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Expectancies and reasons for use of e-cigarettes among young adults: a longitudinal analysis

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Abstract

Background: Use of electronic cigarettes, or e-cigarettes, has increased exponentially in recent years. Mechanisms that might underlie this increase include expectancies and reasons for e-cigarette use. This study was designed to identify and evaluate changes in expectancies and reasons for e-cigarette use among young adults over time and to determine whether such changes were associated with changes in e-cigarette use.

Method: A sample of 137 young adult e-cigarette users completed electronic surveys five times over a 12-month period.

Results: Five expectancy/reason factors were identified: affect-related reasons, social reasons, positive social expectancies, positive internal expectancies, and negative expectancies. Linear mixed models showed that negative expectancies for e-cigarette use significantly increased over time ($p = .004$) while affect-related reasons for e-cigarette use significantly decreased over time ($p = .001$). Additional linear mixed models indicated that, while both frequency and quantity of e-cigarette use decreased over time, changes in positive internal expectancies were positively associated with changes in frequency of e-cigarette use ($p = .032$), and changes in positive social expectancies were positively associated with changes in both frequency ($p = .007$) and quantity ($p = .026$) of e-cigarette use.

Conclusions: Young adults' expectancies and reasons for using e-cigarettes fluctuate over time and changes in expectancies seem to be longitudinally associated with changes in e-cigarette use. Positive expectancies for e-cigarette use represent targets for clinical, prevention, and intervention efforts.

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Keywords

e-cigarettes; expectancies; reasons; young adults; longitudinal

Although prevalence of cigarette smoking has declined in recent years (Jamal, King, Neff, Whitmill, Babb, & Graffunder, 2016), this reduction has occurred alongside an increase in prevalence of use of electronic cigarettes, also known as e-cigarettes (McMillen, Gottlieb, Shaefer, Winickoff, & Klein, 2014). The Dictionary of Cancer Terms from the National Cancer Institute defines e-cigarettes as battery-powered devices that are often shaped like cigarettes or cigars and that convert non-tobacco solutions containing nicotine, flavorings, and other chemicals into an inhalable vapor. E-cigarette devices have undergone multiple "generations" of evolution, and e-cigarette products that are currently popular in the United States include box-mod/tank systems and pod-based systems like JUUL (O'Conner et al., 2019; Huang et al., 2019).

E-cigarettes have been framed as a "disruptive technology" to nicotine and tobacco research (Correa, Ariel, Menzie, & Brandon, 2016), partly because their long-term public health impact is unclear. Some scientists characterize e-cigarettes as a promising form of harm reduction (Fairchild, Lee, Bayer, & Curran, 2018) and a potentially effective smoking cessation aid (Bullen, 2017). Others believe that e-cigarettes may sustain nicotine dependence, promote continued smoking, or serve as a "gateway" to combustible tobacco products (Parrott, 2015; Stanbrook, 2016). A recent report from the National Academies of Sciences, Engineering, and Medicine (NASEM) concluded that more e-cigarette research is needed, especially among younger populations and via longitudinal cohort studies (NASEM, 2018).

One transdisciplinary construct that represents a potential promoter of e-cigarette use in younger populations is expectancies. Expectancies represent a central focus within the social cognitive theory of human behavior (Bandura, 1986) and have been referred to as the "nexus between cognition, emerging neuroscience and…genetic mechanisms on complex behavior" (Goldman, Reich, & Darkes, 2006, p. 107–108). Expectancies reflect beliefs about the results of specific behaviors that are derived from interactions between cognitive, affective, social, and biological factors. Expectancies can be associated with motivation, risk perceptions, intentions, sensory reinforcement, and psychosocial reinforcement, among other constructs.

Both cross-sectional (Doran & Brikmanis, 2017; Pokhrel, Lam, Pagano, Kawamoto, & Herzog, 2018) and longitudinal (Brikmanis, Petersen, & Doran, 2017) studies have demonstrated that, among young adults, positive expectancies for e-cigarettes are positively associated with e-cigarette use. However, given the rapid evolution of e-cigarette products, it is important to maintain surveillance over how e-cigarette expectancies change over time among young adults and whether changes in expectancies for e-cigarettes might correspond to actual e-cigarette use. Therefore, the purpose of this study was to conduct a longitudinal observational analysis of expectancies for e-cigarettes within a sample of young adult e-cigarette users. This approach allows for an empirical evaluation of how expectancies influence behavior over time in a population at risk for initiating use of combustible tobacco

products - namely young adults with minimal history of tobacco use. Two primary aims were considered: 1) to evaluate trajectories of change for clusters of e-cigarette expectancies and reasons for use, and 2) to test the hypothesis that positive expectancies and reasons for use of e-cigarettes would be positively associated with changes in e-cigarette use across time.

Method

Participants

Data from 137 participants were considered for analysis. Eligibility criteria for these analyses required that participants endorse the following: 1) used e-cigarettes at least once a month for the past six months; 2) not smoked tobacco cigarettes in the past 60 days; 3) smoked 10 or fewer lifetime cigarettes; and 4) used other combustible tobacco products 3 or fewer times in the past 6 months. Participants were also required to be 18–24 years old upon recruitment into the study, to have stable and regular Internet access, and to be fluent in English.

Procedure

All procedures were approved by a university-based institutional review board, and all participants provided electronic informed consent before participating. Participants were recruited through advertisements listed on social media websites and completed an electronic eligibility screen upon responding to an ad. Eligible individuals were emailed links to an electronic consent form and the baseline assessment and received links to online assessments 3, 6, 9, and 12 months after baseline, producing five assessment time points. Participants received $20 gift cards for completing the first two assessments, and compensation increased by $10 for every subsequent two assessments completed.

Materials

Demographic characteristics were collected at baseline and included age, gender, race/ethnicity, and student status. Participants could identify as male, female, or other when responding to the item asking about gender. Race/ethnicity was categorized into Caucasian, Asian or Pacific Islander, Hispanic or Latino, and multi-racial/other/unknown. Student status was analyzed as a binary variable that differentiated full-time students from the rest of the sample.

Data on use of e-cigarettes and tobacco cigarettes were collected at baseline and all four follow-up assessments using the Timeline Follow-Back procedure (TLFB; Sobell & Sobell, 1992, 1996). At each time point, participants were asked to report whether they had used e-cigarettes on each of the past 14 days. A positive response triggered a follow-up item asking how many times e-cigarettes had been used that day, with a single use defined as 15 puffs or 10 minutes of use (Foulds et al., 2015). Similar items were used to measure whether cigarettes had been used, and if so how many, on each of the previous 14 days. A 14-day TLFB was used instead of a longer (e.g., 30-day) TLFB because longer assessments may be less accurate, and shorter assessments might be more appropriate for studies evaluating mechanisms underlying use behaviors (Hoeppner, Stout, Jackson, & Barnett, 2010).

To assess e-cigarette expectancies, a 32-item questionnaire was administered at baseline and all four follow-up time points. Twenty-five items were adapted from the Smoking Consequences Questionnaire - Adult version (Copeland, Brandon, & Quinn, 1995), and seven items had been previously developed by one of the co-authors for a study of expectancies for non-cigarette tobacco products (Doran & Brikmanis, 2016). Instructions asked participants to indicate the extent to which each statement about e-cigarettes was true for them, and response options reflected a 4-point Likert scale ranging from 1 (not at all) to 4 (very much).

Finally, reasons for using e-cigarettes were measured on the same assessment schedule via a 9-item questionnaire developed specifically for this study. These items were adapted from previous research evaluating motives for smoking among young adults (Brown, Carpenter, & Sutfin, 2011; Piasecki, Richardson, & Smith, 2007). Participants were asked to rate the extent to which each item reflected a reason for using e-cigarettes over the past few months on a 5-point Likert scale ranging from 0 (not at all true) to 4 (extremely true).

Data Analytic Plan

Analyses were conducted in Stata version 13.1 (StataCorp LP, College Station, TX) and SPSS version 24 (IBM Corp., Armonk, NY). To reduce the number of analyses needed to evaluate the primary study aims, two principal component analyses (PCAs) were conducted. PCAs were utilized because this approach allows single-item scores for expectancies and reasons for e-cigarette use to converge onto summary index factors reflecting broader categories of expectancies and reasons for use. Factor analysis is designed to model measurement items onto latent variables, and since this study was not designed to define latent variables, we chose to utilize PCA in this study rather than an exploratory factor analysis. Default PCA settings in SPSS were implemented, and baseline single-item ratings were considered for the PCAs. Factor loadings ≥ 0.35 were used to identify items to be included under specific factors. If an item showed loadings ≥ 0.35 across multiple factors, the item was included under the factor with the highest loading. Varimax rotation was implemented with each PCA, and Kaiser-Meyer-Olkin statistics were calculated to evaluate whether the sample was large enough to construct factor scores. Cronbach's α statistics were also calculated post-hoc to evaluate internal consistency for resulting expectancy/reason factors.

For the first primary aim, which was to assess change in expectancies and reasons for e-cigarette use over time, five linear mixed models were conducted using the *xtmixed* command with maximum likelihood estimation in Stata. This approach was chosen over similar regression or random effects analyses because *xtmixed* allows for time to be entered as both a fixed and random factor, enabling random estimation of both slopes and intercepts. Statistical significance was set at $p < .01$ to correct for multiple comparisons, and the following demographic variables were covariates in each model: gender (male, female, or other), race/ethnicity (Caucasian, Asian/Pacific Islander, Hispanic/Latino, or Other, including African-American, mixed ethnicity, and missing), baseline student status (part-time student/non-student or full-time student), and baseline age (continuous).

The second primary aim was to test the hypothesis that positive expectancies and reasons for using e-cigarettes would be longitudinally positively associated with changes in e-cigarette use. To evaluate this hypothesis, ten additional linear mixed models were conducted using the *xtmixed* command in Stata. Change scores for both e-cigarette use and expectancy/reason factors were calculated by subtracting an outcome/factor score from the previous time point. This produced four levels of time-varying e-cigarette use outcomes and factor score predictors: 3 months – baseline, 6 months – 3 months, 9 months – 6 months, and 12 months – 9 months. Models considered two e-cigarette use outcomes that were assessed at each time point -frequency/days and quantity/total times of use of e-cigarettes. Separate mixed model regressions were run for each expectancy/reason factor, and statistical significance was set at $p \leq .05$. Seven baseline variables were entered into each regression as covariates: gender, race/ethnicity, student status, age, baseline cigarette use, baseline e-cigarette use, and baseline expectancy/reason factor score. The cigarette-specific and e-cigarette-specific baseline covariates corresponded to the e-cigarette outcome being considered (i.e., either days of use or total times of use).

Results

Demographic Characteristics and Descriptive Statistics

Demographic characteristics are reported in Table 1, and descriptive statistics of e-cigarette and cigarette use across time are reported in Table 2. There was a relatively even split within the sample across gender, participants' baseline mean age was between 19 and 20 years old, and about 74% of the sample was Caucasian. On average, participants reported initiating e-cigarette use before the age of 18, and a majority of participants reported currently using box-mod types of e-cigarettes. Days and total times of use of e-cigarettes showed variability across time points, but mean levels of use appeared to decrease over time. Cigarette smoking remained relatively low and showed high levels of zero-inflation at all five time points, with mean days of cigarette use never exceeding 0.64 and mean total cigarettes smoked never exceeding 1.52 in any one 14-day assessment period.

Principal Component Analyses

Results from the expectancy and reason PCAs are reported in Supplemental Tables 1 and 2, respectively. KMO statistics were ≥ 0.63, and Bartlett's tests of sphericity were statistically significant for both analyses. These results suggest that PCAs were appropriate approaches for data reduction with this sample.

The 32 expectancy items loaded onto three factors: positive internal expectancies for e-cigarettes (15 items; e.g., relaxing, energizing, enjoyment), negative expectancies for e-cigarettes (9 items; e.g., stigmatizing, irritating, causing nicotine dependence), and positive social expectancies for e-cigarettes (8 items; e.g., helping to socialize, looking cool, using with alcohol). The 9 reason for use items loaded onto two factors: affect-related reasons (5 items; e.g., to relax, to increase positive feelings) and social reasons (4 items; e.g., to feel part of a group, to celebrate). Cronbach's alpha was ≥ 0.67 for all five factors, suggesting that these factors demonstrated at least adequate internal consistency.

Longitudinal Change in Expectancy/Reason Scores

Mean scores on all five expectancy/reason factors over time are presented in Figure 1, and results from the five linear mixed models are reported in Table 3. After controlling for gender, race/ethnicity, baseline student status, and baseline age, the negative expectancies factor demonstrated a statistically significant increase in score over time ($z = 2.89$, $p = .004$), while the affect-related reasons factor demonstrated a statistically significant decrease in score over time ($z = -3.29$, $p = .001$). The other three expectancy/reason factors did not show statistically significant changes over the 12-month assessment period (p's $\geq .069$).

Changes in Expectancy/Reason Scores as Predictors of Changes in E-Cigarette Use

Results from the ten mixed model analyses evaluating whether changes in e-cigarette expectancies and reasons for using e-cigarettes predicted changes in actual use of e-cigarettes are reported in Table 4. In all ten regression models, baseline e-cigarette use was a significant negative predictor of changes in both quantity/days and frequency/total times of e-cigarette use (z's = −2.66 to −3.23, p's $\leq .008$). In other words, those who reported greater quantity and frequency of e-cigarette use at baseline were more likely to reduce e-cigarette use at subsequent time points. No other baseline covariates were associated with changes in e-cigarette use. Changes in expectancy/reason factor scores were associated with changes in e-cigarette use in three of the ten models. Consistent with our hypothesis, changes in positive internal expectancies ($z = 2.14$, $p = .032$) and positive social expectancies ($z = 2.71$, $p = .007$) were both positively associated with changes in frequency/days of e-cigarette use, while changes in positive social expectancies ($z = 2.22$, $p = .026$) was also positively associated with changes in quantity/total times of e-cigarette use.

Discussion

This prospective study was designed to quantify changes in expectancies and reasons for e-cigarette use over time among young adult e-cigarette users and to evaluate how these constructs corresponded longitudinally to changes in use of e-cigarettes. Expectancies and reasons for e-cigarette use that were assessed in this study converged onto five factors: affect-related reasons, social reasons, positive internal expectancies, negative expectancies, and positive social expectancies. These factors are consistent with other studies that have attempted to categorize expectancies for e-cigarettes among young adults (Pokhrel, Little, Fagan, Muranaka, & Herzog, 2014). Of those five factors, only two demonstrated significant changes over time: participants endorsed increases in negative expectancies for e-cigarettes and decreases in affect-related expectancies for e-cigarettes.

Outcome expectancies are conceptualized as a construct that can change over time as individuals gain personal experience with a certain product, education about potential consequences of use, and exposure to certain advertisements and public health messages, among other things. These results suggest that young adults' beliefs about e-cigarettes can change over time, and emerging perceptions of negative consequences of e-cigarette use may be driven by the volatile e-cigarette landscape. E-cigarettes have seen multiple "generations" of evolution that have been defined by more efficient nicotine delivery and improved device functionality (Cobb, Hendricks, & Eissenberg, 2015); further, new federal and state-level

regulations on e-cigarettes continue to be developed and imposed (Barraza, Weidenaar, Cook, Logue, & Halpern 2017), and new data on e-cigarettes are being published in academic journals at an exponentially growing rate (Correa et al., 2016). All of these factors could influence changes in e-cigarette expectancies, and with the product, consumer, regulatory, and scientific environments likely to continue evolving rapidly, continued surveillance of expectancies remains critical.

When evaluating the prospective relationship between changes in expectancies and changes in e-cigarette use, our hypothesis was supported. Positive social expectancies and positive internal expectancies were positively associated with quantity and frequency of e-cigarette use. Of particular importance for this study may be the positive prospective relationship between changes in positive social expectancies and changes in use of e-cigarettes. Among younger populations, social and peer influences can promote e-cigarette use (Vogel, Ramo, & Rubinstein, 2018), and social media campaigns can influence e-cigarette use by manipulating positive expectancies for e-cigarettes (Pokhrel et al., 2018). Newer electronic nicotine delivery systems like JUUL are using diverse social media platforms to disseminate stylish, trendy marketing campaigns (Huang et al., 2019). These findings indicate that young adults' beliefs about e-cigarettes may be influenced by social forces, and they support strict regulations on e-cigarette advertisements.

This study should be interpreted within the context of its limitations. First, although individual expectancy items were adapted from previous research, we did not use measures of expectancies or motives for e-cigarette use that had been previously psychometrically evaluated (e.g., Pokhrel, Lam, et al., 2018). Second, we did not assess socioeconomic status or household income in this study; thus, we could not statistically control for this demographic factor. Third, because candidates were self-selected via social media websites, it is possible that our sample is not consistent with the general population of young adult e-cigarette users. Finally, we did not assess the nicotine content of participants' e-cigarette device, precluding analyses of how expectancies predict use within the context of the psychoactive substance nicotine.

Despite these limitations, results demonstrate that expectancies for e-cigarettes change over time, and these changes can predict changes in e-cigarette use. An important future research question would be to evaluate whether the inverse relationship exists - namely, if changes in e-cigarette use over time predict changes in e-cigarette expectancies and motives for use over time. These results also encourage further exploration of how expectancies and reasons for use impact actual use of other nicotine and tobacco products over time. As the e-cigarette and tobacco product landscapes continue to evolve, it will also be critical for public health initiatives, interventions, and educational campaigns to take expectancies and reasons for e-cigarettes into account, as doing so will help ensure that young adults' beliefs about e-cigarettes are rooted in science as much as possible.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

Bandura A (1986). Social foundations of thought and action: a social cognitive theory. Englewood Cliffs, NJ: Prentice Hall.

Barraza LF, Weidenaar KE, Cook LT, Logue AR, & Halpern MT (2017). Regulations and policies regarding e-cigarettes. Cancer, 123(16), 3007–3014. doi:10.1002/cncr.30725 [PubMed: 28440949]

Bullen C (2017). Rise in e-cigarette use linked to increase in smoking cessation rates. BMJ, 358, j3506. doi:10.1136/bmj.j3506. [PubMed: 28747300]

Brikmanis K, Petersen A, & Doran N (2017). E-cigarette use, perceptions, and cigarette smoking intentions in a community sample of young adult nondaily cigarette smokers. Psychology of Addictive Behaviors, 31(3), 336–342. doi:10.1037/adb0000257 [PubMed: 28125242]

Brown AE, Carpenter MJ, & Sutfin EL (2011). Occasional smoking in college: who, what, when and why?. Addictive Behaviors, 36(12), 1199–1204. doi:10.1016/j.addbeh.2011.07.024 [PubMed: 21849231]

Cobb CO, Hendricks PS, & Eissenberg T (2015). Electronic cigarettes and nicotine dependence: evolving products, evolving problems. BMC Medicine, 13(1), 119. doi:10.1186/s12916-015-0355-y [PubMed: 25998379]

Copeland AL, Brandon TH, & Quinn EP (1995). The Smoking Consequences Questionnaire-Adult: Measurement of smoking outcome expectancies of experienced smokers. Psychological Assessment, 7(4), 484–494. doi:10.1037/1040-3590.7.4.484

Correa JB, Ariel I, Menzie NS, & Brandon TH (2016). Documenting the emergence of electronic nicotine delivery systems as a disruptive technology in nicotine and tobacco science. Addictive Behaviors, 65, 179–184. doi:10.1016/j.addbeh.2016.10.021 [PubMed: 27816664]

Doran N, & Brikmanis K (2016). Expectancies for and use of e-cigarettes and hookah among young adult non-daily smokers. Addictive Behaviors, 60, 154–159. doi:10.1016/j.addbeh.2016.04.008 [PubMed: 27155241]

Doran N, Brikmanis K, Petersen A, Delucchi K, Al-Delaimy WK, Luczak S, … & Strong D (2017). Does e-cigarette use predict cigarette escalation? A longitudinal study of young adult non-daily smokers. Preventive Medicine, 100, 279–284. doi:10.1016/j.ypmed.2017.03.023 [PubMed: 28583658]

Fairchild AL, Lee JS, Bayer R, & Curran J (2018). E-cigarettes and the harm-reduction continuum. New England Journal of Medicine, 378(3), 216–219. doi:10.1056/NEJMp171199 [PubMed: 29342380]

Goldman MS, Reich RR, & Darkes J (2006). Expectancy as a unifying construct in alcohol-related cognition In Wiers RW & Stacy AW (Eds.), Handbook of implicit cognition and addiction (pp. 105–119). Thousand Oaks, CA: Sage Publications, Inc.

Harrell PT, Simmons VN, Piñeiro B, Correa JB, Menzie NS, Meltzer LR, Unrod M, … Brandon TH (2015). E-cigarettes and expectancies: why do some users keep smoking?. Addiction, 110(11), 1833–43. doi:10.1111/add.13043 [PubMed: 26173651]

Hoeppner BB, Stout RL, Jackson KM, & Barnett NP (2010). How good is fine-grained Timeline Follow-back data? Comparing 30-day TLFB and repeated 7-day TLFB alcohol consumption reports on the person and daily level. Addictive Behaviors, 35(12), 11381143. doi:10.1016/j.addbeh.2010.08.013

Huang J, Duan Z, Kwok J, Binns S, Vera LE, Kim Y, … & Emery SL (2019). Vaping versus JUULing: how the extraordinary growth and marketing of JUUL transformed the US retail e-cigarette market. Tobacco Control, 28(2), 146–151. doi:10.1136/tobaccocontrol-2018-054382 [PubMed: 29853561]

Jamal A, King BA, Neff LJ, Whitmill J, Babb SD, & Graffunder CM (2016).Current cigarette smoking among adults-United States, 2005–2015. MMWR. Morbidity and Mortality Weekly Report, 65(44), 1205–1211. doi:10.15585/mmwr.mm6544a2 [PubMed: 27832052]

Johnson AL, Collins LK, Villanti AC, Pearson JL, & Niaura RS (2018). Patterns of nicotine and tobacco product use in youth and young adults in the United States, 20112015. Nicotine and Tobacco Research, 20(suppl_1), S48–S54. doi:10.1093/ntr/nty018 [PubMed: 30125012]

McMillen RC, Gottlieb MA, Shaefer RMW, Winickoff JP, & Klein JD (2014).Trends in electronic cigarette use among US adults: use is increasing in both smokers and nonsmokers. Nicotine & Tobacco Research, 17(10), 1195–1202. doi:10.1093/ntr/ntu213 [PubMed: 25381306]

National Academies of Sciences, Engineering, and Medicine (2018). Public health consequences of e-cigarettes. Washington, DC: The National Academies Press. doi:10.17226/24952

O'Connor RJ, Fix BV, McNeill A, Goniewicz ML, Bansal-Travers M, Heckman BW, … & Hammond D (in press). Characteristics of vaporized nicotine products used by participants in the ITC Four Country Tobacco and E-Cigarette Project, Wave 1.Addiction.

Parrott AC (2015). The psychobiological problems of continued nicotine dependency in e- cigarette 'Vapers'. Commentary: "Electronic cigarettes". Frontiers in Psychiatry, 6, 123. doi:10.3389/fpsyt.2015.00123 [PubMed: 26388787]

Piasecki TM, Richardson AE, & Smith SM (2007). Self-monitored motives for smoking among college students. Psychology of Addictive Behaviors, 21(3), 328–337. doi:10.1037/0893-164X.21.3.328 [PubMed: 17874883]

Pokhrel P, Fagan P, Herzog TA, Laestadius L, Buente W, Kawamoto CT, … & Unger JB (2018). Social media e-cigarette exposure and e-cigarette expectancies and use among young adults. Addictive Behaviors, 78, 51–58. doi:10.1016/j.addbeh.2017.10.017 [PubMed: 29127784]

Pokhrel P, Lam TH, Pagano I, Kawamoto CT, & Herzog TA (2018). Young adult e- cigarette use outcome expectancies: validity of a revised scale and a short scale. Addictive Behaviors, 78, 193–199. doi:10.1016/j.addbeh.2017.11.019 [PubMed: 29195147]

Pokhrel P, Little MA, Fagan P, Muranaka N, & Herzog TA (2014). Electronic cigarette use outcome expectancies among college students. Addictive Behaviors, 39(6), 10621065. doi:10.1016/j.addbeh.2014.02.014

Stanbrook MB (2016). Electronic cigarettes and youth: a gateway that must be shut. CMAJ, 188(11), 785 doi:710.1503/cmaj.160728] [PubMed: 27431301]

Sobell LC, & Sobell MB (1992). Measuring alcohol consumption. Totowa, NJ: Humana Press.

Sobell LC, & Sobell MB (1996). Timeline followback: A calendar method for assessing alcohol and drug use. Toronto: Addiction Research Foundation.

Vogel EA, Ramo DE, & Rubinstein ML (2018). Prevalence and correlates of adolescents' e-cigarette use frequency and dependence. Drug and Alcohol Dependence, 188, 109–112. doi: 10.1016/j.drugalcdep.2018.03.051 [PubMed: 29763848]

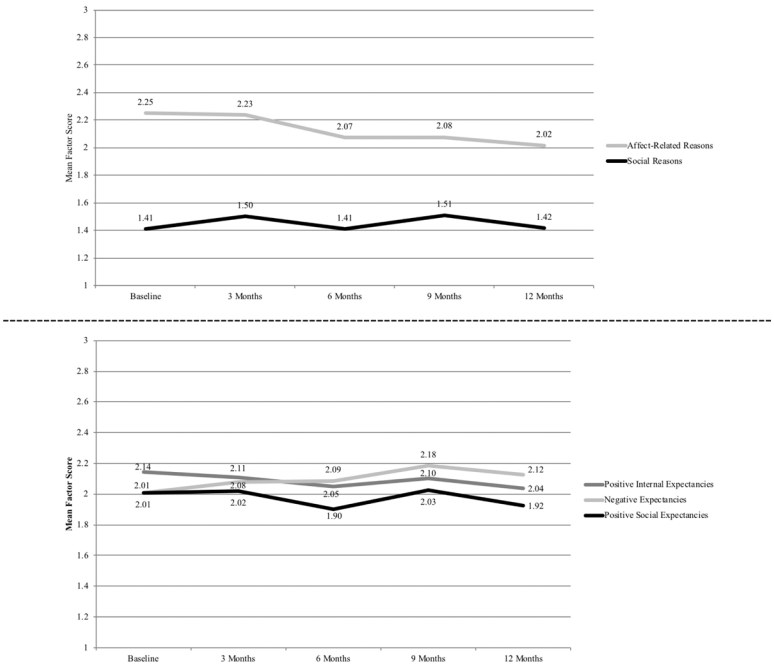

Figure 1.
Mean scores of expectancy/reason factors over time.

Table 1

Demographic Characteristics

	% or *M*(SD)
Gender (% male)	51.8
Age	19.5 (1.6)
Age When First Used an E-Cigarette	17.4 (l.6)
Type of E-Cigarette Used Currently (%)	
Box-Mod	54.0
Vape Pen	21.2
JUUL	5.1
Cig-a-like	4.4
Student Status (% full-time)	54.7
Race/Ethnicity (% Caucasian)	73.7
Education (% High School Grad/GED)	67.9

Table 2

Mean Days and Total Times of Use for E-Cigarettes and Cigarettes

	E-Cigarettes		Cigarettes	
Timepoint	**Days**	**Total Times**	**Days**	**Total Times**
Baseline (n = 137)	6.96 (4.53)	20.79 (27.07)	0.17 (0.95)	0.30 (0.15)
3 Months (n = 126)	7.14 (4.80)	22.98 (30.48)	0.56 (1.74)	1.02 (3.38)
6 Months (n = 124)	6.61 (5.08)	20.48 (30.48)	0.64 (2.19)	1.52 (6.27)
9 Months (n = 124)	5.97 (5.29)	17.81 (23.84)	0.48 (1.98)	1.27 (7.50)
12 Months (n = 117)	5.71 (5.41)	19.30 (27.04)	0.43 (1.49)	0.68 (2.57)

Notes: Total times for e-cigarette use is defined as 15 puffs or 10 minutes of use. Total times for cigarette use is defined as number of cigarettes smoked.

Table 3

Linear mixed models evaluating change in expectancy and reason factor scores over time.

	Positive Internal Expectancies			Negative Expectancies			Positive Social Expectancies			Affect-Related Reasons			Social Reasons		
Effect	**Coefficient**	**SE**	***z***	**Coefficient**	**SE**	***z***	**Coefficient**	**SE**	***z***	**Coefficient**	**SE**	***z***	**Coefficient**	**SE**	***z***
Sex	0.159	0.08	1.89	−0.104	0.09	−1.19	−0.127	0.10	−1.32	0.143	0.11	1.33	−0.259	0.14	−1.85
Race/Ethnicity	0.017	0.04	0.40	−0.007	0.04	−0.16	0.067	0.05	1.39	0.058	0.05	1.07	0.070	0.07	0.99
Student Status	−0.057	0.09	−0.63	0.055	0.09	0.58	−0.101	0.10	−0.97	−0.066	0.12	−0.57	−0.080	0.15	−0.53
Age	0.008	0.03	0.27	−0.034	0.03	−1.13	0.002	0.03	0.07	0.029	0.04	0.82	0.006	0.05	0.12
Time	−0.024	0.01	−1.82	***0.040***	***0.01***	***2.89***	−0.013	0.01	−0.91	***−0.065***	***0.02***	***−3.29***	0.004	0.02	0.20

Notes: SE = standard error. All values in ***bold italics*** represent statistically significant coefficients (*p* < .01).

Table 4

Linear mixed models evaluating whether change in expectancy and reason factor scores over time is associated with changes in e-cigarette use over time.

	Positive Internal Expectancies			Negative Expectancies			Positive Social Expectancies			Affect-Related Reasons			Social Reasons		
Change in E-cig Use (Days)	**Coeff**	**SE**	***z***	**Coeff**	**SE**	***z***	**Coeff**	**SE**	***z***	**Coeff**	**SE**	***z***	**Coeff**	**SE**	***z***
Gender	−0.206	0.38	−0.54	−0.250	0.37	−0.67	−0.194	0.37	−0.52	−0.209	0.38	−0.55	−0.216	0.37	−0.58
Race/Ethnicity	−0.012	0.19	−0.06	−0.023	0.19	−0.12	−0.014	0.19	−0.07	−0.015	0.19	−0.08	−0.041	0.19	−0.21
Full-Time Student	0.024	0.40	0.06	0.021	0.41	0.05	0.028	0.40	0.07	0.047	0.40	0.12	0.032	0.41	0.08
Age	−0.073	0.13	−0.58	−0.078	0.13	−0.61	−0.067	0.12	−0.53	−0.073	0.13	−0.58	−0.074	0.12	−0.59
Baseline cigarette use (days)	0.052	0.21	0.25	0.071	0.21	0.34	0.060	0.20	0.29	0.062	0.21	0.30	0.055	0.21	0.27
Baseline e-cig use (days)	***−0.140***	***0.04***	***−3.14***	***−0.134***	***0.04***	***−3.01***	***−0.137***	***0.04***	***−3.10***	***−0.135***	***0.05***	***−2.99***	***−0.132***	***0.04***	***−2.97***
Time	−0.128	0.18	−0.72	−0.120	0.18	−0.68	−0.111	0.18	−0.63	−0.122	0.18	−0.70	−0.115	0.18	−0.65
Baseline factor score	0.107	0.33	0.33	−0.136	0.34	−0.40	0.190	0.30	0.62	0.051	0.27	0.19	0.207	0.20	1.05
Change in factor score	***0.871***	***0.41***	***2.14***	0.251	0.37	0.67	***1.024***	***0.38***	***2.71***	0.416	0.25	1.64	−0.042	0.23	−0.18
Change in E-cig Use (Total Times)	**Coeff**	**SE**	***z***	**Coeff**	**SE**	***z***	**Coeff**	**SE**	***z***	**Coeff**	**SE**	***z***	**Coeff**	**SE**	***z***
Gender	−0.094	2.48	−0.04	−0.380	2.32	−0.16	−0.020	2.34	−0.01	−0.317	2.43	−0.13	0.027	2.39	0.01
Race/Ethnicity	−0.437	1.24	−0.35	−0.290	1.21	−0.24	−0.407	1.22	−0.33	−0.474	1.23	−0.39	−0.665	1.22	−0.55
Full-Time Student	−1.167	2.62	−0.45	−0.993	2.52	−0.39	−1.277	2.55	−0.50	−1.108	2.61	−0.42	−1.480	2.60	−0.57
Age	−0.626	0.82	−0.77	−0.709	0.78	−0.90	−0.615	0.79	−0.78	−0.651	0.82	−0.80	−0.656	0.80	−0.82
Baseline cigarette use (total times)	0.216	0.72	0.30	0.315	0.68	0.46	0.203	0.70	0.29	0.283	0.72	0.39	0.231	0.71	0.32
Baseline e-cig use (total times)	***−0.144***	***0.05***	***−3.01***	***−0.131***	***0.05***	***−2.83***	***−0.149***	***0.05***	***−3.23***	***−0.143***	***0.05***	***−2.98***	***−0.128***	***0.05***	***−2.66***
Time	−0.154	1.14	−0.13	−0.006	1.12	−0.01	−0.110	1.12	−0.10	−0.139	1.13	−0.12	−0.094	1.13	−0.08
Baseline factor score	0.503	2.14	0.24	−0.959	2.11	−0.45	1.237	1.93	0.64	0.536	1.73	0.31	1.024	1.27	0.81
Change in factor score	4.748	2.53	1.88	−0.152	3.23	−0.05	***6.462***	***2.91***	***2.22***	1.545	1.72	0.90	−0.318	1.39	−0.23

Notes: Coeff = coefficient, SE = standard error. All values in ***bold italics*** represent statistically significant coefficients *($p < .05$)*.