year old students enrolled in the university system were obtained. From this pool of e-mail addresses, 2500 e-mail addresses were randomly selected in order to invite students to participate in the screener survey, with a goal of recruiting approximately 500 participants in the main study. The link to the screener survey was accompanied by an invitation text that described the study in generic terms, as a study on marketing and young adult health behavior. The screener survey asked questions about age, sex, tobacco, alcohol, and dietary behaviors. Invited students were given on average two weeks of time to respond and provided up to three reminders. Approximately 1300 students completed the screener survey, of which 742 were invited to participate in the main study. Those who were not invited included individuals who did not fall in the 18–25 years age range or responded after the quotas for cigarette never-smokers or experimenters were reached. We intended to invite approximately equal numbers of current cigarette smokers, cigarette experimenters, and never smokers to participate in the main study. However, fewer current cigarette smokers completed the screener survey than never smokers and experimenters. Hence, the first 298 and 296 never smokers and experimenters, respectively, who completed the screener were invited to participate in the study. All 148 current smokers who responded were invited to participate. Data collection was stopped after the targeted 500 participants responded. After eliminating 30 cases with over 20% of missing data, the sample size retained for analysis was 470. Data were collected via Inquisit Web (Version 4).

2.3. Measures

2.3.1. Demographics—Age and gender were assessed with a single question each. Socioeconomic status was assessed in terms of parental/family income. Ethnicity was determined based on two items that were inclusive of ethnicities common in Hawaii (e.g., Japanese, Chinese, Korean) (Kolonel et al., 2000). The first ethnicity item provided participants with a list of racial/ethnic categories and asked them to "select all that apply" with regard to their ethnic/racial background. The second item was essentially the same as the first but asked participants to choose one racial/ethnic group that they identified with most. As in our previous research (e.g., Pokhrel, Fagan, Kehl, & Herzog, 2015), for analysis purposes, Japanese, Chinese, and Korean groups were combined into a single "Asian" category: these groups share similar health risk profiles in Hawaii and also exhibit similar socio-economic status.

2.3.2. Social media e-cigarette exposure—Participants were asked to rate on a 4-point scale (i.e., "Never", "Rarely", "Sometimes", "Often") their frequency of use of the following social media: Facebook, Instagram, Twitter, Tumblr, Reddit, and Pinterest. These 6 types of social media were chosen based on a separate survey we conducted in 2014 with college students in Hawaii about their social media use behavior. This previous survey had

asked students, in an open-ended format, to list up to social media that they used on a daily basis. Next, participants were asked how often they had seen e-cigarette related posts on each of the 6 social media. An option was provided to select "I don't use this social networking medium." Other options included "Never", "Rarely", "Sometimes", and "Often." In a similar way, participants were also asked how often they had seen e-cigarette ads on each of the 5 social media. Two separate indices were created for social media e-cigarette exposure through posts and ads, by summing up responses across the 5 social media.

2.3.3. Outcome expectancies—Participants were asked to rate on a 10-point scale how likely or unlikely it would be for them to experience an outcome if they were to use an e-cigarette. A list of 45 items that are based on previous research (Pokhrel et al., 2014; Pokhrel et al., 2015; Pokhrel et al., 2016) were presented. The 45 items assessed both positive and negative outcome expectancies. The four positive outcome expectancy variables included: *social enhancement* (11 items; $\alpha = 0.91$; e.g., "Look cool", "Increase your chances of being liked by members of the opposite sex"); *positive "smoking" experience* (7 items; $\alpha = 0.79$; e.g., "Smoke with family members' approval", "Enjoy 'smoking' without bothering others"); *affect regulation experience* (7 items; $\alpha = 0.91$; e.g., "Feel calm", "Feel good"); and *positive sensory experience* (3 items; $\alpha = 0.89$; e.g., "Smell good", "Have a good taste"). The four negative expectancy variables were: *negative health consequences* (5 items; $\alpha = 0.89$; "Damage health", "Hurt lungs"); *negative social consequences* (5 items; $\alpha = 0.87$; "Look awkward", "Become less popular"); *addiction concern* (4 items; $\alpha = 0.86$; "Feel controlled by e-cigarettes", "Become addicted to e-cigarettes"); and *negative sensory experience* (3 items; $\alpha = 0.90$; "Smell bad," "Feel bad taste").

2.3.4. E-cigarette use in social network—Egocentric social network (Valente, 2010) data were collected. Participants were asked to nominate up to five persons who they are close with, talk to or spend time with most often. Further questions were asked to elicit information about each person thus nominated, including questions about his or her e-cigarette use behavior. A social network e-cigarette use variable was created in terms of number of e-cigarette users in one's social network.

2.3.5. Cigarette use—Participants self-reported their cigarette smoking history. Data were collected on lifetime cigarette smoking (e.g., "How many cigarettes have you smoked in your entire life?" Response options: "I have never smoked a cigarette", "1–100 cigarettes", and "Over 100 cigarettes"), past-30-day cigarette smoking ("Within the last 30-days, on how many did you use cigarettes?" Response options: "0 days", "1–2 days", "3–5" days,…, "20–29 days", "Used daily"), and current smoking behavior ("How do you describe your current cigarette smoking behavior?" Response options: "I don't smoke", "I smoke sometimes/occasionally", "I smoke every day"; Pokhrel et al., 2014). Those who had never smoked a cigarette were classified as never smokers. Self-identified smokers and/or past-30-day smokers were classified as current smokers. The rest were classified as experimenters.

2.3.6. E-cigarette use—Lifetime e-cigarette use was measured with a single question ("Have you ever used an electronic cigarette (e-cigarette) or a similar vaping device?"

Response options: “Yes”, “No”). To assess current e-cigarette use, participants were asked: “How often, if at all, do you currently use an e-cigarette? (Response options: “Daily”, “Less than daily, but at least once a week”, “Less than weekly, but at least once a month”, “Less than weekly, but at least once a month”, “Less than monthly”, “Not at all”). Current e-cigarette use variable was dichotomized based on the last question, as any current use versus no current use at all.

2.4. Data Analysis

Descriptive statistics were computed in SAS. Structural equation modeling (SEM) was conducted in Mplus. In the SEM analysis, a latent variable was estimated for the social media e-cigarette exposure, with exposure through ads and exposure through posts as two indicators. In the structural model, social media e-cigarette exposure, e-cigarette use in one’s social network, cigarette smoking history (dummy-coded as experimenter and current smoker, with never smoker as the reference group), and demographic variables such as age, gender, income, and ethnicity (dummy-coded as East Asian, Filipino, and Other, with White as the reference group) were specified as exogenous variables. The expectancy variables were specified as mediators and current e-cigarette use was specified as the criterion variable. Two separate models were estimated for positive and negative outcome expectancies.

Each model was estimated in two steps. First, paths were specified from all exogenous variables to all mediators and to the criterion variable, and from all mediators to the criterion variable. All exogenous variables were specified to co-vary with each other. Similarly, all mediators were specified to co-vary with each other. This model was estimated and the magnitude, direction, and statistical significance of the paths were examined in terms of standardized path coefficients. Next, the model was re-estimated with only statistically significant paths in the model. Model fit was tested in terms of absolute (χ^2) as well as relative fit indices (e.g., comparative fit index; root mean square error of approximation).

3. RESULTS

3.1. Descriptive statistics

Table 1 shows participants’ cigarette and e-cigarette use behaviors. Approximately 44% of the participants had never smoked a cigarette and 43% of the participants had never used an e-cigarette. Approximately 18% of the participants were current cigarette smokers and 25% were current e-cigarette users. Of the never e-cigarette users (n = 197), 2.5% were current cigarette smokers, 19.8% were cigarette experimenters (i.e., those who had smoked less than 100 cigarettes in their lifetime and were current non-smokers), and 77.7% were never cigarette smokers. Of the e-cigarette experimenters (n = 155), 14.2% were current cigarette smokers, 58.1% were cigarette experimenters, and 27.7% were never cigarette smokers. Of the current e-cigarette users (n = 115), 46.9% were current cigarette smokers, 43.5% were cigarette experimenters, and 9.6% were cigarette never smokers.

Table 2 depicts participants’ social media use behavior and self-reported exposure to e-cigarettes ads and other e-cigarette-related posts. Participants reported using Instagram most

often, followed by Facebook, Twitter, Reddit, Pinterest, and Tumblr. Participants were more likely to have seen e-cigarette-related ads or other posts “sometimes” or “often” on Facebook, followed by Instagram and Twitter. Nineteen percent and 16% of the participants reported having seen e-cigarette ads “sometimes” or “often” on Facebook and Instagram, respectively. Similarly, 24% and 20% reported having seen e-cigarette related posts on Facebook and Instagram, respectively.

3.2. SEM analysis

Figures 1 and 2 present the final structural equation models estimated for positive and negative expectancy mediators, respectively.

3.2.1. Positive outcome expectancies as mediators—The model depicted in Figure 1 showed a reasonably good fit to the data (χ^2= 69.09, DF = 46, p = 0.02; CFI = 0.98; TLI = 0.95; RMSEA = 0.033, 90% CI: 0.015 – 0.048). Higher social media e-cigarette exposure was significantly associated with higher positive outcome expectancies, across all expectancy types. However, among expectancies, only positive ‘smoking’ experience and positive sensory experience were significantly associated with current e-cigarette use. Social media e-cigarette exposure had a statistically significant total indirect effect on current e-cigarette use [Estimate = 0.045 (SE = 0.017), p = 0.008], mediated through positive ‘smoking’ experience [Estimate = 0.024 (SE = 0.012), p = 0.05] and positive sensory experience [Estimate = 0.022 (SE = 0.10), p = 0.03] expectancies.

Greater prevalence of e-cigarette use in individuals’ in-person social networks was significantly associated with higher positive outcome expectancies and was also directly associated with current e-cigarette use. Being a current cigarette smoker or having experimented with cigarettes in the past, relative to having never smoked a cigarette, was associated with higher positive outcome expectancies for all expectancy types except social enhancement expectancies. Being a current cigarette smoker or an experimenter was also directly associated with current e-cigarette use. Among demographic variables, only female gender showed a significant association, an inverse association with social enhancement expectancies (β = −.11; p < .01). Table 3 shows the variance, covariance, and residual variance values that were estimated in the model but are not shown in Figure 1.

3.2.1. Negative outcome expectancies as mediators—The model shown in Figure 2 showed a reasonably good fit to the data (χ^2= 67.84, DF = 47, p = 0.02; CFI = 0.98; TLI = 0.95; RMSEA = 0.033, 90% CI: 0.011 – 0.046). Social media e-cigarette exposure was not associated with any of the negative expectancy variables and had a direct effect on current e-cigarette use such that higher exposure was associated with greater likelihood of current e-cigarette use. Among negative expectancy variables only negative social consequences was associated with current e-cigarette use and the relationship was inverse. Social network e-cigarette use, current cigarette smoker status, and cigarette experimenter status were, in general, associated inversely with negative outcome expectancies. Table 3 shows the variance, covariance, and residual variance values that were estimated in the model but are not shown in Figure 2.

4. DISCUSSION

The presence of e-cigarette marketing and user-generated pro-e-cigarette content on internet social media has been well-documented. However, not much is known regarding the effects of exposure to social media e-cigarette content on young adults' e-cigarette-related attitudes and behavior. Social media platforms allow people to interact with others virtually and hence enable network members to influence each other, through normative or informational social influence. Thus, when it comes to understanding the impact of social media on behavior, a question that naturally arises is how much of the effect is actually because of e-cigarette use prevalence in individuals' in-person social networks. To our knowledge, this is the first study to examine the association between social media e-cigarette exposure and current e-cigarette use in a model that simultaneously estimates associations among relevant covariates, including social network e-cigarette use, cigarette smoking history, and demographics (i.e., age, gender, ethnicity, and socioeconomic status).

Our main hypothesis that social media e-cigarette exposure would be associated with current e-cigarette use, even after adjusting for in-person social network e-cigarette use, was supported by the current data. Support for hypotheses concerning expectancies as mediators was mixed. We found a significant indirect effect of social media e-cigarette exposure on current e-cigarette use through two of the four positive outcome expectancies: positive 'smoking' experience and positive sensory experience. Social media e-cigarette exposure was found to have direct effects on affect regulation and social enhancement expectancies but these variables were not associated with current e-cigarette use in the model. No indirect effect was found through any of the negative outcome expectancy variables. In fact, social media e-cigarette exposure was not found to be associated with any of the negative outcome expectancy variables. It appears that the pro-e-cigarette content on social is focused more on emphasizing the benefits of e-cigarette use rather than countering the perceived negative beliefs about e-cigarettes.

Among positive outcome expectancies, social media e-cigarette exposure had the strongest effect on social enhancement. Previous research shows that e-cigarette use is commonly marketed as "fun", "cool", or "sexy" behavior that fashionable, stylish, and popular people engage in (Grana & Ling, 2014; Pokhrel et al., 2016). E-cigarette marketing via social media is likely to propagate similar messages. Further, past alcohol research suggests that the alcohol-related user-generated content that young people are exposed to on social media glamorize alcohol use within peer contexts (Buellens & Schepers, 2013; Moreno & Whitehill, 2014). Such posts hardly depict the negative consequences of alcohol use. In our past research, we have found that young adults exposed to e-cigarette ads containing messages emphasizing social enhancement themes show increased susceptibility to e-cigarette use (Pokhrel et al., 2016). However, the current study did not find an association between social enhancement expectancies and current e-cigarette use. As literature on cigarette smoking initiation suggests (Barton, Chassin, Presson, & Sherman, 1982), it is possible that higher social enhancement expectancies are more likely to influence e-cigarette use initiation than maintenance of e-cigarette use. Young people tend to start using substances for social reasons because they do not have experience with the physical effects

(Sussman & Ames, 2008). However, social reasons may become less important as they get used to the physical effects.

Relative to social media e-cigarette exposure, we found stronger effects of current cigarette smoker status, cigarette experimenter status, and higher prevalence of e-cigarette use in one's social network on affect regulation expectancies. Affect regulation expectancies in the current study represent beliefs such as that use of e-cigarettes makes one feel good, helps reduce stress, anger, and boredom, and overcome negative mood. For current cigarette smokers who are likely to be dependent on nicotine, to expect hedonistic or stress-relieving effects from e-cigarette use is natural (Kassel, Stroud, & Paronis, 2003). It is also understandable that the higher the presence of e-cigarette users in his or her network the more the person is likely to believe in the perceived benefits of e-cigarette use, including that e-cigarettes help regulate affect. It is unclear why affect regulation expectancies were not associated with current e-cigarette use in the current model. Perhaps the lack of association between affect regulation and current e-cigarette use may be explained in terms of cigarette smoking history: affect regulation may not be a significant predictor of current e-cigarette use after the effects of cigarette smoking history and other expectancies on e-cigarette use are taken into account.

Positive "smoking" experience and positive sensory experience expectancies, which we found to link social media e-cigarette exposure and current e-cigarette use, represent unique aspects of e-cigarettes that are frequently utilized by e-cigarette marketing to promote e-cigarettes (Grana & Ling, 2014). They mainly include promotion of e-cigarettes as safer, cleaner, and better-tasting and better-smelling alternatives to cigarettes. Because of the lower harm perceptions associated with the products (Berg et al., 2015; Pokhrel Fagan, Kehl, & Herzog, 2015), e-cigarettes may be perceived as socially more acceptable. Further, e-cigarette vapors lack the pungency of tobacco smoke and e-liquids (e-juices) come in a variety of pleasant flavors (e.g., fruit and candy flavors). E-cigarette users like these aspects of e-cigarettes (Pokhrel, Herzog, Muranaka, & Fagan, 2015). It appears that similar to e-cigarette marketing, user-generated e-cigarette content on social media highlights the benefits of e-cigarettes relative to cigarettes and the myriad of e-cigarette flavors that are available, which in turn promote current e-cigarette use.

A point to note is that the current data were cross-section. Hence, the models we tested were constructed based on assumptions regarding causal directions. That is, the ordering of exogenous, mediator, and criterion variables in the model was guided by theoretical assumptions and the temporal sequence of change is not supported by the current design. Thus, based on the current design, one cannot deny the possibility of a causal chain in the reverse direction. For example, current e-cigarette users may develop increased positive e-cigarette outcome expectancies, which may in turn prime them to notice the presence of e-cigarette content on social media more readily. Substance abuse research shows that memory associated with past behavior shapes expectancies (Goldman, 1999). Thus, there is a need to test the hypotheses tested herein in a longitudinal design. The current study is thus significant for providing impetus to such longitudinal studies.

The present findings have a number of implications for tobacco control efforts. Young adults, especially those who do not smoke cigarettes currently, are vulnerable to the harmful effects of e-cigarette misuse. The current data provide initial support to the hypothesis that exposure to e-cigarette marketing and user-generated e-cigarette-related content on internet social media is associated with greater likelihood of e-cigarette use among young adults. Because internet social media are an integral part of the lives of the majority of young adults in today's world, it is imperative for tobacco control efforts to address pro-e-cigarette contents on social media. E-cigarette regulations should explicitly address marketing of e-cigarettes on social media. Particularly, marketing messages intending to promote e-cigarettes as reduced harm or socially acceptable smoking alternatives may need to be controlled. Regulatory reach may be limited for user-generated pro-e-cigarette content on social media. Hence, tobacco control efforts may need to incorporate social media literacy components so that youth and young adults are trained to critically deal with messages that encourage e-cigarette misuse.

4.1. Limitations

An important limitation of the present investigation is that the current data were cross-sectional. Longitudinal data spanning over multiple timepoints would have enabled a more valid test of the current mediational model. However, given the novelty and topicality of the hypotheses tested, this limitation hardly reduces the significance of the present investigation. Another limitation is that, despite best efforts, our sample underrepresented Native Hawaiian and community college students compared with the college student demographics of the state of Hawaii. Thus, there may be some concerns about the external validity of the current findings. The concerns about external validity may also be raised in regard to the generalizability of current findings to the young adult population of the U.S. as a whole. Our past research on young adult e-cigarette use (e.g., Pokhrel et al., 2015; Pokhrel et al., 2014) suggests that the findings made in Hawaii are consistent with findings made on the mainland U.S. Moreover, despite the diverse ethnic composition of Hawaii young adults, there is no compelling reason to believe that Hawaii young adults behave in ways different than other U.S. young adults.

4.2. Future Directions

The current study represents an important first step in understanding the mechanisms of how social media e-cigarette exposure is associated with e-cigarette use among young adults. Undoubtedly, more research is needed to vet the current findings. In particular, a longitudinal design would help better estimate the causal links implied in the current model. A longitudinal design would also help understand the role played by social media e-cigarette exposure on e-cigarette use initiation and cigarette/e-cigarette dual use. Further, testing of the model in other young adult and adolescent populations would elucidate the generalizability of current findings across population types. A study with a larger sample size may attempt to compare how e-cigarette exposure across various types of social media differentially relate to expectancies and behavior. In addition, our findings suggest that increasing numbers of young adults are using Instagram, which has been understudied compared with other social media such as Twitter. Future research may benefit from paying increased attention to Instagram.

4.3. Conclusions

The current data suggest that young adults are routinely exposed to e-cigarette marketing and user-generated e-cigarette-related contents on internet social media, mainly Facebook, Instagram, and Twitter. Exposure to e-cigarette contents on social media is likely to be associated with greater likelihood of e-cigarette use, even after adjusting for the effects of a potentially more direct influence of e-cigarette users in one's social network and one's cigarette smoking history. This relationship may be mediated by positive outcome expectancies associated with e-cigarette use, particularly expectancies rooted in beliefs that e-cigarettes provide a safer, socially more acceptable, more convenient, and more enjoyable 'smoking' alternative. Regulating e-cigarette marketing on internet social media may need to be prioritized in tobacco control efforts.

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Highlights

- Social media e-cigarette exposure is associated with e-cigarette use
- The association is independent of the effects of e-cigarette use in in-person social networks
- The association is mediated by beliefs that e-cigarettes offer a better ‘smoking’ alternative
- Findings draw attention to e-cigarette marketing content on social media

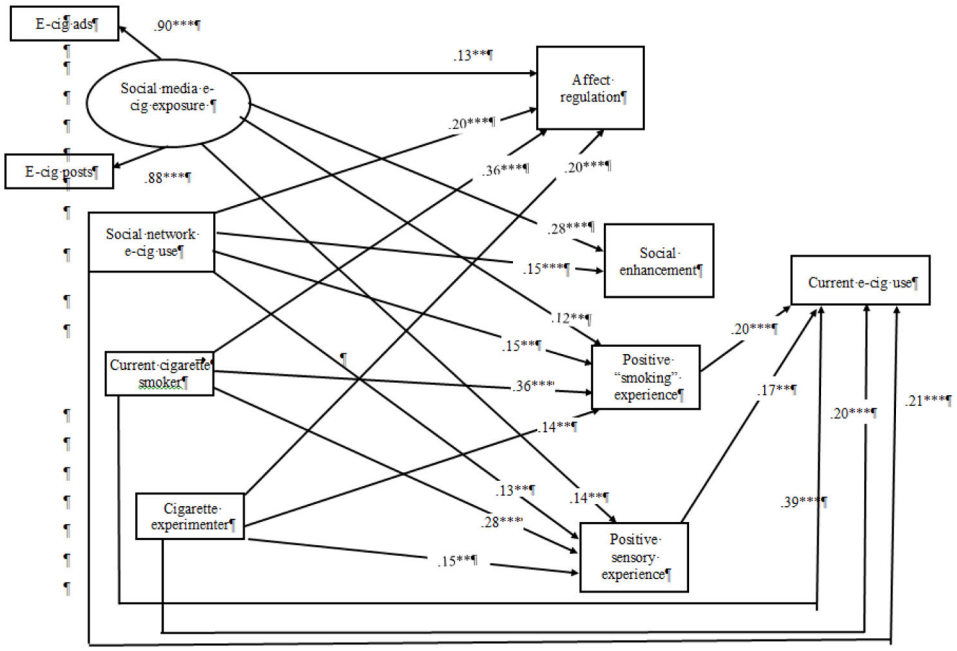

Figure 1.

Associations among social media e-cigarette exposure, positive outcome expectancies, and current e-cigarette use. Straight arrows indicate regression paths. Only statistically significant paths are shown. Values represent standardized regression coefficients. * indicates $p < .05$, ** indicates $p < .01$, *** indicates $p < .001$. Covariances and residual variances were estimated but are not shown on the figure for clarity. Covariance, variance, and residual variance estimates are provided in Table 3. In addition, the model included age, gender, income and ethnicity as exogenous variables, which were specified to covary with each other and with other exogenous variables. Demographic variables are not shown in the figure for clarity of presentation.

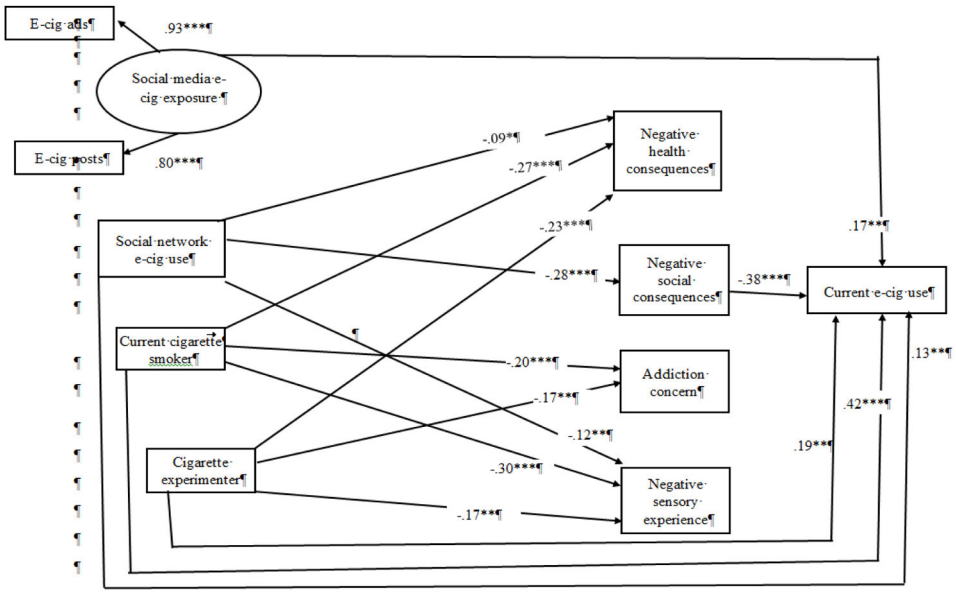

Figure 2.

Associations among social media e-cigarette exposure, negative outcome expectancies, and current e-cigarette use. Straight arrows indicate regression paths. Only statistically significant paths are shown. Values represent standardized regression coefficients. * indicates $p < .05$, ** indicates $p < .01$, *** indicates $p < .001$. Covariances and residual variances were estimated but are not shown on the figure for clarity. Covariance, variance, and residual variance estimates are provided in Table 3. In addition, the model included age, gender, income and ethnicity as exogenous variables, which were specified to covary with each other and with other exogenous variables. Demographic variables are not shown in the figure for clarity of presentation.

Table 1

Participant characteristics ($N = 470$)

	Mean (SD)	Frequency
Age	20.9 (2.1)	
Gender		
Men		34.8%
Women		65.2%
Ethnicity		
White		27.5%
Asian		38.4%
Filipino		16.0%
Other		18.1%
Parental income		
0-$39,999		21.2%
$40K–$59,999		14.4%
$60K–$79,999		16.2%
$80K–$99,999		14.4%
$100K–$119,999		13.5%
$120K and over		20.4%
Cigarette smoking status		
Never smoker		43.7%
Experimenter		38.5%
Current smoker		17.8%
E-cigarette use status		
Never user		42.5%
Experimenter		33.0%
Current user		24.5%

Note. SD = Standard deviation.

Table 2

Frequency of social media use and exposure to e-cigarette posts and ads ($N = 470$)

	Use (%)				Exposure to e-cig ads (%)				Exposure to e-cig posts (%)			
	Never	**Rarely**	**Sometimes**	**Often**	**Never/Don't use**	**Rarely**	**Sometimes**	**Often**	**Never/Don't use**	**Rarely**	**Sometimes**	**Often**
Facebook	8	15	21	56	51	30	16	3	45	31	18	6
Instagram	16	8	16	60	60	23	11	5	56	24	12	8
Twitter	51	18	10	21	82	13	4	1	79	12	7	2
Reddit	59	15	14	12	90	8	1	1	85	11	3	1
Pinterest	45	23	21	10	91	8	1	0	91	7	1	1
Tumblr	61	21	11	7	90	8	2	0	86	9	4	1

Table 3

Covariance, variance, and residual variance estimates

Exogenous variables										
	Age	**Female**	**Income**	**Asian**	**Other**	**Filipino**	**Curr. cig. smoker**	**Cig. exp.**	**Soc. net. e-cig use**	**Soc. media exp.**
Age	4.1 (.34)***									
Female	−.05 (.04)	.23 (.01)***								
Income	−.10 (.23)	−.06 (.05)	6.2 (.52)***							
Asian	.06 (.04)	−.03 (.01)**	−.02 (.06)	.24 (.01)***						
Other	.01 (.04)	.02 (.01)	−.06 (.04)	−.07(.01)***	.14 (.01)***					
Filipino	−.02 (.03)	.01 (.01)	−.08 (.04)	−.06(.01)***	−.03 (.05)	.14(.01)***				
Curr. cig. Smoker	.09 (.04)*	−.02 (.01)**	.03 (.05)	.01 (.01)	.005 (.01)	−.01 (.008)	.14(.01)***			
Cig. exp.	.20 (.05)***	.002 (.01)	.03 (.05)	−.03 (.01)*	.009 (.01)	−.006 (.01)	−.07 (.01)***	.24(.01)***		
Soc. net. e-cig use	−.06 (.17)	−.12 (.04)**	.31 (.19)	−.02 (.04)	.03 (.03)	−.06 (.03)	.14 (.03)***	.07(.04)	3.0 (.16)***	
Soc. media exp.	−.030 (.23)	−.008 (.05)	−.18 (.19)	.008 (.05)	.03 (.04)	.02 (.04)	.19(.04)	−.05 (.05)	1.0 (.15)	3.9 (.39)***
					Mediator variables					
					Positive outcome expectancies					
	Social enhance.		Affect reg.			Pos. ‘smoking’ exp.			Pos. sensory exp.	
Social enhance.	3.3 (.24)***									
Affect reg.	1.6 (.16)***		2.0 (.12)***							
Pos. ‘smoking’ exp.	1.6 (.16)***		1.9 (.19)***			3.2 (.24)***				
Pos. sensory exp.	1.2 (.18)***		2.2 (.22)***			1.7 (.21)***			4.4 (.36)***	
					Negative outcome expectancies					
	Neg. health consq.		Neg. social consq.			Addiction concern			Neg. sensory exp.	
Neg. health consq.	5.8 (.52)***									
Neg. social consq.	3.3 (.42)***		6.4 (.61)***							
Addiction concern	4.3 (.53)***		3.5 (.49)***			7.5 (.75)***				
Neg. sensory exp.	3.9 (.52)***		4.3 (.58)***			3.4 (.57)***			8.3 (.87)***	

Notes. Standard errors are presented in parentheses. For exogenous variables, the diagonal of the matrix represents variance estimates. For mediator variables, the diagonal represents residual variance estimates.

*$p < .05$,

**$p < .01$,

***$p < .001$.

"Curr. cig. smoker" = Current cigarette smoker, "Cig. exp." = Cigarette experimenters, "Soc. net e-cig. use" = Social network e-cigarette use, "Soc. media exp." = Social media e-cigarette exposure, "Social enhance." = Social enhancement, "Affect reg." = Affect regulation, "Pos. 'smoking' exp." = Positive smoking experience, "Neg. health consq." = Negative health consequences, "Neg. social consq." = Negative social consequences, "Neg. sensory exp." = Negative sensory experience.