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Young adult e-cigarette use outcome expectancies: validity of a revised scale and a short scale

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Abstract

The revised youth e-cigarette outcome expectancies measure adds new items informed by recent qualitative research with young adult e-cigarette users, especially in the domain of positive “smoking” experience. Positive “smoking” experience represents beliefs that use of e-cigarettes provide outcomes associated with a better “smoking” alternative: for example, an alternative that is more socially approved, more suitable for indoor use, and that provides a safer means of enjoying nicotine. In addition, we tested a short, 8-item version of the measure which may be more easily incorporated into surveys. We tested the validity of the revised measure, both long and short versions, in terms of factor structure and associations of expectancy factors with current e-cigarette use, e-cigarette use susceptibility, and e-cigarette use dependence. Participants were young adults ($N = 470$; 65% women; mean age = 20.9, $SD = 2.1$). Results replicated the findings of the previous study as well as highlighted the importance of the added domain of positive “smoking” experience and the validity of the short scale. Furthermore, results showed that positive outcome expectancies are strongly associated with e-cigarette use dependence. The long and short versions of the revised youth e-cigarette outcome expectancies scale appear to be valid and useful for application not only among cigarette smokers and e-cigarette users but also among never smokers and never e-cigarette users.

Keywords

e-cigarette; outcome expectancies; young adults; dependence

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Contributors

PP designed the study and led the manuscript preparation. TL and IP assisted with data analysis and data interpretation. CTK was assisted with data collection and manuscript preparation. TAH assisted with measure development and manuscript preparation.

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1. INTRODUCTION

Electronic or e-cigarette use prevalence is increasingly rapidly among adolescents and young adults. The Monitoring the Future survey (Johnston et al., 2015) found that past-30-day e-cigarette use prevalence among 8th and 10th graders are twice as high as the prevalence of past-30-day cigarette use. While e-cigarette use prevalence is highest among current or former regular cigarette smokers (Delnevo et al., 2016; Pearson et al., 2012), there are concerns that e-cigarette use is on the rise even among non-tobacco smoking adolescents and young adults (Primack et al., 2015; Wills et al., 2017).

Outcome expectancies are central to the motivational models of substance use etiology (Brandon, Juliano, & Copeland, 1999; Patel & Fromme, 2010). Outcome expectancies refer to the beliefs that certain outcomes can be experienced by engaging in a behavior. Research on e-cigarette use outcome expectancies is burgeoning (Hendricks et al., 2014; Harrell et al., 2017; Brikmanis, Peterson, & Doran, 2017). However, there is still a relative dearth of empirical research examining various types of positive and negative outcome expectancies associated with e-cigarette use, especially among youth and young adults. This is partly because of a lack of well-validated scales that would be predictive of not only e-cigarette use but also e-cigarette use susceptibility and dependence. Very few detailed self-report instruments for e-cigarette outcome expectancies exist that can be administered simultaneously to e-cigarette users, cigarette smokers, and non-users, including never users. In addition, outcome expectancy scales developed primarily for use among adults may not assess dimensions particularly relevant for young people; for example, use of e-cigarettes for social enhancement (Pokhrel et al., 2014).

The previous version of the youth e-cigarette outcome expectancies scale (Pokhrel et al., 2014) was developed as a comprehensive measure for application among adolescents and young adults; based on an existing measure of adolescent cigarette smoking expectancies (Hine et al., 2007). The measure was also informed by the current science of the time regarding e-cigarette use motives (Etter 2010; Etter & Bullen, 2011). The factor structure of the scale was established through exploratory and confirmatory factor analyses in separate subsamples of young adult college students and included three positive and four negative outcome expectancy factors. The positive outcome expectancy factors included social enhancement, affect regulation, and positive sensory experience. Social enhancement expectancies referred to beliefs such as use of e-cigarettes will result in popularity among peers and enhanced social image. Affect regulation referred to beliefs that e-cigarette use will help reduce stress or make one feel good. Positive sensory experience expectancies referred to the beliefs that e-cigarette use will allow one to enjoy good taste and smell. We found the positive outcome expectancy factors to be associated with higher odds of lifetime and past-30-day e-cigarette use and, among never e-cigarette users, increased e-cigarette use susceptibility.

The four negative outcome expectancy factors were negative health consequences, addiction concern, negative appearance, and negative sensory experience. Addiction concern items assessed beliefs that use of e-cigarettes will lead to nicotine addiction or e-cigarette dependence and may make quitting cigarettes more difficult. Negative appearance referred

to beliefs that e-cigarette use would look odd, awkward, or unpleasant. Negative health consequences assessed beliefs that e-cigarette use harmed one's health and body. Lastly, negative sensory experience included beliefs that e-cigarette use resulted in bad smell, breathe and taste. In general, we found that the negative expectancy factors were inversely associated with lifetime and past-30-day e-cigarette use and, among never e-cigarette users, lower e-cigarette use susceptibility.

This e-cigarette outcome expectancies scale was recently revised based on the findings of a focus group study we conducted with young adult e-cigarette users (Pokhrel et al., 2015). The purpose of the qualitative study was to conduct an in-depth examination of young adults' motives and expectancies associated with e-cigarette use. The study found several reasons for e-cigarette use that were not adequately represented by the existing scale. These included reasons for liking e-cigarettes as a better, more convenient alternative to tobacco cigarettes, and reasons for not liking e-cigarettes because of social disapproval. Thus, we developed new items to represent e-cigarette use motives previously not represented.

The current study has two main objectives. The first is to test the validity and reliability of the revised scale using exploratory and confirmatory factor analysis and regression analysis. The previous scale included 32 items, to which we added 22 new items. We expect to retain the factor structure of the previous study (Pokhrel et al., 2014) as well as generate a new factor representing positive "smoking" experience. Part of the validation process involves testing the associations of negative and positive outcome expectancies with current e-cigarette use, e-cigarette use susceptibility among never e-cigarette users, and e-cigarette use dependence among current e-cigarette users. The second objective is to propose and test a short version of the youth e-cigarette use outcome expectancies scale. Because incorporating the long version of the measure may be challenging for many survey-based studies not focused on outcome expectancies exclusively, a short version of the measure may be useful. Thus, we will create and test a short version of the measure based on the findings on the long version.

In summary, this study attempts to extend the previous study by making several new contributions. First, the study will test whether the factor structure of the previous study would replicate in a new sample and whether the factors would show similar patterns of associations with e-cigarette use, use susceptibility, and dependence as in the previous study. Secondly, this study will improve the existing measure by adding a new and important factor to the multidimensional measure as well as improve the reliability and validity of the existing factors by increasing the number of items to assess them. Thirdly, this study will contribute a new, short scale of youth e-cigarette use outcome expectancies that may be conveniently used in survey-based research. Lastly, this study will test the associations between e-cigarette use outcome expectancies and e-cigarette dependence for the first time.

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%). 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.

2.2. Procedures

Participants were recruited from two 4-year and four 2-year colleges belonging to a single university system and located on the island of Oahu in Hawaii, where 75% of Hawaii’s population resides. 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 which 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 2 weeks of time to respond and provided up to 3 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 never cigarette smokers or experimenters who responded after the quota for never smokers and experimenters was 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. Each individual was provided, on average, 2 weeks’ time and 3 reminders to complete the main study survey. Data collection was stopped after the targeted 500 participants responded. The total sample size for the current analysis was 470 and removing cases with more than 20% missing data. Data were collected via Inquisit Web.

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.

2.3.2. 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 55 items were presented, which included 32 existing items (Pokhrel et al., 2014) and 23 new items that were developed based on qualitative research (Pokhrel et al., 2015). The new items tapped dimensions not represented or under-represented by the existing items, such as the use of e-cigarettes as a better smoking alternative and negative social consequences of e-cigarette use. Further details about the measure, including psychometric properties, are presented in the results section below.

2.3.3. Social network e-cigarette use—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.

2.3.4. 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.

2.3.5. 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 monthly”, “Not at all”) (Beard et al., 2016). Current e-cigarette use variable was dichotomized based on the last question, as any current use versus no current use at all.

2.3.6. E-cigarette use susceptibility—E-cigarette use susceptibility was assessed using two measures: intentions and willingness. Intentions were measured using a widely used 4-item measure of smoking susceptibility (Pierce et al., 1998) adapted for e-cigarettes (e.g., “Do you think that in the future you might experiment with e-cigarettes?”; “If one of your best friends were to offer you an e-cigarette, would you use it?”; response options included 1: “Definitely no” to 5: “Definitely yes.”) Willingness is a less direct measure of susceptibility. A measure of willingness (Gibbons, Gerrard, Blanton, & Russell, 1998; Gibbons et al., 2004) was adapted for e-cigarettes based on previous research: participants

were first described a scenario (“Suppose you were with some of your friends at a party. Some of your friends were using and sharing e-cigarettes.”) and were asked 3 questions (e.g., “How willing would you be to try an e-cigarette?”; response was coded on 7 point scale, ranging from “Not willing at all” to “Very willing”).

2.3.7. E-cigarette use dependence—E-cigarette use dependence was assessed using the 10-item Penn State Electronic Cigarette Dependence Index (Foulds et al., 2015).

2.4. Data Analysis

Data were analyzed using SPSS (IBM Corp., 2013), SAS (SAS Institute, 2013), and Mplus (Muthén & Muthén, 1998–2016). Exploratory factor (EFA) and confirmatory factor analysis (CFA) were conducted among lifetime and never e-cigarette users following steps outlined in our previous study (Pokhrel et al., 2014). Based on the results of the CFA and internal consistency of the items, indices were created for each negative and positive expectancy factor. Predictive validity of the factors was tested using regression analysis and zero-order correlations between factors were examined in the entire sample to ascertain the convergence and divergence among positive and negative outcome expectancy factors.

To create a short version of the scale, the highest loading item for each factor was selected across factors from the EFA on the 55 items among e-cigarette ever users. Next, an EFA was conducted among items thus selected among e-cigarette ever users and the resulting model was tested in CFA among e-cigarette never users. Next, the factors’ predictive validity was tested via regression analysis. In the regression analysis, the main dependent variables examined were e-cigarette use susceptibility (intentions and willingness), current e-cigarette use and e-cigarette use dependence. Current e-cigarette use variable was dichotomous; hence, logistic regression models for this dependent variable. Linear regression was used for other dependent variables (i.e., susceptibility and dependence).

The analyses pertaining to susceptibility and dependence were restricted to e-cigarette never-users ($n = 197$) and current users ($n = 115$), respectively. All regression models accounted for the following covariates: age, sex, ethnicity, parental income, e-cigarette use in one’s social network, college type (4-year vs. 2-year) and cigarette smoking status (dummy coded as current cigarette smoker and experimenter relative to never smoker). E-cigarette use by friends and family members who compose immediate social networks was adjusted for as a covariate because social influence is strongly associated with substance use among youth and young adults and may also be associated with beliefs such as outcome expectancies (Wood, Read, Palfai, & Stevenson, 2001; Sussman & Ames, 2008).

3. RESULTS

3.1. Exploratory and confirmatory factor analysis

Ten factors with eigenvalue > 1 were extracted from analysis of the 55 items. However, two of the 10 factors were excluded from further consideration. One of the two excluded factors did not have any items with salient factor loadings. The other factor only had two items, one of which cross-loaded with another factor. Total 12 items were excluded. The remaining 43 items were found to represent 8 factors, of which 4 represented positive outcome

expectancies and 4 represented negative outcome expectancies. The 8-factor model fit moderately well to the data among e-cigarette never users [$\chi^2 = 1577$, $df = 862$, $p < .001$; RMSEA = 0.05, (90% CI = 0.045, 0.055); CFI = 0.91; SRMR = 0.06]. Of the 8 factors, 3 positive expectancy factors (i.e., social enhancement, affect regulation, and positive sensory experience) and 3 negative expectancy factors (i.e., negative health consequences, addiction concern, and negative sensory experience) were the same as in the previous version of the scale (Pokhrel et al., 2014). The remaining 2 were new factors: a positive expectancy factor, namely positive “smoking” experience, and a negative expectancy factor, namely negative social experience. Table 2 shows the items that loaded on the two new factors along with their factor loadings based on the confirmatory analysis. Both new factors showed relatively high internal consistencies (see Table 2).

3.2. Correlations among factors

Data (see Table 3) indicated that positive outcome expectancy factors correlated positively and strongly with each other and barring an exception, showed small-to-moderate inverse correlations with negative outcome expectancy factors. The exception was the correlation between “social enhancement” and “addiction concern” which was positive and statistically significant, even though weak. The negative outcome expectancy factors were also positively and strongly correlated with each other.

3.3. Factors’ associations with e-cigarette use susceptibility and e-cigarette use and dependence

As in the earlier study (Pokhrel et al., 2016), we found each of the 3 old positive expectancy factors to be statistically significantly ($p < .01$; 2-tailed) and positively associated with e-cigarette use intentions and willingness among never e-cigarette users, adjusting for cigarette smoking status and demographic variables, and with current e-cigarette use, also adjusting for cigarette smoking status and demographic variables. In addition, each of the 3 variables was significantly and positive associated with e-cigarette use dependence among current e-cigarette users, adjusting for cigarette smoking status and demographic variables: $\beta = .25$ ($p < .001$) for social enhancement, $\beta = .37$ ($p < .001$) for affect regulation, and $\beta = .24$ ($p < .001$) for positive sensory experience. As with other positive expectancy variables, we found positive “smoking” experience to be positively and significantly associated with e-cigarette use intentions [$\beta = .23$ ($p < .001$)] and willingness [$\beta = .25$ ($p < .001$)] among e-cigarette never users; current e-cigarette use [Odds Ratio (OR) = 1.42, 95% Confidence Interval (CI) = 1.24–1.63, $p < .001$]; and e-cigarette use dependence among current e-cigarette users [$\beta = .31$ ($p < .001$)].

Consistent with the earlier study (Pokhrel et al., 2014), we found each of the 3 old negative expectancy variables to be statistically significantly and inversely associated with e-cigarette use intentions and willingness among never e-cigarette users, adjusting for cigarette smoking status and demographic variables, and with current e-cigarette use, also adjusting for cigarette smoking status and demographic variables. Likewise, negative social experience was associated inversely and significantly with intentions [$\beta = -.25$ ($p < .001$)] and willingness [$\beta = -.17$ ($p < .001$)] among never e-cigarette users and with current e-cigarette use [OR = 0.76, 95% CI = 0.68–0.86]. Except addiction concern [$\beta = .21$ ($p < .05$)], none of

the negative expectancy factors, including negative social experience, was associated with e-cigarette use dependence among current smokers ($p > .05$).

3.4. The short youth e-cigarette outcome expectancies measure

Table 4 shows the results of the factor analysis on the items that were selected from the 8 dimensions (i.e., one item per factor) represented in the long version of the measure. EFA among e-cigarette ever users showed that the 8 items resulted in two factors: positive and negative outcome expectancies. CFA among never e-cigarette users showed that the two-factor model fit well to the data [$\chi^2 = 26.1$, $df = 19$, $p < .13$; RMSEA = 0.04, (90% CI = 0.03, 0.05); CFI = 0.98; SRMR = 0.05].

As shown in Table 5, the positive outcome expectancy variable was positively and significantly associated with e-cigarette use susceptibility (both intentions and willingness) and negative outcome expectancy variable was inversely and significantly associated with e-cigarette use susceptibility. Similarly, positive and negative outcome expectancies associated positively and inversely with current e-cigarette use. However, both positive and negative outcome expectancies were positively associated with e-cigarette use dependence, although the association between negative outcome expectancy and dependence was weak and only marginally significant ($p = .06$).

4. DISCUSSION

Outcome expectancies are crucial to understanding the motives behind e-cigarette use behavior and as such, are important in the context of increasing e-cigarette use prevalence among youth and young adults. The current study tested a revised measure of e-cigarette use outcome expectancies, which can be used in empirical assessments among youth and young adults. Research on e-cigarette use is advancing rapidly. As a result, the increase in new knowledge is rapid, which in turn necessitates that measurement instruments be continuously developed and revised. We revised the youth e-cigarette outcome expectancies scale (Pokhrel et al., 2014) so that the measure is up-to-date with the current science and is inclusive of the dimensions that appear important in shaping young people's e-cigarette use behavior (Pokhrel et al., 2015).

The current study advanced the contributions of the previous study in several important ways. The present analysis resulted in retention of 29 of the previous items and addition to the measure of 14 of the 23 new items. The 14 new items represented one new dimension of positive e-cigarette use outcome expectancies, namely "positive 'smoking' experience" (7 items); added 3 items to 2 previously existing items to result in a new factor, namely "negative social consequences"; and added a new item each to the previously determined subscales of "social enhancement," "affect regulation," "negative health consequences," and "addiction concern." The 12 items that were excluded mostly represented items that would be exclusive to habitual cigarette smokers (e.g., "quit smoking", "have more spending money"). Because the present measure is meant to be applicable across smokers and non-smokers, excluding the items that are narrowly relevant to regular cigarette smokers may not be a big loss.

A major contribution of this study is the addition of the two dimensions that were missing from the previous measure: positive “smoking” experience and negative social experience. Recent research (Pokhrel et al., 2015; Soule et al., 2017) has highlighted that beliefs that e-cigarettes provide a better ‘smoking’ alternative serves as a strong motive for e-cigarette use. These beliefs represent the perceptions that the act of smoking or the consumption of nicotine in itself is an enjoyable activity; however, smoking tobacco cigarettes has a number of disadvantages such as bad smell, ashes, risk of secondhand exposure, inconvenience (e.g., prohibited indoors) and exposure to carcinogens. Additionally, it is perceived that, contrary to combustible cigarettes, e-cigarettes do not smell bad, are considered less harmful, and may be used indoors. The items showed high reliability and the index of positive “smoking” experience was associated, as expected, with higher e-cigarette use susceptibility, use, and dependence.

The negative social consequences factor included some pre-existing and some new items. The pre-existing items were two items (“Look awkward” and “Look unpleasant”) previously grouped under a negative outcome expectancy factor labeled “negative appearance.” In the current analysis, these two items grouped together with three new items (“Lose respect of friends,” “Become less popular,” and “Look embarrassing”). The new factor was labeled “negative social consequences” with the assumption that “negative appearance” is subsumed within negative social experience. Negative social consequences were identified as important outcomes of e-cigarette use in our qualitative research with young adult e-cigarette users (Pokhrel et al., 2015). In the current study, negative social consequences were strongly associated with lower e-cigarette use susceptibility and lower likelihood of e-cigarette use.

Another contribution of the current study is replication of the previous factor structure in a new sample. All factors other than positive “smoking” experience and negative social consequences were carryovers from the previous measure. Thus, the three positive expectancy factors (social enhancement, affect regulation and positive sensory experience) and three negative expectancy factors (negative health consequences, addiction concern and negative sensory experience) from the previous study replicated very well in the current sample. The internal consistency of the items, already strong in the previous version, improved slightly in the current version with the addition of the items. In addition, the pattern of associations between expectancy variables and e-cigarette use susceptibility and use replicated well across the two studies. The confirmatory model showed moderate fit to the data (as opposed to excellent fit); however, it should be noted that the confirmatory analysis was conducted among never e-cigarette users, among whom positive expectancies may be less relevant than current or lifetime users. The moderate fit is in fact good evidence that the current model is applicable to never e-cigarette users and may be useful in studying e-cigarette use initiation. Overall, the findings suggest that the present outcome expectancies measure has a strong construct validity.

This is likely to be the first study to examine how e-cigarette outcome expectancies are related to e-cigarette use dependence after adjusting for, among other variables, cigarette smoking history, including current smoking status. The finding that higher positive outcome expectancies have strong effects on increased e-cigarette use dependence is consistent with findings on outcome expectancies and nicotine dependence (Kristjansson et al., 2011). We

did not find significant associations between negative outcome expectancies and e-cigarette use dependence, except for the association between addiction concern and dependence. The latter is plausible because research shows that youth who are more dependent on a substance are more likely to be concerned about their addiction (Sussman & Dent, 1996; Sussman, Dent, & Galaif, 1997). We will need a future longitudinal study to examine how addiction concerns are related to e-cigarette use progression over time. Of note is that we did not find negative health or social consequences to be associated with lower e-cigarette dependence.

Lastly, an important contribution of the present study is the development of a short version of the e-cigarette outcome expectancies measure that may be administered to youth and young adults irrespective of their cigarette smoking or e-cigarette use status. While the long version of the measure may be useful for the in-depth studies of e-cigarette use outcome expectancies and their antecedents and consequences, the short version may be useful for inclusion on more general surveys. Currently, there is a lack of such measures that have been empirically developed. The current short has items that are inclusive of all domains represented in the long version and adequately represent both positive and negative outcome expectancies. Moreover, the current data indicate that the positive and negative outcome expectancies, as measured by the short measure, are strongly associated with e-cigarette use susceptibility and use.

In conclusion, this study provided evidence of validity and reliability for the revised and updated youth e-cigarette outcome expectancies scale. The study showed that positive “smoking” experience and negative social consequences are important additions to the previous version of the measure. The study replicated the findings of the previous study in a new sample, thus providing more support for the validity of the measure. Longitudinal studies are needed to further test the predictive validity of the current expectancy factors. We also found that higher positive outcome expectancies are associated with higher e-cigarette use dependence among current users. Future studies need to examine how outcome expectancies affect e-cigarette use dependence over time. In addition, studies are needed to examine how e-cigarette outcome expectancies affect e-cigarette use and cigarette smoking over time among dual users. Lastly, the current study contributed a short version of the youth e-cigarette outcome expectancy scale which may be incorporated easily into a wide variety of survey questionnaires.

There are some limitations to this study. First, the study is based on cross-sectional data. Hence, the associations between outcome expectancies and e-cigarette use, susceptibility, and dependence should not be considered causal based on the current findings. Second, the current sample was predominantly Asian/Pacific Islander, which may limit the external validity of the current findings. Other limitations related to the generalizability of findings are that the current sample did not include non-college going young adults and included relatively fewer men and community or 2-year college students. Given that e-cigarette use more prevalent among men, underrepresentation of men in the sample may have introduced some bias. In fact, among current e-cigarette users in the current sample significantly more men were represented than women (31% vs. 21%). Third, there were some missing data; although the missing data applied to only less than 5% of the cases in each analysis performed in the study. Fourth, although we adjusted for the effects of 4-year vs. 2-year

colleges in the regression analysis, we did not collect the right data to be able to account for the random effects due to participants being nested within different colleges. In addition, the current sample was restricted in terms of testing the interaction effects of cigarette smoking status and expectancies on e-cigarette use behavior. The effects of expectancies may differ by cigarette smoking status (Harrell et al., 2017). Lastly, additional data that would enable analysis to establish the discriminant validity of different positive and negative expectancy factors would be desirable. Such analysis would demonstrate why different dimensions within each of the positive and negative expectancy domains are non-redundant. Despite the limitations, however, the current study is of significance because the study presents a valid, standardized measure of e-cigarette outcome expectancies which may be used in future research with youth and young adults.

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Highlights

- The revised youth e-cigarette outcome expectancies measure is valid and reliable
- Positive ‘smoking’ experience is a major dimension of positive e-cigarette outcome expectancies
- Higher positive outcome expectancies are associated with higher e-cigarette use dependence
- The short version of the measure is reliable and valid
- The short version of the measure may be easily integrated into surveys

Table 1Participant characteristics ($N = 470$)

		Mean (SD)	Frequency	Range
Age		20.9 (2.1)		18–25
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

Results of the confirmatory factor analysis among never e-cigarette users for the new factors

Factors	Items	Standardized factor loadings	Cronbach's α
Positive "smoking" experience			0.92
	Enjoy "smoking" without bothering others	0.666	
	Enjoy "smoking" indoors	0.671	
	Enjoy "smoking" without attracting negative attention	0.817	
	Enjoy the company of smokers without smoking real cigarettes	0.821	
	"Smoke" with family members' approval	0.551	
	"Smoke" with friends' approval	0.681	
	Enjoy nicotine without harming health	0.696	
Negative social consequences			0.87
	Lose respect of friends	0.693	
	Look awkward	0.767	
	Look unpleasant	0.792	
	Become less popular	0.633	
	Look embarrassing	0.764	

Table 3

Zero-order correlation among e-cigarette outcome expectancy factors

	Social enhancement	Affect regulation	Positive “smoking” experience	Positive sensory experience	Negative health consequences	Negative social consequences	Addiction concern	Negative sensory experience
Social enhancement	1							
Affect regulation	.64***	1						
Positive “smoking” experience	.67***	.68***	1					
Positive sensory experience	.47***	.69***	.55***	1				
Negative health consequences	-.05	-.14**	-.21***	-.15**	1			
Negative social consequences	-.06	-.23***	-.25***	-.20***	.55***	1		
Addiction concern	.14**	.006	-.03	-.03	.67***	.48***	1	
Negative sensory experience	-.06	-.25***	-.29***	-.39***	.59***	.57***	.45***	1

Note.

** p < .01,

*** p < .001

Table 4

Factor analysis on items for the short e-cigarette use outcome expectancies measure

		EFA among e-cigarette ever users	CFA among e-cigarette never users
		Factor loading	Standardized factor loading
Positive Outcome expectancies			
	Become more popular	.77	.73
	Feel relaxed	.79	.68
	Enjoy “smoking” without bothering others	.74	.59
	Smell good	.64	.52
Negative outcome expectancies			
	Hurt your lungs	.76	.72
	Look awkward	.68	.69
	Become addicted to e-cigarettes	.64	.50
	Feel bad taste	.71	.70

Note. EFA = Exploratory factor analysis; CFA = Confirmatory factor analysis; $p < 0.001$ for all CFA factor loadings.

Table 5

Associations of the positive and negative outcome expectancy scales (short version) with e-cigarette use susceptibility, e-cigarette use, and e-cigarette use dependence.

	E-cigarette use susceptibility (n = 197)		E-cigarette use (n = 470)	E-cigarette use dependence (n = 115)
	Willingness	Intentions	Current use	Dependence
	β	β	Odds Ratio (95% Confidence Interval)	β
Positive outcome expectancies	.29***	.26***	1.50 (1.29–1.75)***	.42***
Negative outcome expectancies	-.17**	-.26***	.75 (.66–.85)***	.16 ^T

Notes.

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$,

^T $p = .06$;

β = standardized regression coefficients. All models included the following co-variables: age, sex, ethnicity, parental income, college type (4-year vs. 2-year), cigarette smoking status and e-cigarette use among friends and family members.