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Validation of the Electronic Cigarette Expectancy Scale for Adolescents

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Abstract

Introduction: Expectancies of costs and benefits can be predictive of tobacco use, as well as cessation attempts and success. Measuring electronic cigarette (ECIG) expectancies is in its infancy, particularly among adolescents. However, the popularity of adolescent ECIG use demonstrates the need to understand better these contributing factors. Our aim was to evaluate the factor structure and initial psychometric properties of an ECIG expectancies questionnaire adapted from an existing validated scale for conventional cigarette smoking (*Smoking Expectancy Scale for Adolescents*; SESA).

Methods: Five-hundred sixty-nine adolescents (14–18 years; 60.1% female; 84.1% White) were recruited from high schools and an adolescent medicine clinic. Participants completed a battery of self-report measures, including the *ECIG Expectancies Scale for Adolescents* (EESA). Exploratory factor analyses were used to examine the underlying factor structure, and convergent validity was evaluated using variables conceptually related to ECIG expectancies.

Results: A three-factor solution was chosen based on statistical evidence and conceptual relevance. All three factors - Costs, Social Benefits, and Affective/Weight Benefits - had strong internal consistencies and demonstrated convergent validity via significant associations with peer ECIG use and Conscientiousness. The Costs and Affective/Weight Benefits factors also demonstrated convergent validity with sensation-seeking, intention to use ECIGs, and ECIG use status (current, lifetime, nonuser).

Conclusion: Results support the initial reliability and validity of the EESA scores. This factor structure is related to, yet different from, that observed not only for the SESA but also for other ECIG-expectancy measures among adult populations.

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Author Contributions

Authors PE, DW, and CD were involved in the conceptualization, design, administration and data collection. PE and NF conducted statistical analyses. PE and NF wrote the first draft. All authors were involved in the revision of the manuscript and have approved the final manuscript.

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Keywords

Electronic Nicotine Delivery Systems; Adolescent Health; Psychometrics; Attitudes

Introduction

In 2014, electronic cigarettes (ECIGs) surpassed conventional cigarettes as the most commonly used tobacco product among adolescents (Arrazola et al., 2015), raising concerns about nicotine dependence (Lanza & Vasilenko, 2015), serious health problems from inhaling chemicals (Rubinstein et al., 2018), and initiation of cigarette smoking (Wills et al., 2016). Understanding adolescents' outcome expectancies, or their beliefs about the outcome of engaging in ECIG use, can help in the design/development of efforts to reduce ECIG use (Abrams & Niaura, 1987). Individuals are more likely to engage in a behavior, such as ECIG use, when they believe there will be positive outcomes and are less likely to engage in that same behavior when they believe there will be negative outcomes (Fishbein & Ajzen, 1977). Outcome expectancies have been a key construct in understanding cigarette use in adolescents (Anderson et al., 2002), directly informing prevention and cessation interventions for this tobacco product. More specifically, outcomes expectancies may inform the messaging for large-scale prevention efforts or inform the targets of cessation interventions (e.g., belief structures around the pros and cons of cigarette use). Indeed, smoking-cessation interventions that are tailored to individuals' attitudes regarding smoking have been shown to be more effective than non-tailored interventions (Stanczyk et al., 2014).

Work addressing ECIG outcome expectancies shows that adolescents are more likely to try ECIGs if they believe they are safer (Chaffee et al., 2015; Rohde et al., 2018) or less addictive than other tobacco products (Bernat et al., 2018; Rohde et al., 2018), or if they believe they will enjoy using them (Barker et al., 2019). Adolescents who use ECIGs also perceive fewer negative social costs (e.g., upsetting friends) (Barrington-Trimis et al., 2015; Chaffee et al., 2015) and more social benefits (e.g., fitting in with peers) (Bernat et al., 2018), and report that ECIGs provide stress relief (Bernat et al., 2018).

Few well-validated measures of adolescent ECIG expectancies exist. Five studies (Correa et al., 2019; Grigsby, 2019; Morean et al., 2019; Morean & L'Insalata, 2017; Pokhrel et al., 2014) have reported on the validation of an ECIG expectancy measure for adults, revealing multiple subscales of potential benefits (e.g., social enhancement, affect control) and costs (e.g., addiction, health consequences). However, it may not be appropriate to use measures validated for young adults with adolescent samples. Risk perceptions for young adults may differ from those for adolescents (Johnson et al., 2002). Additionally, it is illegal to sell ECIGs to minors and schools likely have policies for students' possession or use of ECIGs; therefore, consequences for ECIG use may differ for adolescents when compared with young adults. Finally, studies have shown differences in the associations between expectancies and ECIG use (Barker et al., 2019), as well as reasons for ECIG use (Kong et al., 2015), among adolescents and young adults. Thus, measures of ECIG expectancies designed specifically for adolescents are needed.

Although prior work, addressed ECIG expectancies in adolescents, it is fairly narrow in the domains assessed. Rohde and colleagues (2018) targeted expectancies related to health only, including health worry, health consequences, and addiction. Barker and colleagues (2019) assessed adolescents' expectancies beyond those health-related (Enjoyment, Social Influences, Advantage over Cigarettes, Smoker Association), but omitted other domains often associated with adolescent ECIG use (social costs; (Bernat et al., 2018) or included in ECIG expectancy measures for adults (i.e., appearance/presentation, weight/appetite control) (Morean & L'Insalata, 2017; Pokhrel et al., 2014). Barker and colleagues (2019) also did not perform an exploratory factor analysis, limiting understanding of the underlying structure of their measure. Cristello and colleagues (Cristello et al., 2020) validated a measure of ECIG expectancies in adolescents that included domains related to affect control, social costs and benefits, taste, and weight control. However, health-related concerns were not included in this measure. This omission is potentially problematic because adolescents may view ECIGs as less harmful than conventional cigarettes (Amrock et al., 2016), be more likely to use ECIGs when they perceive them as less harmful (Chaffee et al., 2015; Rohde et al., 2018), and identify health risks as a reason for discontinuation of ECIGs (Kong et al., 2015). Taken together, adolescent ECIG expectancy measures can be improved by including a broad spectrum of expectancies, as well as being validated specifically with samples of adolescents.

Well-validated tools that measure diverse expectancies of using an ECIG can help elucidate adolescents' reasons for using these devices. Many such measures exist for cigarette smoking, some of which might reasonably be adapted for ECIG use given the overlap in reported expectancies for both products (Correa et al., 2019; Harrell et al., 2019; Pokhrel et al., 2014). The *Smoking Expectancy Scale for Adolescents* (SESA) is a self-report measure that assesses a broad range of expectancies (e.g., social benefits, affect control, health costs, appearance/presentation) from smoking a cigarette (Hine et al., 2007). Items from the SESA were included in Pokhrel and colleagues' expectancy measure (2014), but the full SESA has not been adapted. The inclusion of a broad range of expectancy domains is a notable strength of the SESA and make it a good candidate for adapting to ECIG use. The current study is a secondary data analysis of an existing dataset. The aim of the current study was to adapt and validate the SESA, as a more comprehensive measure of expectancies, to assess adolescents' perceived costs and benefits of using ECIGs.

Exploratory factor analysis (EFA) was used to examine the factor structure of the adapted measure, the *Electronic Cigarette Expectancy Scale for Adolescents* (EESA), because it was not clear that the original SESA factor structure would be applicable. It was hypothesized that the EESA would yield subscales that measure costs and benefits; however, the exact number of subscales was not hypothesized. After establishing the factor structure of the EESA, internal consistency and convergent validity were assessed. Convergent validity with intention to use ECIGs and self-reported ECIG use status (never, lifetime, current) was examined. ECIG expectancies also are associated with parent and peer ECIG use (Trucco et al., 2021), and ECIG use is associated with sensation-seeking (Wills et al., 2015) and concurrent cigarette use (Wills et al., 2015). Therefore, convergent validity between the EESA subscales and these constructs also was examined. Personality traits may also relate to outcome expectancies. Individuals with higher levels of conscientiousness are more likely

to delay gratification and follow rules/norm; therefore, they may perceive more costs and fewer benefits to ECIG use. Conversely, individuals with higher levels of extraversion may perceive more social benefits to ECIG use. The association between such personality traits and ECIG use has been examined among adolescents in only a few studies with mixed findings (Grzywacz et al., 2020; Hittner et al., 2020). Therefore, we used select personality traits (Conscientiousness and Extraversion) to further assess convergent validity. Cost-related subscales were hypothesized to be positively associated with conscientiousness and negatively associated with ECIG use behavior, parent and peer ECIG use, extraversion, and sensation seeking. The opposite pattern was expected for benefit-related subscales.

Method

Participants

Adolescents were recruited from 2015–17 from high schools in West Virginia, Ohio, and Pennsylvania (n = 513) as well as an adolescent medicine clinic in north-central West Virginia (n = 54). The sample consisted of 567 English-speaking adolescents enrolled in high school and aged 14–18 years. Adolescents exhibiting significant cognitive deficits (identified by teachers or clinic staff) were excluded from participation.

Procedure

Recruitment sites and the university Institutional Review Board approved study procedures. At schools, research staff described the study to students and asked adolescents to give invitation letters and consent forms to parents/legal guardians; consent forms included a box for participants to indicate if they *did* or *did not* want to participate. Researchers returned 2–7 days later to collect signed consent forms and administer questionnaires. In the adolescent medicine clinic, medical providers gave a brief study description to identified eligible adolescents. For those interested, research staff then provided details about participation and obtained informed consent (caregivers and adolescents ≥ 18 years old) and assent (adolescents < 18 years old).

Adolescents completed a questionnaire packet including but not limited to the measures described below. Youth who returned consent forms, regardless of whether they chose to participate, were entered into a lottery to win $20 gift cards. Participating youth were entered into a different lottery drawing to win $20 gift cards.

Measures

Participant Information Form (PIF)—The PIF was created to gather information on demographic variables including sex, grade in school, and race.

Electronic Cigarette Expectancy Scale for Adolescents (EESA)—The EESA was adapted from the SESA, a self-report questionnaire for rating the likelihood of potential consequences of smoking a cigarette (e.g., “Look more attractive”, “Get heart disease”) (Hine et al., 2007). Answers to 43 items are reported on a 10-point Likert scale ranging from 0 (“completely unlikely”) to 9 (“completely likely”). The original SESA items were developed via qualitative interviews with adolescent smokers and non-smokers and refined

in an iterative process by content matter experts (see Hine et al., 2007 for details). The SESA was validated with smokers and non-smokers and found to have satisfactory internal consistency and demonstrated convergent validity with concurrent cigarette use and intention to use cigarettes (Hine et al., 2007). To adapt the SESA for ECIG expectancies, the term "cigarette" was replaced with "electronic cigarette" throughout the measure. The newly adapted EESA was then reviewed by subject matter experts (PTE, NJF, CLD, MDB) to ensure items remained relevant to ECIG use.

Youth Risk Behavior Survey (YRBS)—ECIG-specific items from the 2015 YRBS (CDC, 2015) were utilized for the current study. Adolescents were categorized based on their responses to two questions: 1) "Have you ever used an electronic vapor product?" (lifetime ECIG use), and 2) "During the past 30 days, on how many days did you use an electronic vapor product?" (past 30-day ECIG use). Non-users were those who reported no use of an ECIG in their lifetime. Lifetime users were those who responded "yes" to lifetime use but "no" to use in the past month. Current users were those who responded to "yes" to lifetime use as well as use on at least one day in the past 30. We also included YRBS items about cigarette use and used a similar process to categorize adolescents as non-smokers, lifetime smokers, and current smokers. Parental use was evaluated by a yes/no response to a question about lifetime parental ECIG use. Peer use of ECIGs was assessed by asking participants how many of their 5 closest friends (scale of 0 to 5 friends) have tried an ECIG.

Intention to use ECIGs—Intention to use ECIGs was assessed via adolescents' responses to the item "Do you think you will use an ECIG before you graduate from high school?" (0 = no, 1 = yes). This item was adapted from the Smoking Self-Efficacy Scale (Lawrance et al., 1989).

Brief Sensation-Seeking Scale (BSSS)—The BSSS (Hoyle et al., 2002) is an 8-item measure of sensation-seeking ("I like wild parties"), scored on a 5-point Likert-type scale (1 = "strongly disagree" to 5 = "strongly agree"). Scores are averaged across items to create a total score; higher scores suggest higher levels of sensation-seeking. The BSSS demonstrated satisfactory internal consistency and convergent validity with other measures of sensation-seeking and youth reports of substance use (Hoyle et al., 2002). The BSSS possessed adequate internal consistency in the current sample (α = .76)

Mini International Personality Item Pool (Mini-IPIP)—The Mini-IPIP (Donnellan et al., 2006) is a 20-item measure of personality characteristics ("am the life of the party", "like order") that uses a 5-point Likert-type scale (1 = very inaccurate to 5 = very accurate). Responses are averaged across items to yield five subscale scores mapping onto the Big 5 personality traits: Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Intellect/Imagination. Higher scores indicate greater levels of a personality trait. Conscientiousness, Extraversion, and Neuroticism have demonstrated associations with cigarette use (Terracciano et al., 2008). In the current sample, the Neuroticism subscale demonstrated poor internal consistency (α = .45). The Extraversion and Conscientiousness subscales possessed good (α = .81) and questionable (α = .63) internal consistency, respectively, and were included in analyses.

Data Analysis

Analyses were conducted with IBM SPSS v24. Bartlett's test of sphericity (Bartlett, 1954) and Kaiser-Meyer-Olkin (Kaiser, 1974) were used to determine if the correlation matrix was appropriate for factor analysis. A common factor analysis with a direct oblimin rotation was conducted to determine the latent factor structure of the EESA (Fabrigar et al., 1999). Empirical Kaiser Criterion keying (Braeken & van Assen, 2017), visual inspection of the scree plot, and theoretical relevance were used to determine the number of factors to retain. Descriptive statistics performed before the EFA indicated that individual items were non-normally distributed; thus, an unweighted least squares extraction method was used due to its tolerance of non-normality (Briggs & MacCallum, 2003). Items with factor loadings ≤ .40 were examined for removal. The final factor structure was chosen based on four criteria (Watkins, 2018): (a) achieving simple structure (secondary factor loadings < .30) (Thurstone, 1947); (b) at least three items loading onto each factor; (c) internal consistency ≥ .70 for each factor; and (d) each factor being theoretically meaningful.

Confirmatory factor analysis (CFA) was used to examine measurement invariance for youth by ECIG use category (never vs. ever/current use) following guidelines outlined by Putnick and Bornstein (2016). Configural invariance, which indicates that the number of factors and pattern of loadings is the same between the two groups, was supported if the configural model demonstrated adequate fit (Root Mean Square Error of Approximation [RMSEA] ≤ .08, Comparative Fit Index [CFI] ≥ .90, Standardized Root Mean Square Residual [SRMR] = .08). Metric, scalar, and residual invariance were examined by comparing the two-group model with all free parameters (configural model) to a model with constrained loadings (metric), loadings and intercepts (scalar), and loadings, intercepts, and residuals (residual). Non-significant chi-square and absence of change in model fit statistics (RMSEA, CFI) were evidence of invariance.

Convergent validity was assessed using univariate analyses and regression models involving variables conceptually related to ECIG use and ECIG expectancies. In three linear regression models, demographic characteristics (age, gender), cigarette use, personality (extraversion, conscientiousness, sensation seeking), and social factors (parental and peer ECIG use) were regressed onto each of the three EESA subscales. One-way ANOVA (with Tukey's HSD post-hoc tests) was used to compare EESA subscales across levels of ECIG use (never users, lifetime ECIG use, past 30-day ECIG use). Then, four logistic regressions were used to predict intention to use ECIGs and the likelihood of ECIG use based on the EESA subscales, controlling for age, gender, and cigarette use. Models were run to predict intention to use ECIGs (yes vs. no), current ECIG versus nonuser, lifetime ECIG versus nonuser, and current ECIG versus lifetime ECIG use. Results were considered statistically significant at $p < .05$.

Results

Demographics/Descriptives

Table 1 displays descriptive statistics for demographics, academic characteristics, and ECIG and cigarette use. Recruitment site (clinic vs. school), grade in school, and peer and parent ECIG use were associated with ECIG use.

Exploratory Factor Analysis

A significant Bartlett's test of sphericity (X^2[903] = 18916.63, $p < .001$) indicated a non-random correlation matrix. The Kaiser-Meyer-Olkin statistic was 0.95, which is above the cut-off of .70 for sampling adequacy (Kaiser, 1974). Thus, the correlation matrix was deemed appropriate for factor analysis.

The Empirical Kaiser Criterion suggested a 7-factor solution was the appropriate number of factors to extract, while examination of the scree plot indicated a 3-factor solution would be most suitable; thus, 7- through 3-factor solutions were examined. A 7-factor solution was investigated first. When an adequate solution was not produced (i.e., not meeting all four criteria noted above), the factor analysis was conducted with one less factor and repeated until a final solution meeting all four criteria was found. The 7- and 6-factor solutions were rejected due to under-identified factors (i.e., < 3 items with loadings ≥ .40). The 3-, 4-, and 5-factor solutions included at least three items per factor but had items with secondary loadings ≥ .30. To address issues with cross-loadings, communalities and factor loadings for each factor solution were examined to potentially remove problematic items. An iterative approach was used when removing items that performed poorly; the EFA was re-run after removing an item to re-examine fit with the respective solution.

After reviewing the final scales, the 5- and 4-factor solutions were rejected because all items related to health costs (e.g., "Hurt your lungs") had been removed. The relative health risks of ECIGs compared to cigarettes are consistently associated with ECIG use (Wills et al., 2015); removing these items may threaten the overall content validity of the measure. Additionally, the variance accounted for in the 5- (64.45%) and 4- (61.28%) and 3-factors solutions (57.92%) were comparable. Therefore, the 5- and 4-factor solutions did not bestow statistical advantages. Four items with cross-loadings ≥ .30 were removed from the 3-factor solution, resulting in a 39-item measure, but items related to health costs were retained. Some items related to affective benefits and weight/appetite control were removed, but the final measure still included items related to these constructs (e.g., "Feel less bored," "Help you from overeating"). Therefore, the 3-factor solution was determined to have the best theoretical and statistical fit.

Factor loadings for the 3-factor solution (Table 2) ranged from 0.41 to 0.87, and were labeled as, "Costs," "Affective/Weight Benefits," and "Social Benefits." The Costs subscale (21 items) included items that reflected perceived health, addiction, social, appearance, and financial consequences associated with using an ECIG. The Affective/Weight Benefits subscale (11 items) reflected mood control, boredom reduction, and weight control associated with using an ECIG. Finally, the Social Benefits subscale (7 items) pertained to possible social advancement and positive appearances associated with using an ECIG (e.g., look more attractive, gain respect from your friends). The Costs subscale was not strongly associated with Affective/Weight Benefits ($r = 0.01$) or Social Benefits ($r = -0.10$), though Affective/Weight Benefits and Social Benefits were strongly correlated ($r = 0.50$).

Results from the two-group CFA indicated that the EESA has configural invariance based on ECIG use (X^2 [1332] = 2935.79, $p < .001$; RMSEA = .07 [95%CI = .06-.07]; CFI = .90; SRMR = .08). Additionally, results satisfied metric invariance (X^2 (36) = 46.07, $p = .12$;

ΔRMSEA = 0.003; ΔCFI=0.000) but not scalar invariance (X^2 (36) = 1334.37, $p < .001$; ΔRMSEA = 0.005; ΔCFI=0.085). Residual invariance was not examined as scalar invariance was not satisfied. Overall, this suggests that the factor structure and loadings of the EESA fit well for youth who had and had not use ECIG's and therefore support comparison of the EESA across ECIG user groups.

Reliability

Internal consistencies were excellent for the Costs (α = .97), Affective/Weight Benefits (α = .91), and Social Benefits (α = .88) subscales, and item-to-total correlations ranged from .49 to .84.

Convergent Validity

Three linear regressions were used to predict the EESA subscales (Table 3). Higher perceived costs of ECIG use were associated with identifying as male, higher levels of conscientiousness, lower levels of sensation seeking, and having fewer peers that tried ECIGs. Higher perceived Affective/Weight Benefits were associated with having smoked a cigarette at least once in their lifetime, lower levels of conscientiousness, higher levels of sensation seeking, and having more peers that tried ECIGs. Finally, higher perceived Social Benefits were associated with lower levels of conscientiousness and having more peers that tried ECIGs.

Table 1 displays descriptive statistics for the EESA subscales, conscientiousness, extraversion, sensation-seeking, peer ECIG use, and parental ECIG use. In results from one-way ANOVA's there were statistically significant differences in EESA subscales by ECIG use status (Table 1). Post-hoc tests revealed that all groups differed significantly on Costs (nonuser > lifetime user > current user) and Affective/Weight Benefits (current user > lifetime user > nonuser). Both current and lifetime user groups had higher Social Benefits scores than nonusers, but differences were not statistically significant.

Logistic regressions (Table 4) were used to predict intention to use ECIGs and ECIG use group based on EESA subscale scores. Higher perceived Costs was associated with reduced odds of intending to use and ECIG or being a lifetime ECIG user compared to nonuser, while higher perceived Affective/Weight Benefits was associated with increased odds of intending to use ECIGs or being a lifetime ECIG user compared to nonuser. The same pattern of results for Costs and Affective/Wiehgt Benefits was found for predicting current ECIG use compared to nonusers and for predicting current ECIG use compared to lifetime ECIG use.

Discussion

The current study examined the factor structure and initial psychometric properties of the *Electronic Cigarette Expectancy Scale for Adolescents* (EESA). An EFA produced three theoretically meaningful and conceptually distinct factors (Costs, Affective/Weight Benefits, Social Benefits) with strong item loadings, minimal cross-loadings, high internal consistency, and preliminary evidence of measurement invariance. EESA subscale scores also demonstrated convergent validity with a broad range of conceptually related

variables, including ECIG use, peer ECIG use, and trait-level factors of sensation-seeking, conscientiousness, and extraversion.

Comparison to the SESA

The SESA (Hine et al., 2007) has eight first-order subscales, split evenly between benefits (Affect Control, Social Benefits, Boredom Reduction, Weight Control) and costs (Appearance-Presentation Costs, Health Costs, Social Costs, Addiction), as well as two second-order factors (overall Benefits and Costs). The EESA factors more closely mirror these latter SESA factors, with two subscales for benefits (Affective/Weight Benefits and Social Benefits) and one for costs (combines appearance/presentation, health, social, and addiction factors). Also similar to that observed for the SESA (Hine et al., 2007), the EESA subscales had statistically significant associations with ECIG use and peer ECIG use. This overall pattern of results suggests that ECIG and cigarette expectancies are different yet related, as noted elsewhere (Morean & L'Insalata, 2017).

Comparison to Other ECIG Expectancy Measures

The EESA possesses similarities with other measures of ECIG expectancies. The EESA Social Benefits and Affective/Weight Benefits subscales mirror the Social Enhancement ("Become more popular"), Positive Social Expectancies ("ECIGs help me socialize"), Affect Regulation ("Feel less bored"), and Positive Internal Expectancies ("Feel more relaxed") subscales identified in young adults (Correa et al., 2019; Pokhrel et al., 2014) and adolescents (Cristello et al., 2020), as well as the Social Influences ("Be more popular") and Enjoyment ("Like it") subscales identified in adolescents and young adults (Barker et al., 2019; Cristello et al., 2020) using other measures. The consistent finding of subscales defined by social factors is not surprising; users often tout that ECIGs facilitate their interactions with others, are permissible in many locations, and engender less stigma than cigarette smoking (Soule et al., 2017; Soule et al., 2016). Some users also report that ECIGs help to relieve unpleasant states (e.g., stress, boredom) and to control their appetite (Harrell et al., 2019; Morean et al., 2019), similar to that for cigarette smoking (Mathew et al., 2014). Thus, social, affective, and weight benefits appear to be salient ECIG expectancies for both populations (Barker et al., 2019; Correa et al., 2019; Cristello et al., 2020; Pokhrel et al., 2014).

Interestingly, items related to affect and weight control loaded onto the same subscale, in contrast to other work (e.g., Cristello et al., 2020). Smoking to manage stress has been associated with decreased food intake and weight loss (Meule et al. 2018). Therefore, it may be that when adolescents perceive benefits in affect control they also perceive benefits in weight control, resulting in these items loading onto the same subscale. It should also be noted that items assessing positive (feel good) and negative (relax, stress relief) affect reinforcement loaded onto the same scale, which is congruent with other ECIG expectancies scales (Correa et al., 2019; Cristello et al., 2020). The pattern of results herein may be because only one item assessed positive affect reinforcement. However, future research should examine whether adolescents differentiate between positive and negative affective benefits.

Nonetheless, the EESA differs from ECIG expectancy measures in the number of costs subscales. Only a single cost subscale was identified for the EESA, consistent with two expectancy measures validated with adults (Correa et al., 2019; Morean & L'Insalata, 2017). However, other work has identified additional cost subscales (health, addiction, smoker association, social costs) in adolescents (Barker et al., 2019; Cristello et al., 2020) or adults (Pokhrel et al., 2014). Cross-study differences may be due to the types of items included in the measure. The EESA, for example, excludes items related to sensory experience (e.g., taste, smell, hand-to-mouth movement) and to cigarette smoking (e.g., ECIG use for cigarette cessation or harm reduction; look like a cigarette smoker). Differences also may be due to the tobacco use history of those sampled; rates of lifetime (18.1%) and current (7.8%) cigarette use were low relative to those in previous research (Barker et al., 2019; Pokhrel et al., 2014). Future qualitative work may help refine the items for the costs subscale on the EESA and other expectancy measures.

Importantly, results support previous work in that the Costs and Affective/Weight Benefits EESA subscales were associated with ECIG use, peer ECIG use, and sensation-seeking in the expected directions (Barker et al., 2019; Correa et al., 2019; Pokhrel et al., 2014). The Social Benefits EESA subscale was associated with ECIG use in univariate but not multivariable analyses. It may be that other variables (e.g., expectancies, concurrent cigarette use) are stronger predictors of ECIG use than Social Benefits. The average score on the Social Benefits subscale also was low relative to scores on the other EESA subscales, possibly impacting findings. Finally, results expand the literature by demonstrating associations between ECIG expectancies and conscientiousness, a risk factor for smoking initiation and progression (Kubicka et al., 2001; Terracciano et al., 2008; Zvolensky et al., 2015). Consistent with the literature on personality and risk-taking during adolescence (Gullone & Moore, 2000), less conscientious adolescents may perceive using ECIGs as less risky.

Strengths, Limitations, and Future Directions

Strengths of the current study include the adaptation of a previously validated measure for cigarette smoking expectancies, an approach used by others (Pokhrel et al., 2014), and a relatively large sample. We also used the recommended best practices for EFA to promote statistical validity and examined convergent validity with a variety of psychological and social variables, in addition to ECIG use. Limitations include the cross-sectional study design; predominantly white, rural/suburban, and academically successful sample; inability to assess discriminant validity; and limited assessment of ECIG use (e.g., quantity of use). Additionally, data were collected prior to the widespread use of pod/salt devices (e.g., Juul), and expectancies regarding these devices may be different. Future research should use nationally representative samples who use more current devices, examine discriminant validity, and further examination of measurement invariance for other sociodemographic and ECIF use groups (never vs. ever vs. current use). Confirmatory factor analysis for the EESA is also needed using a different sample.

Conclusions

The EESA is a valid and reliable measure of adolescents' expectancies of ECIG use. While the EESA used the same items as the SESA, albeit referencing ECIG rather than cigarette use, the factor structure is different from that reported by Hine and colleagues (Hine et al., 2007). This suggests that the EESA more accurately measures adolescents' expectancies of using an ECIG than the SESA's original factors. The EESA can help researchers obtain valid assessments of adolescents' beliefs around ECIG use and how these expectancies relate to ECIG use, which can inform messaging used in prevention and cessation interventions (e.g., highlighting the potential costs of ECIG use).

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Data Availability Statement:

The data that support the findings of this study are available from the corresponding author, PE, upon reasonable request.

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Table 1

Participant Demographics/Descriptives

		ECIG Use Group				
	Full Sample n = 567	Nonuser n = 343	Lifetime n = 123	Current n = 100		
Categorical Variables					***X²***	***p value***
Gender (% Female)	60.4	62.1	59.5	51.0	4.00	0.14
Race (%)					15.62	0.11
White	84.1	82.5	83.7	80.8		
Black	3.6	2.4	7.3	3.0		
Asian	4.1	5.3	2.4	2.0		
Hispanic	1.8	1.8	0.8	3.0		
Multiple	5.5	4.5	4.9	10.1		
Recruitment Site (%)					**5.33**	**0.07**
High School	90.4	92.4	85.4	91.0		
Clinic	9.5	7.6	14.6	9.0		
Grade in School (%)					**30.78**	**<.001**
9	12.9	16	4.9	12.1		
10	36.1	38.5	33.3	31.3		
11	30.8	32.1	30.1	27.3		
12	20.2	13.4	31.7	29.3		
Cigarette Use (%)					**209.98**	**<.001**
Nonsmoker	74.1	94.1	49.6	36.0		
Lifetime	18.1	5.0	40.7	35.0		
Current	7.8	0.9	9.8	29.0		
Parents used ECIG (% Yes)	16.1	9.1	23.0	32.0	**35.43**	**<.001**
Intend to use ECIG (% Yes)[a]	---	7.7%	---	---		
Continuous Variables					***F***	***p* value**
Age (years)	15.96 (.05)	15.76 (.06)	16.33 (.10)	16.17 (1.18)	**13.74**	**<.001**
IPIP						
Extraversion	3.13 (.04)	2.93 (.05)	3.57 (.09)	3.42 (.10)	**19.63**	**<.001**
Conscientiousness	3.40 (.03)	3.51 (.04)	3.30 (.07)	3.17 (.08)	**8.94**	**<.001**
BSSS	3.12 (.03)	2.93 (.04)	3.32 (.06)	3.52 (.06)	**37.59**	**<.001**
EESA						
Costs	4.69 (.11)	5.57 (.13)	3.85 (.20)	2.71 (.20)	**67.77**	**<.001**
Affective/Weight Benefits	2.58 (.08)	2.08 (.09)	3.06 (.17)	3.70 (.20)	**35.93**	**<.001**
Social Benefits	1.18 (.06)	0.87 (.07)	1.59 (.16)	1.75 (.18)	**19.4**	**<.001**
Friends who tried ECIG	2.96 (.08)	1.97 (.07)	4.22 (.16)	4.76 (.15)	**198.29**	**<.001**

Note:

[a] Intention to use ECIGs only assessed among non-users

Table 2

3-Factor Structure for the EESA

Items	General Costs	Affective / Weight Benefits	Social Benefits
1. Feel lethargic &/or unhealthy	**.86**		
2. Die prematurely	**.84**		
3. Get heart disease	**.83**		
4. Feel controlled by ECIGs	**.82**		
5. Have bad breath	**.82**		
6. Smell bad	**.82**	−.18	
7. Hurt your lungs	**.82**	.11	
8. Have a bade taste in your mouth	**.82**		
9. Stain your fingers & teeth	**.81**		
10. Get lung cancer	**.79**		−.11
11. Make it harder to quit	**.78**	.11	
12. Do serious damage to your health	**.77**	.13	−.15
13. Perform less well at sports	**.77**		
14. Become addicted to ECIGs	**.76**	.12	
15. Get hooked	**.72**	.26	−.12
16. Feel like an outsider	**.70**	−.15	.15
17. Become less popular	**.69**	−.13	
18. Have less spending money	**.68**	.14	
19. Lose respect of your friends	**.67**	−.13	
20. Lose the respect of your bro/sis	**.66**	−.18	
21. Become dependent on nicotine	**.56**	.23	−.11
22. Relax		**.85**	
23. Feel calm		**.78**	
24. Feel less stressed	−.14	**.75**	
25. Distract you from negative feelings		**.69**	.13
26. Feel good		**.65**	.20
27. Control or reduce anger		**.61**	.17
28. Help kill time		**.61**	
29. Feel less bored	−.11	**.58**	.14
30. Feel less weary	.18	**.52**	.14
31. Help you from overeating	.18	**.50**	
32. Control your weight	.19	**.41**	.19
33. Increase your status			**.87**
34. Look more attractive			**.81**
35. Gain respect from your friends			**.75**
36. Fit in better w/ your friends			**.73**
37. Gain respect of your bros/sis		.17	**.57**
38. Look cool	−.23		**.56**
39. Increase your probability of getting a bf/gf		.15	**.48**

Note: All factor loadings < .10 are hidden to improve readability.

Table 3

Linear Regressions Predicting EESA Subscales

	Costs			Affective/Weight Benefits			Social Benefits		
	β	***t***	***p***	**β**	***t***	***p***	**β**	***t***	***p***
Age	−0.016	−0.395	0.69	−0.052	−1.24	0.22	−0.029	−0.66	0.51
Gender[a]	**0.104**	**2.64**	**0.009**	−0.027	−0.66	0.51	0.041	0.98	0.33
Cigarette Status[b]	−0.049	−1.10	0.27	**0.131**	**2.83**	**0.005**	0.046	0.96	0.34
Extraversion	−0.021	−0.49	0.63	−0.074	−1.66	0.10	−0.03	−0.66	0.51
Conscientiousness	**0.098**	**2.40**	**0.017**	**−0.091**	**−2.17**	**0.031**	**−0.115**	**−2.66**	**0.008**
Sensation-Seeking	**−0.123**	**−2.71**	**0.007**	**0.205**	**4.38**	**<.001**	0.082	1.70	0.09
Parental ECIG Use[c]	0.066	1.62	0.107	0.017	0.40	0.688	−0.026	−0.61	0.54
Peer ECIG Use[d]	**−0.296**	**−6.44**	**<.001**	**0.202**	**4.27**	**<.001**	**0.239**	**4.89**	**<.001**
Model Statistics									
F	17.67		<.001	13.03		<.001	8.24		<.001
R^2	.21			.17			.11		

Note:

* $p < .05$;

** $p < .01$;

*** $p < .001$;

[a] Pearson's *r* correlations;

[b] Spearman's ρ correlation

Table 4

EESA Subscales Predicting ECIG use

			95% CI		
		OR	Lower	Upper	*p*
Intention to use ECIGs (REF = No)	**Costs**	**0.61**	**0.55**	**.068**	**< .001**
	Affective Benefits	**1.60**	**1.34**	**1.91**	**< .001**
	Social Benefits	0.99	0.81	1.21	0.91
Lifetime ECIG (REF = Never)	**Costs**	**0.73**	**0.65**	**0.81**	**<.001**
	Affective Benefits	**1.38**	**1.15**	**1.65**	**<.001**
	Social Benefits	1.05	0.86	1.29	0.53
Past 30 Day ECIG (REF = Never)	**Costs**	**0.53**	**0.46**	**0.62**	**<.001**
	Affective Benefits	**1.84**	**1.49**	**2.28**	**<.001**
	Social Benefits	0.94	0.75	1.18	0.59
Past 30 Day ECIG (REF = Lifetime)	**Costs**	**0.72**	**0.62**	**0.84**	**<.001**
	Affective Benefits	**1.34**	**1.11**	**1.62**	**0.003**
	Social Benefits	0.9	0.74	1.09	0.27

Controlled for: Age, Gender, Cigarette Status