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Development and validation of the nicotine vaping expectancy questionnaire: Item generation, scale construction, reliability and validity

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DEVELOPMENT AND VALIDATION OF THE NICOTINE VAPING EXPECTANCY QUESTIONNAIRE: ITEM GENERATION, SCALE CONSTRUCTION, RELIABILITY AND VALIDITY

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ABSTRACT

Over the past two decades, cigarette smoking has decreased among teenagers and young adults, but nicotine vaping has increased dramatically. Liquid vape products contain harmful chemicals ingested when vapor is inhaled, and vaping is associated with lung damage and chronic obstructive pulmonary disease. There has been relatively little research on nicotine vaping and effective prevention and intervention methods have yet to be developed. Changing expectancy processes has been successful in preventing early alcohol use and cigarette smoking, but little is known about nicotine vaping expectancies. An appropriately developed nicotine vaping expectancy measure is necessary to better understand vaping behavior and to provide a foundation for the development of effective prevention and intervention methods. In the present study, the Nicotine Vaping Expectancy Questionnaire (NVEQ) was developed using items collected from 8th graders, 12th graders, and college students. Exploratory and confirmatory factor analysis and Rash analysis were used to select items and create subscales. The NVEQ was found to have good internal consistency, test-retest reliability, convergent, discriminant, and predictive validity.

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One of the greatest joys you can obtain in life is when you find your passion and have people there to share it with. Thank you for being with me on this academic adventure.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

CFA: Confirmatory Factor Analysis
EC: Expectancy Challenge
EFA: Exploratory Factor Analysis
IRT: Item Response Theory
ICC: Item Characteristic Curve
ML: Maximum Likelihood
PCA: Principal Components Analysis

CHAPTER ONE: LITERATURE REVIEW

Among adolescents and young adults, 27.3% have reported use of electronic vaping devices while cigarette use in this group has fallen to 16.8% (Kramarow et al., 2021; NIDA, 2022; Harrell et al., 2023). Among middle school and high school students, nicotine vaping use is more prevalent (19.4%) than cigarettes (8.1%), with other forms of nicotine use lower than 5% (Gentzke et al., 2022). Nicotine vaping continues to be elevated compared to other nicotine consumption methods despite associations with acute lung damage and chronic obstructive pulmonary disease (Osei et al., 2020; Perrine et al., 2019; Pokhrel et al., 2018). Furthermore, adolescents and young adults continue to have elevated vape use compared to other age groups despite laws prohibiting the purchase of vape products by anyone under the age of 18, with some states raising the legal purchasing age to 21 years old (The Florida Legislature, 2023; NIDA, 2022). Vaping among young adults is also associated with initiation, persistence, and escalation of combustible cigarette smoking (Fadus et al., 2019), and college students continue vaping despite reporting motivation to quit and knowledge of associated harms (Fadus et al., 2019; Leventhal et al., 2020). Because of the sustained prevalence of nicotine vaping, research on variables associated with vaping is needed to develop effective prevention and intervention strategies.

The age of onset of nicotine vaping during the teenage years is similar to initiation of alcohol use and cigarette smoking (Brandon et al., 2019; Mittal et al., 2022; NIDA, 2022). Nicotine vaping onset among youth has been compared to that of smoking combustible cigarettes in that peer influence is the most common reason for onset (Fadus et al., 2019; Gentzke et al., 2022). Approximately 17% of children have experimented with vaping by 8th grade, and rates escalate rapidly between 10th and 12th grades (28.2% in 10th grade to 38.8% in 12th grade; NIDA, 2022). Meanwhile, only 8.1% of middle school and high school students have experimented with

smoking, and 1.5% are current smokers (Gentzke et al., 2022). In a longitudinal study of 11th and 12th graders, dual-use of cannabis and nicotine was most prevalent among frequent vapers (mean days a month=19.5), with the probability of dual vaping between 85% and 93% (Fadus et al., 2019; Lanza et al., 2020). Young adults (18-24 years old) are the largest population of vapers compared to the total adult population. Eleven percent of young adults report ongoing vaping of nicotine compared to 6.5% of those aged 25-44, and 2% of those over 45 (Kramarow et al., 2021; NIDA, 2022).

Vaping devices have been promoted as a nicotine replacement method for harm-reduction from cigarette use and as an aid for smoking cessation (Fadus et al., 2019; Harrell et al., 2023). Vaping devices rose in prevalence compared to smoking, with initial data in 2010 indicating that 19.5% of young adults smoked cigarettes and only 1.6% used vaping devices (CDC, 2023). By 2015, vaping had become more popular (20.2%) than cigarettes (17.5%) and has remained so (CDC, 2023). While vaping has been advertised as a form of harm reduction for cigarette smoking, many people who start vaping to reduce their cigarette intake remain dual users past their first year (Brandon et al., 2019; Lanza et al., 2020). People who vape nicotine report the belief that vaping is safer than smoking as influential in their decision to start vaping (Kim et al., 2020). However, the results of actual harms from vaping nicotine are still inconclusive (Perrine et al., 2019). Thus, nicotine vaping behaviors and the mechanisms that contribute to use must be further examined.

Nicotine vaping products hit the US market in 2007 and the prevalence did not surpass smoking until 2015, and popularity has consistently grown (CDC, 2023; Schraufnagel et al., 2014). Vaping nicotine is relatively new compared to other substance use behaviors, and as a result, the vaping literature lacks breadth and depth. The consistency of contributing factors

across different substances with abuse potential, however, suggests the same pattern will be found for vaping nicotine (Brockenberry et al., 2022; Kim et al., 2022). Research thus far has found vaping initiation to be associated with availability, peer use, and personality factors, similar to early use of alcohol and other drugs (Berg et al., 2019; Kim et al., 2022; Mittal et al., 2022). Young men are more likely to vape than women and young adults who identify as LGBTQ, particularly bisexuals report higher rates of vaping (Kim et al., 2022). Furthermore, lower socioeconomic populations and racial minorities report higher rates of vaping and have been targeted by advertisements for vape products, increasing their risk (Ma et al., 2022; NIDA, 2022; Venugopal et al., 2020). Emerging evidence confirms the conclusion that psychological distress, anxiety, and dual substance use are associated with vaping as they are with the use of other substances (Brockenberry et al., 2022; Kim et al., 2022; Zvolensky et al., 2023).

Consistent with research on other substances with abuse potential, it is difficult or currently impossible to address biological predispositions, socioeconomic factors, or personality traits to prevent vaping or effectively treat those who have been unable to stop vaping. Despite these difficulties, one approach that has been successful as a universal and targeted prevention strategy for alcohol use has been to focus on expectancies. Expectancy processes are changeable and have been conceptualized as a final common pathway for the influence of other variables on alcohol and substance use (Goldman, 2002). EC methods have been successful as alcohol prevention and intervention programs for elementary school students (Cruz & Dunn, 2003) and college students (Dunn et al, 2020, 2022; Fried & Dunn, 2012). Tobacco smoking expectancies are also modifiable using EC methods resulting in greater motivation to quit (Kaufmann et al., 2020). Targeting nicotine vaping expectancies has been suggested by several researchers based on the lack of effectiveness of smoking cessation methods to treat vaping (Berg et al., 2019;

Kaufmann et al., 2020). Thus, it is essential to understand the expectancies associated with nicotine vaping use.

A simple description of expectancies is that they represent knowledge about the perceived effects of a substance. For example, a basic expectancy for alcohol is that if someone drinks, they will feel more sociable. Simple if-then relationships, however, cannot describe the complexity of expectancy operation and its influence on behavior. Based on decades of research, a more thorough conceptualization of expectancies describes them as "multilayered neurobehavioral processes (Benitez & Goldman, 2019, p. 540)," and "anticipatory cognitive–memory processes" with a "neural substrate that might support such processes (Goldman & Darkes, 2004, p. 12)." Conceptualizing expectancies as a process that controls behavior has been the basis of "expectancy challenge" methods (EC) designed to change expectancy processes to change drinking behavior (see Darkes & Goldman, 1993, 1998; Dunn et al., 2000). Previous expectancy measures assessed expectancies using a memory model approach with items being developed from open-ended prompts (Brown, Christiansen, & Goldman, 1987; Dunn, & Goldman, 1996; Fromme, Stroot, & Kaplan, 1993). Thus, a nicotine vaping expectancy measure should be made similarly to theory.

Nicotine vaping expectancy measures have largely been adapted from the tobacco cigarette smoking literature (Brockenberry et al., 2022; Harrell et al., 2019), but modified smoking expectancy measures do not adequately capture unique aspects of vaping (Sharman et al., 2021). By simply modifying a smoking measure, researchers have not adequately addressed the unique characteristics of vaping likely to correspond to unique expectancies that differ from smoking. According to qualitative reports, there are distinct differences between expectancies of smoking a combustible cigarette compared to an e-cigarette or vape (Harrell et al., 2019). Some

dual users report vaping for different reasons than smoking combustible cigarettes, primarily citing the flavors and "tricks" of vaping (tricks included the ability to exhale large clouds of vapor; Harrell et al., 2019). Tricks were categorized under expectancies of "social benefits" because tricks were perceived as socially rewarding and facilitating social use. Vape flavor was labeled as a "positive reinforcement" expectancy which included sensorimotor reward and flavor. "Cognitive" expectancies associated with smoking nicotine focused on getting the "head high" which was not found to be a prevalent expectancy for vaping. These differences were specifically reported by those who smoke and vape (dual users) and were listed as reasons they chose one or the other.

A commonly cited measure used to assess combustible cigarette expectancies is the Smoking Consequences Questionnaire (SCQ; Brandon & Baker, 1991). The SCQ consists of four factors that were labeled negative consequences, positive reinforcement-sensory satisfaction, negative reinforcement-negative affect reduction, and appetite weight control (Brandon & Baker, 1991). A modified version of the SCQ (S-VCQ; Morean & L'Insalata, 2017) was evaluated for validity among vapers by simply changing the words to reflect vaping (e.g., cigarettes to e-cigarette; smoking to vaping). While results demonstrated good internal consistency (α = .89), development of this measure did not include the generation of new items that might be unique to vaping (Morean & L'Insalata, 2017). The SCQ has been modified numerous times to assess nicotine vaping expectancies, adding factors for urgency and persistence of use (Brockenberry et al., 2022), craving and cost (Harrell et al., 2015), and health consequences (Copeland et al., 2000). The result, however, is a mix of items and factors for smoking and vaping nicotine. A measure focused specifically on vaping expectancies developed

based on comprehensive item generation for vaping, followed by an EFA and CFA, would be a more appropriate empirical approach and would likely result in unique items and factors.

Other studies have examined nicotine vaping expectancies using different methods of measurement other than the SCQ. In a qualitative study, social benefits were commonly reported by nicotine vape users but not smokers (Harrell et al., 2019). Furthermore, some cultural norms of various forms of nicotine consumption (e.g., hookah which is viewed as safer) may impact nicotine expectancies and use (Kim et al., 2022). Assistance with smoking cessation is a common expectancy among vapers who intend to quit smoking cigarettes, and cessation is not reflected in smoking nicotine expectancy measures (Kaufmann et al., 2000). Furthermore, the same measures for nicotine smoking expectancies and nicotine vaping expectancies based on dual-use cannot be assumed to adequately represent nicotine vaping expectancies alone. As noted above, dual users have different expectancies for vaping and smoking. Also, expectancies of those who have never smoked, and expectancies of previous smokers do not align with expectancies of those who vape (Harrell et al., 2019). For example, vaping was described as fun by people who had never smoked, but previous smokers did not report vaping as fun (Harrell, et al., 2019). Vaping was also associated with passive sensorimotor use, but only among vapers who never smoked and non-users. (Harrell et al., 2019; Sharma et al., 2021). It was also noted that smoking measures do not strongly correlate with vaping behavior (Sharma et al., 2021). A meta-analysis of modified smoking expectancy measures found poor to moderate internal consistency when used to assess vaping (α = .47-.72; Sharma et al., 2021). Overall, the poor performance of modified smoking expectancy measures applied to vaping underscores the importance of development of a comprehensive measure of vaping expectancies to improve the validity of future research on vaping.

Previous nicotine smoking expectancy research suggests five factors represent the domain of nicotine expectancies (Copeland et al., 2000; Harrell et al., 2015; Kaufman et al., 2000). Because there have been no measures developed for nicotine vaping expectancies beginning with comprehensive item generation focused specifically on vaping nicotine, the number of factors for a nicotine vaping expectancy measure is unknown. To develop effective prevention and intervention EC methods for nicotine vaping, researchers must first identify nicotine vaping expectancies and develop a measure with sound psychometric characteristics.

Diversity Considerations

Individuals with minority status are at increased risk for vaping. Research suggests that certain sexual minorities, lower socioeconomic neighborhoods, and racial minorities such as Hispanic and African-American populations may be targeted by advertisements for vape usage (Ma et al., 2022; Venugopal et al., 2020). Furthermore, e-cigarette usage among LGBTQ populations, particularly individuals who identify as bisexual, is elevated compared to heterosexual norms (Ma et al., 2022; Kim et al., 2022). Some cultural norms of various forms of nicotine consumption such as hookah, which is viewed as safer, may impact nicotine expectancies and use (Kim et al., 2022). Similarly, different ethnic backgrounds may be more accepting of certain smoking products than others. Gender differences in reasons for smoking and vaping have also been observed. The most common reason for vaping among women is that it is “less harmful to others,” and “less harmful than cigarettes,” among men (Kim et al., 2022). Men are also more likely to use e-cigarettes than women (Kim et al., 2022). Elevated mental health concerns for individuals with minority status include psychological distress and issues with emotion regulation which are frequently tied to nicotine use, and one of the primary motivators for nicotine use is coping (Brockenberry et al., 2022). Furthermore, psychological

distress, anxiety, and suicide attempts are elevated among some minority groups and are also associated with nicotine vaping (Brockenberry et al., 2022; Kim et al., 2022; Zvolensky et al., 2023).

Present Study

Nicotine vaping expectancy measures have been created based on modified smoking measures, may not represent the entire domain of vaping expectancies, and have not accounted for as much variance in vaping behavior as expected (Sharma et al., 2021). An empirical approach to measure development is needed. The current study aimed to develop a new nicotine vaping expectancy measure starting with comprehensive item generation and exploratory factor analysis. Additional data was collected to confirm factor structure and assess test-retest reliability, convergent validity, discriminant validity, and predictive validity of the new measure of nicotine vaping expectancies.

The project was conducted in three phases: 1) item generation and initial data collection 2) EFA to develop the new nicotine vaping expectancy measure and Rasch analysis to assess item level functioning 3) CFA to evaluate test-retest reliability and validity (discriminant, convergent, & predictive) of the new scale.

Hypotheses:

1. EFA will result in a solution with an acceptable fit to the data.
    a. Subscales based on EFA will have good internal consistency.
2. CFA based on a new sample will validate the factor structure identified from the EFA.
    a. Subscales will have good internal consistency.
    b. Subscales will have good test-retest reliability.

c. The new nicotine vaping expectancy measure will have good convergent validity.

d. The new nicotine vaping expectancy measure will have good discriminant validity.

e. The new nicotine vaping expectancy measure will have good predictive validity.

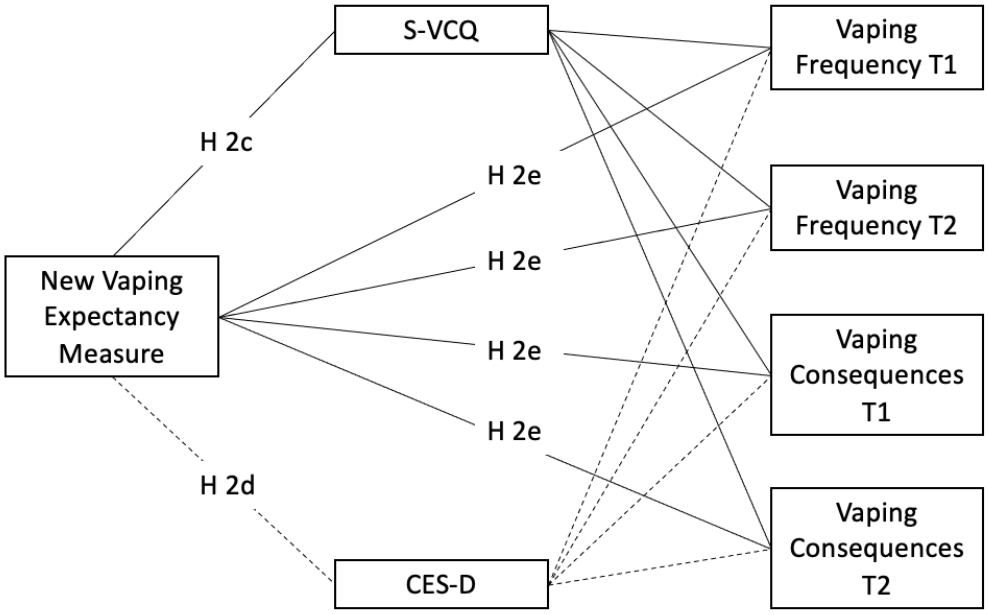


Figure 1: Hypotheses for Validity

CHAPTER TWO: METHOD

Participants

IRB approval was received before data collection began (APPENDIX B: UCF IRB LETTER). Phase 1 participants of 8th and 12th graders were recruited by Qualtrics and paid $6 for participation. Phase 2 participants were from a large public university in the southeast, and all were 18 years of age or older. Phase 2 participants were recruited through SONA and granted class credit for survey completion. Phase 3 participants were a mix of undergraduate college students from a large public university in the southeast recruited through SONA and national participants recruited through CloudResearch. SONA participants were granted class credit for both Survey 1 and Survey 2 while CloudResearch participants were granted $10 compensation for completion of both Survey 1 and Survey 2. All samples included vapers and non-vapers.

Phase 1: Item generation

Students in 8th grade (n=100), 12th grade (n=100), and college (n=429) responded to open-ended prompts asking them to describe their perceptions of the effects of vaping nicotine. College students were recruited from a large public university in the southeast through Qualtrics. The 8th and 12th grade students were a national sample recruited through Qualtrics. The Phase 1 sample was predominantly white (71.8%) and non-Hispanic (61%) with representation of black (10.7%) and Asian (8.5%) populations. This representation of racial demographics is comparable to that of young adults in the United States (US Census Bureau, 2022). Detailed demographic information and self-reported vaping behavior are presented in Table 1.

Phase 2: EFA and Measure Development

Items created from material collected in Phase 1 were administered to 862 undergraduate students from a large public university in the southeast who were recruited through SONA (see Table 1 for Demographics). The Phase 2 sample was predominantly white (71.8%) and non-

Hispanic (60.4%) with representation of black (9.4%) and Asian (7.3%) populations. This is moderately representative of the US population for college-aged students (US Census Bureau, 2022). An EFA was conducted on this sample to identify items for a new nicotine vaping expectancy measure.

Phase 3: CFA and Measure Validation

Data was collected from a new sample (n= 554) to conduct CFA and Rasch for the new expectancy measure. This sample was a combination of undergraduate college students from a large public university (n=504) in the southeast recruited through SONA and a national sample of young adults (n=50) recruited through CloudResearch. The Phase 3 sample was predominantly white (65.3%) and non-Hispanic (69.1%) with representation of black (12.2%) and Asian (11.4%) populations. Further demographic information is included in Table 1.

Procedure

Phase 1

Students in 8th grade, 12th grade, and college completed open-ended expectancy prompts online. A total of 453 participants completed Phase 1, but 24 cases were removed from the analysis due to inattentive responses. The end sample size for Phase 1 was 429 participants. Prompts asked how they think people feel after vaping nicotine (see APPENDIX C: ITEM GENERATION PROMPTS for list of prompts). Responses to prompts produced an initial pool of 325 nicotine vaping expectancy items. All items were reviewed by a team of four graduate students and a subject matter expert to identify items representing expectancy effects (not flavors or purely physical outcomes such as yellow teeth, etc.). A qualitative review of the items by age group revealed no substantive differences in expectancy items across grade level. A total of 128

items were retained from the initial item generation (APPENDIX E: NICOTINE VAPING EXPECTANCIES).

Phase 2

The 128 expectancy items retained in Phase 1 were administered to a new sample of college students who rated each item on how likely it would be for someone to experience that effect if they vaped nicotine. Participants also provided self-report data on their vaping frequency, and validity and attention checks were included throughout the survey. EFA was conducted on the Phase 2 data. Phase 2 data was prepared for analysis by removing cases with substantial amounts of missing data (>35%) or crucial items missing (i.e., vaping use, nicotine use, age). Cases with two or more items indicative of inattentive responding were removed. Students were also granted the option for their data to not be used resulting in these cases being removed. A total of 1,181 undergraduate college students completed the survey. 33 were removed due to substantial missing data, 3 were removed due to inattentive responding, and 283 requested we not use their data. There was a statistical difference in age for the included sample (M = 19.704, SD = 3.577) and the participants who requested we not use their data (M = 19.123, SD = 1.554; $t(1015) = 2.160$, $p < .001$). No other demographic variables were statistically different between the groups. The end sample size for Phase 2 was 826 participants.

Phase 3

Phase 3 data was collected to conduct CFA, test-retest reliability and predictive validity analyses. Two online surveys were completed at least 30 days apart. Survey 1 consisted of the following measures completed in order: new nicotine vaping expectancy scale, smoking expectancy measure modified for vaping in previous research (S-VCQ; Morean & L'Insalata, 2017), nicotine consequences (TANCS; Grigsby, 2019), a depression screening measure (CES-

D; Radloff, 1991), and self-report of nicotine vaping behavior. Survey 2 was accessible to participants 30 days after completing Survey 1 to assess test-retest reliability and predictive validity. Survey 2 consisted of the new vaping expectancy measure, a measure of nicotine consequences, and a self-report measure of vaping behavior. Validity and attention checks were included throughout Survey 1 and Survey 2. Students were also granted the option for their data to not be used resulting in these cases being removed. A total of 598 completed Survey 1 and Survey 2. Twelve cases were removed due to inattentive responding, 23 cases were removed due to missing data, and 13 requested we not use their data. The end sample size for Phase 3 was 554 participants.

Measures

Demographics: Self-report of race, ethnicity, sex at birth, gender, year in college, involvement in Fraternity and Sorority Life, and age (APPENDIX D: DEMOGRAPHIC QUESTIONS).

Nicotine Vaping Expectancy Scale: The new expectancy measure was developed by applying EFA to the 128 items generated in Phase 1 (see APPENDIX E: NICOTINE VAPING EXPECTANCIES). Item response format was a 4-point Likert scale ("Agree," "Slightly agree," "Slightly disagree," "Disagree."). A four-factor solution was optimal. The final scale consisted of four subscales based on the factors, and 31 items (additional details below). The total scale had good internal consistency ($\alpha = .921$) as did each subscale. The four subscales are Tension Reduction ($\alpha = .894$), Guilt and Regret ($\alpha = .941$), Dizzy/Disoriented ($\alpha = .952$), and Arousal ($\alpha = .881$). The measure has good test-retest reliability (see Table 6). Item removal and factor structure are further discussed in the methods section.

Comprehensive Effect of Alcohol (CEOA): The CEOA is a 38-item measure of alcohol expectancies which was used for discriminant validity (see APPENDIX F: COMPREHENSIVE EFFECTS OF ALCOHOL MEASURE; Fromme, Stroot, & Kaplan, 1993). This measure has good internal consistency (α = .859). Subscales include Sociability (α = .943), Tension Reduction (α = .789), Sexuality (α = .828), Liquid Courage (α = .912), Cognitive Behavioral Impairment (α = .904), Risk and Aggression (α = .812), and Self-Perception (α = .778).

Attention and Consistency of Responses: The Infrequency Scale (IER; Huang et al., 2015; see APPENDIX G: VALIDITY QUESTIONS) consists of 8 items that cannot be truthfully endorsed (e.g., "I work twenty-eight hours in a workday"). Four pairs of IER items were placed between measures. If 3 or more items were "True," the participant was removed from analysis due to inattentive responding.

Tobacco and Nicotine Consequences Scale (TANCS): The TANCS (Grigsby, 2019; see APPENDIX H: TOBACCO AND NICOTINE CONSEQUENCES SCALE) is a 17-item self-report scale. The scale has good internal consistency (α = .779), correlates with nicotine vape use (r = .331, p <.001). Tobacco and nicotine consequences were assessed to identify potential correlations between expectancies and consequences.

Short Form Vaping Consequences Questionnaire (S-VCQ): The S-VCQ (Morean & L'Insalata, 2017; see APPENDIX I: SHORT-VAPING CONSEQUENCES QUESTIONNAIRE) is a version of the commonly used Smoking Consequences Questionnaire (SCQ; Brandon & Baker, 1991) adapted to assess vaping expectancies. The S-VCQ was used to assess convergent validity. The measure has good internal consistency (α = .956) and has been used in previous vaping expectancy research (Morean & L'Insalata, 2017). Four nicotine expectancy factors of negative consequences (α = .932), positive reinforcement-sensory satisfaction (α = .964),

negative reinforcement-negative affect reduction (α = .954), and appetite weight control (α = .924) are included in this measure.

Center for Epidemiological Studies Depression Scale (CES-D): The CES-D (Radloff, 1991; see APPENDIX J: CENTER FOR EPIDEMIOLOGIC STUDIES DEPRESSION SCALE) is a measure of depressive symptoms and was used to assess discriminant validity. The measure has been used to demonstrate discriminant validity in the development of other expectancy measures (Stein et al., 2007; Torrealday et al., 2008). Internal consistency for the CES-D for alcohol consumers is good (α = .880), and the CES-D has been found to discriminate persons with depression from persons without depression among individuals with alcohol use disorder (Stein et al., 2007).

Self-reported Nicotine Use: This measure consisted of questions regarding the frequency of nicotine use during the previous 30-day period similar to the DDQ (Daily Drinking Questionnaire, Collins, et al., 1985) and nicotine devices for delivery (vaping, cigarettes, chewing tobacco, etc.;APPENDIX K: SELF REPORT NICOTINE VAPE USE). Lifetime use of tobacco and vaping products was assessed to account for variance in smoking history. Participants were asked the type of vaping product they use (i.e., vape pen, juul, e-cigarette, dab pen) and frequency of nicotine product use ranging from never to daily. A follow-up question asked how many times the participant vaped in a day if they selected daily use (range 1- 12 or more), and about lifetime exposure to nicotine (e.g., use of tobacco products).

Analysis Overview

Phase 2 data was used for the EFA. Primary analyses were conducted in RStudio and MPlus. An initial Principal Components Analysis (PCA) was conducted to examine the components and potential item reduction for the measure. PCA has been used to develop other

expectancy measures (Brown, Christiansen, & Goldman, 1987; Fromme, Stroot, & Kaplan, 1993; Leigh & Stacy, 1993) but recent literature recommends using PCA as an initial informative process and using Maximum Likelihood (ML) for the measure structure as PCA is not a form of factor analysis (Goretzko et al., 2019; Young & Pierce, 2013). Furthermore, measure development and factor structure results do not vary greatly whether using PCA or EFA with ML (Goretzko et al., 2019). An exploratory PCA was conducted to examine component structures and item communalities, and a subsequent EFA was conducted using ML to assess item removal.

An oblique rotation (direct oblimin) was applied because expectancy factors are rarely orthogonal. Parallel analysis of factor structures, interpretability of factors, number of items per factor, examination of scree plots, Eigenvalues over 1.00, and fit with expectancy theory and nicotine effects were used to determine the optimal factor structure. Items with a total item correlation value <.30 and factor loading < .45 were removed due to poor concurrent validity (Tabachnick & Fidell, 2001). Items with substantial cross-loading were considered for removal (.35 across two factors; Tabachnick & Fidell, 2001; Yong and Pearce, 2013) as well as items with <5% endorsement (Leigh & Stacy, 1993) due to poor construct representation. The item removal process is further described in the results. Factors with two or less items were removed from the model due to insufficient representation.

Model fit to the data was evaluated by Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA). Minimum CFIs and TLIs of .90 and an RMSEA value <.06 were used to indicate an acceptable model with good fit (Fabrigar et al., 1999; Hu & Bentler, 1999). These fit indices were chosen because they represent absolute and relative fit indices, indicate a stable fit even when sample size and loadings vary, and are

recommended in publications on measure development (Chen, 2007; Fabrigar et al., 1999). Last, Cronbach's alpha was used to assess internal consistency for each subscale.

A Rasch analysis was conducted on the Phase 2 data to examine item-level functioning within the proposed 4-factor model. Statistical testing was conducted in RStudio using a Generalized Partial Credit Model (GPCM) due to the scale response format of polytomous Likert items (Bond et al., 2021). The GPCM method was chosen as optimal for this analysis due to the partial credit to each item response and the ability to examine hierarchical response options. Item fit was examined through infit and outfit mean square (MNSQ), with values ranging from .5 to 1.5 indicating optimal fit (Bond et al., 2021). Items outside of this range were considered for removal based on poor functionality of the measure. Item Characteristic Curve (ICC) plots were made to demonstrate the predictability of item response for each item on each factor. ICC categorical response curve plots were made for each item to display the probability of each response option onto the proposed factor. Ideally, there should be unique curves with some overlap in response.

Phase 3 data was collected for the CFA and to test the relationship between nicotine vaping expectancies and vaping behaviors. A power analysis for the CFA with α =.05, RMSEA = .05, and 50 items indicated 469 participants would provide sufficient power. Another power analysis was conducted using an anticipated effect size of .51 based on previous literature (Brandon et al., 2019) on the relationship between vaping expectancies and vaping behavior, which resulted in a recommended sample size of 108. Thus, a sample of 500 participants was deemed sufficient. The CFA was conducted on Phase 3 data (Survey 1) to test the results of the EFA (factor loadings and goodness-of-fit expected to be similar). Measurement invariance of the new measure was tested across age, sex, and vaping behaviors by examining loadings within

each group for configural invariance. Factor structure and model fit were evaluated using the same approach as the EFA (see above). RMSEA of <.06 was used as the threshold for good fit.

Internal consistency was confirmed using Cronbach's alpha for each subscale. Similar scores to the EFA indicate good internal consistency.

Convergent validity was assessed by comparing the new measure (each subscale and the total score) to the S-VCQ (Morean & L'Insalata, 2017). Significant correlations were expected between expectancy measures and indicated good convergent validity.

Discriminant validity was evaluated by comparing the new expectancy measure to the CES-D (depression measure; Radloff, 1991) and the CEOA measure of alcohol expectancies (Fromme, Stroot, & Kaplan, 1993). A simple correlation matrix with variables from the CES-D, COEA, and the new nicotine vaping expectancies measure was conducted to assess discriminant validity.

Test-retest reliability was assessed by correlating subscale scores and the total score for the new expectancy measure from Survey 1 and Survey 2 data.

Predictive validity was assessed by evaluating the correlation between the new expectancy measure and the S-VCQ completed during Survey 1 (each subscale and the total score) and vaping and vaping consequences from Survey 2. Each subscale score and total score from the new expectancy measure from Survey 1 was entered into a simple regression to assess predictive validity of expectancies from Survey 1 to vaping behaviors in Survey 2.

CHAPTER THREE: RESULTS

Exploratory Analysis (H1)

The exploratory PCA produced very similar results to that of the EFA using ML, including that of item loading and factor structure. Communalities from the PCA were examined for scale structure and item utility (Table 2). An EFA using ML and oblique rotation was conducted with the 128 items from Phase 2 data to examine the factor structure of the nicotine vaping measure. The KMO results indicated great sampling adequacy (KMO = .962) and Bartlett's test of sphericity was significant (χ^2 (351) = 21609.591, p = .000). Results indicated a maximum of 8 factors based on eigenvalues greater than one, yet both the scree plot and proportion of variance accounted for indicated a factor range between 2-4 factors (Table 3).

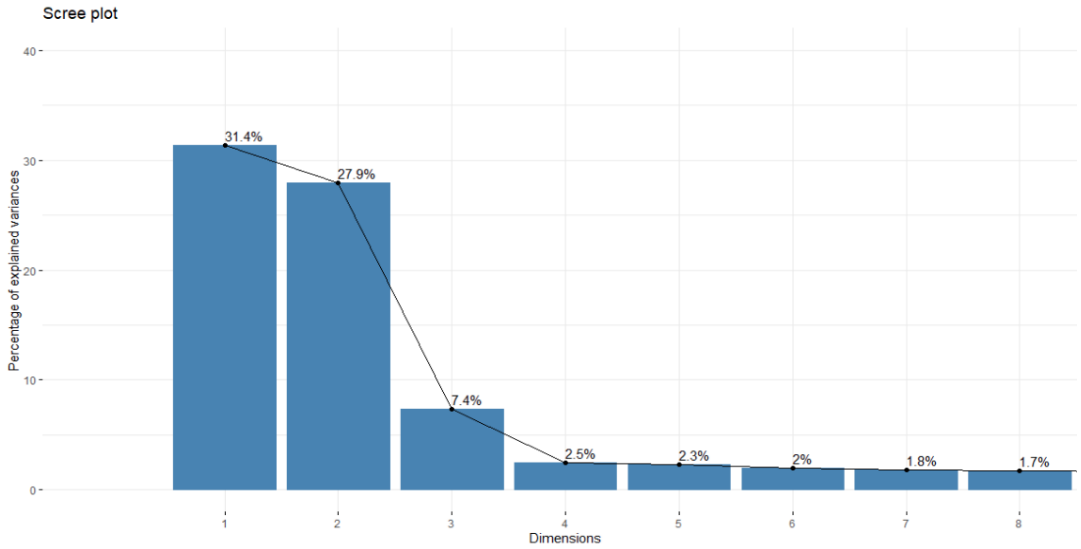


Figure 2: Scree Plot

A parallel analysis was conducted for 2-5 factors to assess item loading and structure. Based on variance accounted for, CFI/TLI, RMSEA, and theoretical construct appearance, a 4-factor structure was pursued. The 4-factor model emerged as optimal, demonstrating good fit compared to alternative factor structures (CFI = .945, TLI = .930, RMSEA = .051). The model had robust item loadings with strong associations.

During iterative item removal (Figure 3), each item that was considered for removal based on any statistical implications was also evaluated for content relevance. If an item was on the threshold for removal, did not significantly change the factor structure, and appeared to tap meaningful content, the item was kept. The 4-factor solution demonstrated robust item loading, no cross-loading, and good fit (Table 4).

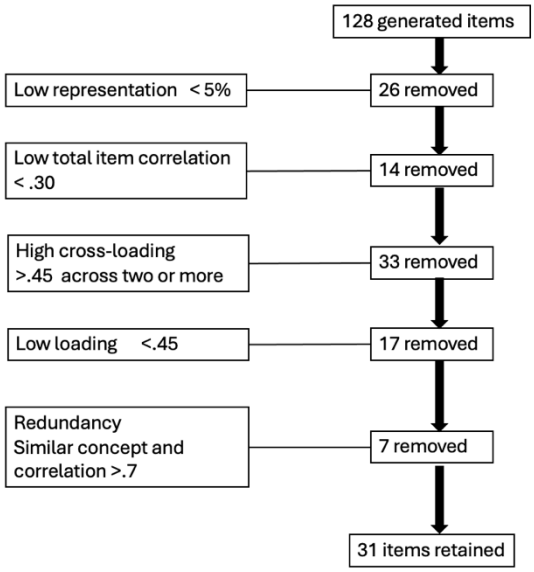


Figure 3: Item Removal Process

The result of the EFA was a 4-factor model including 31 items (CFI = .960, TLI = .948, RMSEA = .043). Cronbach's alpha coefficients were calculated for each subscale to determine internal consistency. The Tension Reduction subscale consisted of 8 items (α = .902), Guilt and Regret consisted of 9 items (α = .948), Dizzy/Disoriented consisted of 10 items (α = .953), and Arousal consisted of 4 items (α = .881). The total NVEQ includes 31 items (α = .890). Removal of any individual item would not improve internal consistency further.

The 4-factor model was deemed superior to the 3-factor solution because the 3-factor model may have excluded important aspects of nicotine vaping expectancies (e.g., foggy, ease tension, buzzed, etc.). Furthermore, the 4-factor model had better fit statistics (χ^2 (247) =

744.431, p = .001) compared to the 3-factor model (χ^2 (273) = 976.531, p = .001). The 5-factor structure was not considered the optimal model due to low proportion of variance and factor loadings less than .35 (Table 3).

Rasch Item Functioning

Rasch analysis revealed infit and outfit mean square (MNSQ) values which were within the range of .5-1.5, indicating items meaningfully contributed to the measure and responses were not overly unpredictable. All items had good metrics using the specified Rasch GPCM method. One item in particular, "foggy," was close to the threshold for unpredictable response patterns (Figure 4). Review of other fit indices including the ICC plots and MNSQ indicate the item is acceptable for inclusion.

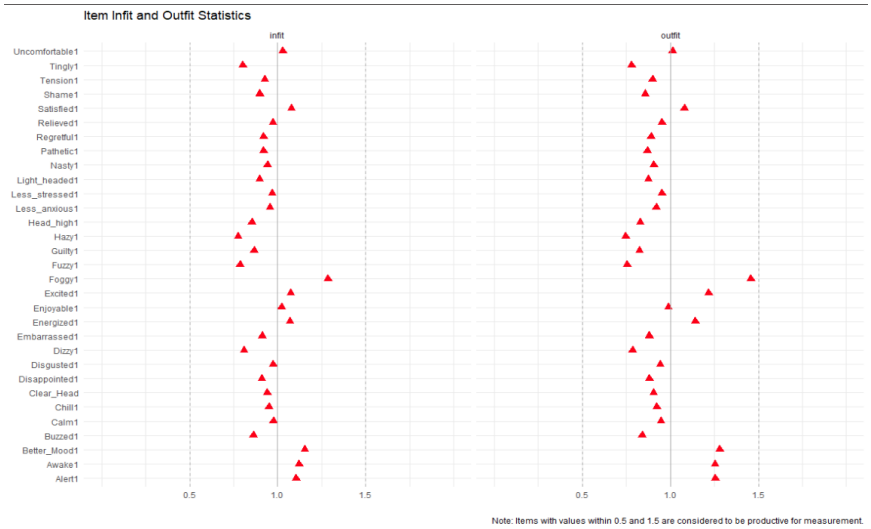


Figure 4: Infit and Outfit Range

The ICC plot illustrated that item responses for their proposed factor were consistent, with no overly unpredictable patterns or impairing overlap in item function. Curves on the ICC plot indicate that each of the included items fits well on their proposed factor and provides a meaningful contribution (

).

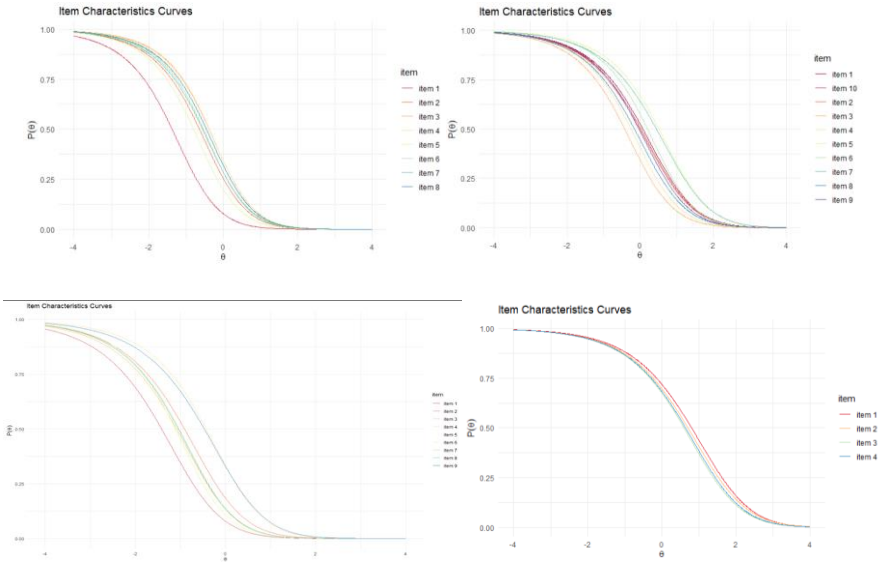


Figure 5: ICC Plots

Note: Upper left=Tension Reduction, upper right=Guilt and Regret, lower left=Dizzy/Disoriented, lower right=Arousal.

The ICC categorical response plots demonstrate that items had unique responses in alignment with their proposed factor (APPENDIX L: ICC PLOTS FOR ALL ITEMS). Figure 6 provides an example of adequate discrimination between levels of a trait. All items displayed adequate discrimination with some marked overlap in the middle-range response categories. The overlap in the middle-range response categories indicates these response options have a less distinct representation of the factor construct.

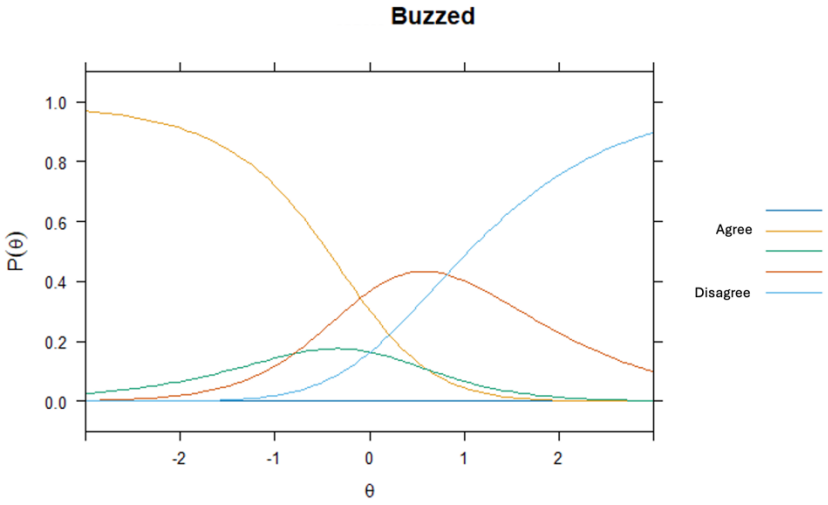


Figure 6: ICC Categorical Response Plot

Confirmatory Analysis (H2)

A CFA with an oblique rotation and 4-factor solution with the 31 items from the EFA was conducted. Results were like that of the EFA (CFI = .956, TLI = .941, RMSEA = .045) indicating good fit to the data. The CFI and TLI remained at satisfactory levels and the RMSEA slightly improved. Overall, the Phase 3 data supports the proposed 4-factor structure and Rasch analyses.

Internal consistency was assessed using Cronbach's alpha coefficients calculated for each subscale. Tension Reduction consisted of 8 items (α = .894), Guilt and Regret consisted of 9 items (α = .941), Dizzy/Disoriented consisted of 10 items (α = .951), and Arousal consisted of 4

items (α = .881). The total NVEQ includes 31 items (α = .921). Results indicate overall good to excellent internal consistency and are consistent with that of the EFA.

Convergent validity was assessed by correlating the subscales and total scale of the new nicotine vaping expectancy measure with the S-VCQ. The NVEQ showed moderate convergent validity with the S-VCQ (r = .449, p < .001) and its subscales (Table 5).

Discriminant validity was assessed by correlating the new nicotine vaping expectancy measure with the CES-D and CEOA. Subscale correlations with the CEOA subscales were low to moderate (Table 5), showing the relatedness and distinctiveness of alcohol and nicotine vaping expectancies. Results indicated good discriminant validity (Table 5).

Test-retest reliability was assessed by correlating the subscales and total scales from Phase 3 Survey 1 data and Survey 2 data. Correlations between the baseline and follow-up total score (r = .791, p < .001), Tension Reduction (r = .689, p < .001), Guilt and Regret (r = .766, p < .001), Dizzy/Disoriented (r = .750, p < .001), and Arousal (r = .711, p < .001) were statistically significant. Correlations between Survey 1 and Survey 2 indicate adequate test-retest reliability.

Predictive validity was assessed by evaluating the correlation between the S-VCQ, NVEQ, and Survey 2 vaping. Both the total scale and subscales from the NVEQ were significantly positively correlated with Survey 2 vaping behaviors (Table 6). The NVEQ was more strongly correlated with vaping behaviors at Survey 2 than the S-VCQ, indicating greater predictive validity. Vaping consequences were significantly correlated with the NVEQ and S-VCQ (Table 6). A simple regression of each subscale and total score of the NVEQ from Survey 1 and vaping behaviors in Survey 2 further indicated good predictive validity (R^2 = .327, F(1, 115) = 13.793, p < .001). Lastly, the NVEQ accounted for more variance in nicotine vaping behaviors than the S-VCQ (R^2 = .272, F(1, 110) = 9.507, p < .003).

CHAPTER FOUR: DISCUSSION

This study aimed to develop and validate a nicotine vaping expectancy measure. Youth continue to use nicotine vaping devices at a higher prevalence than cigarettes, and research on the associated harms of vaping is still inconclusive (Perrine et al., 2019; Pokhrel et al., 2018) EC intervention methods may be effective in reducing nicotine vaping (Berg et al., 2019; Kaufmann et al., 2020), making expectancies an important construct for examination. The current study developed a nicotine vaping expectancy measure starting with item generation rather than using items from a smoking measure. Developing a measure this way could lead to a better understanding of vaping expectancies which could lead to effective EC methods for nicotine vaping. Nicotine vaping expectancy items were developed using open-ended prompts, and items were selected based on a combination of PCA and EFA to construct an expectancy measure. Multiple previous alcohol expectancy measures relied on some combination of item generation, PCA, EFA, and CFA for measure development (Brown, Christiansen, & Goldman, 1987; Fromme, Stroot, & Kaplan, 1993 Leigh & Stacy, 1993). The current study followed a similar method to previous alcohol expectancy measure development using ML for the EFA to support findings from an exploratory PCA (Fabrigar et al., 1999; Fromme, Stroot, & Kaplan, 1993). By using a combination of previous methods and newer advanced statistical methods, we have made a new measure that is consistent with previous practice and modern advancements. Our results support previous findings (Goretzko et al., 2019) which stated that results from PCA and EFA are often similar, with no notable differences in structure or item inclusions.

The psychometric properties of the newly developed NVEQ are quite good. Each factor demonstrated excellent internal consistency and the EFA and CFA produced the same factor structure with similar goodness of fit measures. Furthermore, the Rasch analysis indicated each item on the measure made a meaningful contribution to the scale. The ICC categorical plots from

the Rasch analysis indicate that the 4-point Likert scale is not necessary for measurement of expectancies, and that a 2-point scale would suffice. This conclusion is drawn from the finding that the middle two response options (slightly agree, slightly disagree) did not demonstrate distinct response utility. Similar results have occurred for alcohol expectancies, resulting in the AEQ and AEQ-A using a 2-point Likert scale (Brown, Christiansen, & Goldman, 1987), and this is one of the most widely used alcohol expectancy measures. Expectancy measurement may benefit from similar assessments of item response using Rasch to identify optimum response formats rather than using a Likert scale by default. Previous expectancy measures have been improved by conducting Rasch analysis to assess interval-level measure properties and item bias (Macintosh, Earleywine, & Dunn, 2006). Research specifically examining the utility of the Likert scale format for expectancy measures was not found in a search of the published literature.

Convergent and discriminant validity of the NVEQ was acceptable. Correlations of NVEQ subscales with the S-VCQ were significant which demonstrates relatedness between similar constructs of expectancies (convergent validity). Discriminant validity was established by computing correlations between NVEQ subscales and the CES-D, a measure of depression. All correlations were non-significant except for the Dizzy/Disoriented subscale ($r=.141$, $p<.05$). This correlation is logical because this subscale may be picking up cognitive effects related to depression (i.e., confusion). Discriminant validity was further established with the CEOA with demonstrated small to moderate correlations. Test-retest validity was established through correlation of Survey 1 and Survey 2 and was adequate.

Predictive validity was assessed by computing correlations between NVEQ subscale scores and vaping behavior and consequences 30 days later. Correlations with vaping behavior were significant for all four subscales, and correlations were significant for three of the four

subscales in predicting consequences. Predictive validity was particularly good for the Guilt and Regret and Dizzy/Disoriented subscales. The simple regression of Survey 1 NVEQ predicting Survey 2 nicotine vaping use also indicated good predictive validity. Overall, the psychometric properties of the NVEQ support it as a reliable and valid instrument to assess nicotine vaping expectancies and predict vaping behavior and consequences.

The NVEQ items and constructs measured by four subscales varied from previous nicotine vaping expectancy measures. This may be attributed to the process used for item generation and inclusion. Item generation for the NVEQ used a prompt inquiring about "thoughts, feelings, behaviors" associated with nicotine vaping. Previous nicotine vaping measures did not begin measure development by generating new items. Instead, they adapted items from smoking expectancy measures, and as a result, they failed to include important aspects of nicotine vaping. Previous measures focused on aspects like cost, craving, tricks, and appetite suppression, while our measure demonstrated cognitive effects and mood are also important. Of the few initial items related to those constructs (i.e., cost, craving, tricks, appetite suppression), none passed the statistical cutoffs for relevance in more than 5% of the population and factor loading greater than .45. When examining the prevalence endorsement of the S-VCQ, several of these items did not pass the cutoffs, indicating these items may not be well suited for measuring nicotine vaping expectancies. This discrepancy may also contribute to the difference in the NVEQ constructs compared to that of the S-VCQ (i.e., appetite weight control and negative consequences constructs). Previous expectancy measures were developed using open-ended prompts for item generation or a combination of item generation and using preexisting items (Brown, Christiansen, & Goldman, 1987; Fromme, Stroot, & Kaplan, 1993; Leigh & Stacy, 1993), rather than solely working from created items or those of existing measures

(Morean & L'Insalata, 2017). Such differences in item development may have impacted the type of items included in an initial EFA. The NVEQ is in alignment with expectancy theory due to the process of item generation using open-ended prompts and item removal which was consistent with statistical recommendations and considerations of expectancy constructs.

While our measure demonstrates good psychometric properties, there were some limitations to the study. Firstly, appetite suppression is not represented in the NVEQ despite this being salient for smoking expectancies. As mentioned in item removal, none of the original 128 items which included appetite suppression or weight loss passed the thresholds of loading greater then .45 on a factor or were represented in less than 5% of the sample. This may indicate appetite suppression is not as prevalent for people who vape, or it might be age related as well. Furthermore, we did not have any participants under 18 years old in our validation analysis or older adults in item generation which may contribute to generalizability issues.

Clinical utility of this measure is to examine nicotine vaping expectancies in hopes of predicting future use and informing future intervention. Whether nicotine vaping is deemed harm reduction, safe, or harmful, examination of expectancies can be pivotal to any need for future intervention. Nicotine vaping expectancy research can provide insight on developing effective prevention, EC intervention, and treatment methods for nicotine vaping. Targeting nicotine vaping expectancies may be a more effective way to reduce vaping than smoking cessation methods (Berg et al., 2019; Kaufmann et al., 2020). This present study supports that nicotine vaping expectancies are predictive of nicotine vaping behaviors, and this measure can be used to inform future interventions.

Diversity Considerations

A core consideration of this measure development is the generalizability in utility. The sample is representative of the national population. Despite this representation, there were relatively few black and Hispanic individuals among children who participated in item generation. Previous research suggests that Hispanic and African-American populations may be targeted by vaping advertisements (Ma et al., 2022; Venugopal et al., 2020) which may impact their expectancies. Greater consideration should be put into this issue and future research would suggest a mixed-methods study to assess if expectancy item development would differ.

While our analyses did not assess for differences in expectancies among LGBTQ populations, future research would benefit from such considerations. In our data, there was no evidence of differences in expectancies based on sexual orientation. However, since LGBTQ populations have elevated use compared to heterosexual norms (Ma et al., 2022), expectancies and use should be further researched. Overall, we have developed a reliable and valid nicotine vaping measure which should be assessed for its utility among more diverse populations, particularly those with elevated use.

Ethical Considerations

All newly recruited participants in Phase 3 were at least 18 years of age and provided informed consent before data collection. Consent included information about mental health services for substance misuse and how data will be kept confidential. The current law in Florida is that one must be 21 and older to purchase or use nicotine products. Most of our sample was underage for legal use and purchase of nicotine products. No names or directly identifying information was collected. Archival data used from Phase 1 included minors, for which assent was received from participants and consent was received from parents. No directly identifying

information was collected on participants under 18 years old. Identifying information on participants 18 years and older was disconnected from the data and only used to give credit for participation and connect test-retest data. All identifying information was discarded after the Survey 1 and Survey 2 datasets were linked for test-retest and predictive validity analysis. This study was approved by the university IRB (APPENDIX B: UCF IRB LETTER).

APPENDIX A: TABLE

Table 1: Sample Demographics

		Phase 1			Phase 2	Phase 3	
		8th Graders	12th Graders	College Students	College Students	Survey 1	Survey 2
Sex		N(%)	N(%)	N(%)	N(%)	N(%)	N(%)
	Female	50(50%)	50(50%)	242(56.4%)	552(64%)	305(61.1%)	51(42.86%)
	Male	50(50%)	50(50%)	187(43.6%)	305(35.4%)	192(38.2%)	66(55.46%)
	Decline to respond				5(0.6%)	2(0.4%)	2(1.68%)
Gender Identity							
	Female			243(56.6%)	539(62.5%)	296(59.2%)	49(41.18%)
	Male			186(43.4%)	306(35.5%)	189(37.8%)	67(56.3%)
	Transgender				2(0.2%)	4(0.8%)	0(0%)
	Genderqueer				12(1.4%)	6(1.2%)	2(1.68%)
	Option not listed				1(0.1%)	4(0.8%)	1(0.84%)
	Decline to respond				2(0.2%)	1(0.2%)	0(0%)
Race							
	White	67(67%)	62(62%)	324(75.5%)	619(71.8%)	345(69%)	61(51.26%)
	Black	12(12%)	12(12%)	35(8.2%)	81(9.4%)	46(9.2%)	29(24.36%)
	Asian	3(3%)	15(15%)	32(7.5%)	63(7.3%)	53(10.6%)	17(14.29%)
	Native Hawaiian/Pacific Islander	1(1%)	0(0%)	2(0.5%)	4(0.5%)	2(0.4%)	0(0%)
	American Indian/Alaska Native	2(2%)	3(3%)	1(0.2%)	3(0.3%)	1(0.2%)	0(0%)
	Multiple Races	9(9%)	5(5%)	19(4.4%)	44(5.1%)	39(7.8%)	9(7.56%)
	Other	6(6%)	3(3%)	16(3.7%)	48(5.6%)	14(2.8%)	2(1.68%)
Ethnicity							
	Hispanic	43(43%)	35(35%)		255(29.6%)	159(31.8%)	29(24.36%)
	Non-Hispanic	57(57%%)	65(65%)		605(70.2%)	340(68%)	90(75.63%)
Age		M(SD)	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)
		13.65(0.80)	17.34(0.82)	20.25(3.66)	19.17(3.59)	20.05(3.57)	22.86(2.07)

Note: Ethnicity data was not collected among college students in Phase 1 due to an error in data collection.

Table 2: Total Communalities

Item	α
Lightheaded	0.518
Fuzzy	0.646
Hazy	0.67
Buzzed	0.558
Tingly	0.629
Foggy	0.666
Dizzy	0.705
Head High	0.605
Shame	0.666
Uncomfortable	0.613
Disappointed	0.688
Pathetic	0.689
Nasty	0.724
Guilty	0.755
Disgusted	0.746
Embarrassed	0.656
Regretful	0.703
Enjoyable	0.728
Clear Headed	0.689
Calm	0.767
Less Stressed	0.695
Less Anxious	0.684
Better Mood	0.735
Relieved	0.749
Ease Tension	0.712
Chill	0.708
Satisfied	0.631
Awake	0.735
Energized	0.767
Alert	0.662
Excited	0.685

Table 3: Factor Variance

	1	2	3	4	5
SS Loading	6.46	4.18	3.42	6.55	1.00
Proportion Variance	0.21	0.13	0.11	0.21	0.03
Cumulative Variance	0.21	0.42	0.55	0.66	0.70

Table 4: Pattern Matrix

	TR	GR	DD	Ar
Lightheaded	-0.021	0.067	**-0.731**	0.139
Fuzzy	0.087	0.039	**-0.771**	0.016
Hazy	0.017	0.124	**-0.780**	0.031
Buzzed	0.216	-0.170	**-0.704**	-0.023
Tingly	0.119	-0.078	**-0.736**	-0.108
Foggy	-0.099	0.151	**-0.762**	-0.007
Dizzy	-0.069	0.074	**-0.817**	0.036
Head High	0.179	-0.132	**-0.727**	-0.019
Shame	0.131	**0.888**	0.023	0.086
Uncomfortable	-0.315	**0.736**	0.215	0.008
Disappointed	0.074	**0.847**	-0.007	0.054
Pathetic	-0.016	**0.822**	0.011	-0.06
Nasty	-0.045	**0.814**	-0.056	0.059
Guilty	0.145	**0.934**	0.043	0.054
Disgusted	-0.085	**0.842**	-0.007	0.008
Embarrassed	-0.054	**0.789**	-0.016	-0.108
Regretful	0.056	**0.880**	0.050	-0.014
Enjoyable	**0.694**	-0.120	-0.062	-0.177
Clear Headed	**0.756**	0.086	0.047	-0.181
Calm	**0.867**	0.007	-0.040	0.007
Less Stressed	**0.862**	0.066	0.005	0.013
Less Anxious	**0.874**	0.108	0.021	0.032
Better Mood	**0.684**	0.051	-0.040	-0.222
Relief	**0.798**	0.006	-0.013	-0.095
Ease Tension	**0.831**	0.064	-0.089	0.01
Chill	**0.824**	-0.021	-0.126	0.001
Satisfied	**0.676**	-0.118	-0.017	-0.119
Awake	0.181	0.007	-0.003	**-0.751**
Energized	0.081	-0.032	-0.021	**-0.838**
Alert	0.095	-0.013	0.056	**-0.821**
Excited	0.161	-0.046	0.032	**-0.755**

Note: TR=Tension Reduction, GR=Guilt and Regret, DD=Dizzy/Disoriented, Ar=Arousal

Table 5: Bivariate Correlations of NVEQ Total Score and Subscales

	NVEQ	TR	GR	DD	Ar
S-VCQ	.449**	.298**	.504**	-.080*	.437**
Neg Con	0.075	.215**	.161**	-0.261**	.134**
Pos Reinf	.457**	.211**	.466**	0.071	.406**
Neg Reinf	.532**	.248**	.578**	0.018	.474**
Appetite	.333**	.231**	.386**	-.178**	.358**
CEOA	.253**	.376**	.283**	-.250**	.296**
Soc	.361**	.320**	.313**	-.206**	.288**
TR	.290**	.226**	.348**	-.123**	.304**
LC	.298**	.272**	.261**	-.151**	.289**
Sex	.311**	.205**	.308**	-0.028	.354**
CB	0.65	.325**	.143**	-.356**	.145**
Agg	.196**	.229**	.203**	-.104**	.242**
SP	-0.051	.123**	0.032	-.277**	0.059
CES-D	-0.2	-0.265	-0.255	.141**	-0.266

Note: *p < .05. **p < .01. Neg Con=negative consequences, Pos Reinf=positive reinforcement, Neg Reinf=negative reinforcement, Appetite=appetite/weight management. Soc=sociability, TR=tension reduction, LC=liquid courage, Sex=sexuality, CB=cognitive behavioral, Agg=aggression, SP=self-perception. Note: TR=Tension Reduction, GR=Guilt and Regret, DD=Dizzy/Disoriented, Ar=Arousal

Table 6: Test-Retest Reliability Bivariate Correlations

	NVEQ T1	TR T1	GR T1	DD T1	Ar T1
NVEQ T2	.791**	-	-	-	-
TR T2	-	.689**	-	-	-
GR T2	-	-	.766**	-	-
DD T2	-	-	-	.750**	-
Ar T2	-	-	-	-	.711**

Note: TR=Tension Reduction, GR=Guilt and Regret, DD=Dizzy/Disoriented, Ar=Arousal

Table 7: Predictive Validity Bivariate Correlations

	Tension Reduction	Guilt & Regret	Dizzy/Disoriented	Arousal	NVEQ	S-VCQ
Vaping T2	0.271*	0.492**	.327*	.435**	.458**	.182*
Consequences T2	.126*	.264**	0.147*	.396**	.262**	.317*

Note: TR= Tension Reduction, GR=Guilt and Regret, DD=Dizzy/Disoriented, Ar=Arousal

APPENDIX B: UCF IRB LETTER AND VERIFICATION

UNIVERSITY OF CENTRAL FLORIDA

Institutional Review Board
FWA00000351
IRB00001138
Office of Research
12201 Research Parkway
Orlando, FL 32826-3246

EXEMPTION DETERMINATION

October 29, 2019

Dear Mark Crisafulli:

On 10/29/2019, the IRB determined the following submission to be human subjects research that is exempt from regulation:

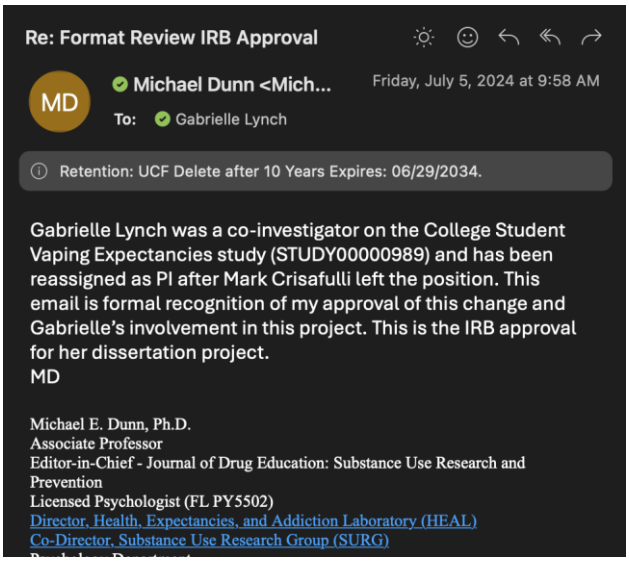
Type of Review:	Initial Study, Exempt Category
Title:	College Student Vaping Expectancies
Investigator:	Mark Crisafulli
IRB ID:	STUDY00000989
Funding:	None
Grant ID:	None

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made, and there are questions about whether these changes affect the exempt status of the human research, please contact the IRB. When you have completed your research, please submit a Study Closure request so that IRB records will be accurate.

If you have any questions, please contact the UCF IRB at 407-823-2901 or irb@ucf.edu. Please include your project title and IRB number in all correspondence with this office.

Sincerely,

Kamille Chaparro
Designated Reviewer



Re: Format Review IRB Approval

MD

Michael Dunn <Mich...

Friday, July 5, 2024 at 9:58 AM

To: Gabrielle Lynch

Retention: UCF Delete after 10 Years Expires: 06/29/2034.

Gabrielle Lynch was a co-investigator on the College Student Vaping Expectancies study (STUDY00000989) and has been reassigned as PI after Mark Crisafulli left the position. This email is formal recognition of my approval of this change and Gabrielle's involvement in this project. This is the IRB approval for her dissertation project.
MD

Michael E. Dunn, Ph.D.
Associate Professor
Editor-in-Chief - Journal of Drug Education: Substance Use Research and Prevention
Licensed Psychologist (FL PY5502)
Director, Health, Expectancies, and Addiction Laboratory (HEAL)
Co-Director, Substance Use Research Group (SURG)

APPENDIX C: ITEM GENERATION PROMPTS

Prompts for item generation

In the space below report all of the positive experiences (thoughts, feelings, behaviors) you have, or you imagine you would have, when you vape nicotine?

In the space below report all of the negative experiences (thoughts, feelings, behaviors) you have, or you imagine you would have, when you vape nicotine?

APPENDIX D: DEMOGRAPHIC QUESTIONS

Age: _____ years old

What is your gender identity: Male Female Trans Genderqueer Option not listed_____ Decline

What is your biological sex? Male Female Decline

What year are you in school? FRESHMAN SOPHOMORE JUNIOR SENIOR

Which answer best describes your race? (Please select the best answer) White Black Asian American Indian or Alaskan Native Native Hawaiian or other Pacific Islander More Than One Race Other:_____

Which answer best describes your ethnicity? (Please select the best answer) Hispanic Non-Hispanic

Are you currently a member of a fraternity or sorority? (circle one) YES NO

APPENDIX E: NICOTINE VAPING EXPECTANCIES

The following section assesses what you would expect to happen <u>if you were vaping nicotine</u>.

<u>If you do not vape nicotine,</u> please answer questions based on your beliefs, knowledge, and understanding of the effects of vaping nicotine.

Circle one option from disagree to agree – depending on whether you expect the effect to happen to you if you were <u>under the influence of nicotine</u> These effects will vary, depending on the concentration of nicotine.

<u>This is not a personality assessment</u>. We want to know what you expect to happen if you were to vape nicotine, not how you are when you are sober. Example: If you are always emotional, you <u>would not</u> circle agree as your answer unless you expected to become MORE EMOTIONAL if you vaped nicotine.

I would feel domed	disagree	slightly disagree	slightly agree	agree
I would feel small	disagree	slightly disagree	slightly agree	agree
I would feel content	disagree	slightly disagree	slightly agree	agree
I would lose focus	disagree	slightly disagree	slightly agree	agree
It would help me fit in	disagree	slightly disagree	slightly agree	agree
I would feel frustrated	disagree	slightly disagree	slightly agree	agree
I would feel refreshed	disagree	slightly disagree	slightly agree	agree
I would feel lightheaded	disagree	slightly disagree	slightly agree	agree
I would be confused	disagree	slightly disagree	slightly agree	agree
I would be high	disagree	slightly disagree	slightly agree	agree
I would feel satisfying	disagree	slightly disagree	slightly agree	agree
I would feel shame	disagree	slightly disagree	slightly agree	agree
I would feel accepted	disagree	slightly disagree	slightly agree	agree
I would be uncomfortable	disagree	slightly disagree	slightly agree	agree
It would make me sleepy	disagree	slightly disagree	slightly agree	agree

I would be productive	disagree	slightly disagree	slightly agree	agree
I would be carefree	disagree	slightly disagree	slightly agree	agree
I would feel Stimulated	disagree	slightly disagree	slightly agree	agree
I would be disoriented	disagree	slightly disagree	slightly agree	agree
I would feel soothed	disagree	slightly disagree	slightly agree	agree
I would feel powerful	disagree	slightly disagree	slightly agree	agree
I would feel Warm	disagree	slightly disagree	slightly agree	agree
I would be lazy	disagree	slightly disagree	slightly agree	agree
I would feel Popular	disagree	slightly disagree	slightly agree	agree
I would feel energized	disagree	slightly disagree	slightly agree	agree
I would forget my problems	disagree	slightly disagree	slightly agree	agree
I would get annoyed	disagree	slightly disagree	slightly agree	agree
I would feel relieved	disagree	slightly disagree	slightly agree	agree
I would feel light	disagree	slightly disagree	slightly agree	agree
It would ease tension	disagree	slightly disagree	slightly agree	agree
I would be chill	disagree	slightly disagree	slightly agree	agree
I would feel disappointed	disagree	slightly disagree	slightly agree	agree
I would feel heavy	disagree	slightly disagree	slightly agree	agree
It would make me nervous	disagree	slightly disagree	slightly agree	agree
I would be in pain	disagree	slightly disagree	slightly agree	agree
It would clear my head	disagree	slightly disagree	slightly agree	agree

I would be sensitive	disagree	slightly disagree	slightly agree	agree
I would feel Rejuvenated	disagree	slightly disagree	slightly agree	agree
I would feel a rush	disagree	slightly disagree	slightly agree	agree
I would be scared	disagree	slightly disagree	slightly agree	agree
I would become dependent	disagree	slightly disagree	slightly agree	agree
I would feel unconcerned	disagree	slightly disagree	slightly agree	agree
I would feel bold	disagree	slightly disagree	slightly agree	agree
I would be impulsive	disagree	slightly disagree	slightly agree	agree
I would feel sick	disagree	slightly disagree	slightly agree	agree
It would be fun	disagree	slightly disagree	slightly agree	agree
I would feel calm	disagree	slightly disagree	slightly agree	agree
I would feel Slow	disagree	slightly disagree	slightly agree	agree
I would feel nauseated	disagree	slightly disagree	slightly agree	agree
I would fidget less	disagree	slightly disagree	slightly agree	agree
I would feel less stressed	disagree	slightly disagree	slightly agree	agree
I would be careless	disagree	slightly disagree	slightly agree	agree
I would feel angry	disagree	slightly disagree	slightly agree	agree
It would make me alert	disagree	slightly disagree	slightly agree	agree
It would help me focus	disagree	slightly disagree	slightly agree	agree
I would be jumpy	disagree	slightly disagree	slightly agree	agree
I would feel tired	disagree	slightly disagree	slightly agree	agree

I would feel hyper	disagree	slightly disagree	slightly agree	agree
I would feel less anxious	disagree	slightly disagree	slightly agree	agree
I would feel pathetic	disagree	slightly disagree	slightly agree	agree
I would be happy	disagree	slightly disagree	slightly agree	agree
I would be comfortable	disagree	slightly disagree	slightly agree	agree
I would feel numb	disagree	slightly disagree	slightly agree	agree
I would be mature	disagree	slightly disagree	slightly agree	agree
It would make me fuzzy	disagree	slightly disagree	slightly agree	agree
It would make me hazy	disagree	slightly disagree	slightly agree	agree
I would feel anxious	disagree	slightly disagree	slightly agree	agree
I would feel relaxed	disagree	slightly disagree	slightly agree	agree
It would make me jittery	disagree	slightly disagree	slightly agree	agree
I would feel Smooth	disagree	slightly disagree	slightly agree	agree
I would lash out	disagree	slightly disagree	slightly agree	agree
I would be at peace	disagree	slightly disagree	slightly agree	agree
I would feel good	disagree	slightly disagree	slightly agree	agree
It would be enjoyable	disagree	slightly disagree	slightly agree	agree
I would feel ashamed	disagree	slightly disagree	slightly agree	agree
I would feel buzzed	disagree	slightly disagree	slightly agree	agree
I would feel tingly	disagree	slightly disagree	slightly agree	agree
It would make me restless	disagree	slightly disagree	slightly agree	agree

I would feel depressed	disagree	slightly disagree	slightly agree	agree
I would feel productive	disagree	slightly disagree	slightly agree	agree
I would feel addicted	disagree	slightly disagree	slightly agree	agree
I would feel paranoid	disagree	slightly disagree	slightly agree	agree
I would be on edge	disagree	slightly disagree	slightly agree	agree
I would feel excited	disagree	slightly disagree	slightly agree	agree
I would feel nasty	disagree	slightly disagree	slightly agree	agree
It would relieve my problems	disagree	slightly disagree	slightly agree	agree
I would feel gross	disagree	slightly disagree	slightly agree	agree
I would feel guilty	disagree	slightly disagree	slightly agree	agree
I would be funny	disagree	slightly disagree	slightly agree	agree
I would feel panicked	disagree	slightly disagree	slightly agree	agree
I would feel free	disagree	slightly disagree	slightly agree	agree
I would feel sad	disagree	slightly disagree	slightly agree	agree
I would feel crazy	disagree	slightly disagree	slightly agree	agree
My body would tingle	disagree	slightly disagree	slightly agree	agree
I would be embarrassed	disagree	slightly disagree	slightly agree	agree
I would be fuzzy	disagree	slightly disagree	slightly agree	agree
I would be tired	disagree	slightly disagree	slightly agree	agree
I would feel dizzy	disagree	slightly disagree	slightly agree	agree
I would feel stressed	disagree	slightly disagree	slightly agree	agree

I would lose feeling	disagree	slightly disagree	slightly agree	agree
I would be elated	disagree	slightly disagree	slightly agree	agree
I would feel secure	disagree	slightly disagree	slightly agree	agree
It would make me cool	disagree	slightly disagree	slightly agree	agree
I would feel disgusted	disagree	slightly disagree	slightly agree	agree
I would be in a better mood	disagree	slightly disagree	slightly agree	agree
I would feel fulfilled	disagree	slightly disagree	slightly agree	agree
I would feel skinnier	disagree	slightly disagree	slightly agree	agree
I would feel foggy	disagree	slightly disagree	slightly agree	agree
I would feel bliss	disagree	slightly disagree	slightly agree	agree
I would be dizzy	disagree	slightly disagree	slightly agree	agree
I would be regretful	disagree	slightly disagree	slightly agree	agree
I would feel fatigued	disagree	slightly disagree	slightly agree	agree
I would feel awake	disagree	slightly disagree	slightly agree	agree
I would be stressed out	disagree	slightly disagree	slightly agree	agree
I would feel energized	disagree	slightly disagree	slightly agree	agree
I would get a head high	disagree	slightly disagree	slightly agree	agree

APPENDIX F: COMPREHENSIVE EFFECTS OF ALCOHOL MEASURE

The following section assesses what you would expect to happen <u>if you were under the influence of alcohol</u>.

If you do not drink alcohol, please answer questions based on your beliefs, knowledge, and understanding of the effects of alcohol.

Circle one option from disagree to agree – depending on whether you expect the effect to happen to you if you were <u>under the influence of alcohol</u>. These effects will vary, depending upon the amount of alcohol you typically consume.

1=disagree 2=slightly disagree 3=slightly agree 4=agree

<u>This is not a personality assessment</u>. We want to know what you expect to happen if you were to drink alcohol, not how you are when you are sober. Example: If you are always emotional, you <u>would not</u> circle agree as your answer unless you expected to become MORE EMOTIONAL if you drank.

<u>If I were under the influence of alcohol</u>:

1. I would be outgoing
2. My senses would be dulled
3. I would be humorous
4. My problems would seem worse
5. It would be easier to express my feelings
6. My writing would be impaired
7. I would feel sexy
8. I would have difficulty thinking
9. I would neglect my obligations
10. I would be dominant
11. My head would feel fuzzy
12. I would enjoy sex more
13. I would feel dizzy
14. I would be friendly
15. I would be clumsy
16. It would be easier to act out my fantasies
17. I would be loud, boisterous, or noisy
18. I would feel peaceful
19. I would be brave and daring
20. I would feel unafraid
21. I would feel creative
22. I would be courageous
23. I would feel shaky or jittery the next day
24. I would feel energetic
25. I would act aggressively
26. My responses would be slow
27. My body will be relaxed
28. I would feel guilty
29. I would feel calm
30. I would feel moody
31. It would be easier to talk to people
32. I would be a better lover
33. I would feel self-critical
34. I would be talkative
35. I would act tough

36. I would take risks
37. I would feel powerful
38. I would act sociable

APPENDIX G: VALIDITY QUESTIONS

Check Items: Bogus/Infrequency Items

Huang, Bowling, Liu, & Li (2014)

Table 1 Confirmatory factor analysis for the eight-item IER Scale for *Study 1*

	M	SD	Loading
1. I can run 2 miles in 2 min	0.16	0.36	0.81***
2. I eat cement occasionally	0.11	0.31	0.97***
3. I can teleport across time and space	0.16	0.37	0.93***
4. I am interested in pursuing a degree in parabanjology	0.16	0.36	0.87***
5. I have never used a computer	0.10	0.29	0.96***
6. I work fourteen months in a year	0.15	0.35	0.82***
7. I will be punished for meeting the requirements of my job	0.17	0.37	0.80***
8. I work twenty-eight hours in a typical work day	0.02	0.13	0.44*

$N = 284$

* $p < 0.05$; *** $p < 0.001$. Standardized loadings are shown

APPENDIX H: TOBACCO AND NICOTINE CONSEQUENCES SCALE

All items below were answered with Yes or No, and if yes participants were asked to indicate the number of times in the past month they have experienced each item.

Tobacco and Nicotine Consequences Scale (TANCS)
Please consider the past 30 days.
Because of my smoking or vaping…

1. I have put myself into life-threatening situations
2. I have had to steal to pay for more cigarettes or vape products
3. I have had to sell my own belongings to pay for more cigarettes or vape products
4. I have found it difficult to limit how much I smoke or vape
5. I have ended up smoking or vaping when I didn't plan to
6. I have felt bad about myself
7. I have been unhappy
8. I have felt guilty or ashamed
9. I spend too much time trying to get more tobacco or nicotine products
10. I have not eaten properly
11. I haven't been as sharp mentally
12. I have not had as much time to pursue activities
13. I have lost motivation to do things
14. I have felt embarrassed when smoking or vaping in public
15. I have been rude or obnoxious towards others while smoking or vaping
16. I have said things while smoking or vaping that I have later regretted
17. I have caused shame or embarrassment to others

APPENDIX I: SHORT-VAPING CONSEQUENCES QUESTIONNAIRE

Below is a list of statements about vaping. Each statement contains a possible consequence of vaping. For each of the statements below, please rate how LIKELY or UNLIKELY you believe each consequence is for you when you vape. **If you have never vaped**, you are to answer according to your personal beliefs about the consequences when vaping, regardless of what other people might think.

If the consequence seems UNLIKELY to you, circle a number from 0 to 4. If the consequence seems LIKELY to you, circle a number from 5 to 9. That is, if you believe that a consequence would never happen, circle 0; if you believe a consequence would happen every time you vape, circle 9. Use the guide below to aid you further. For example, if a consequence seems completely likely to you, you would circle 9. If it seems a little unlikely to you, you would circle 4.

Please circle your answer to each question using the scale below.

Vapes tastes good.....0 1 2 3 4 5 6 7 8 9
Vaping controls my appetite.....0 1 2 3 4 5 6 7 8 9
Vapes help me deal with anxiety or worry.....0 1 2 3 4 5 6 7 8 9
I enjoy the taste sensations while vaping.....0 1 2 3 4 5 6 7 8 9
Vaping helps me deal with depression.....0 1 2 3 4 5 6 7 8 9
Vapes keep me from overeating.....0 1 2 3 4 5 6 7 8 9
Vapes help me deal with anger.....0 1 2 3 4 5 6 7 8 9
When I vape the taste is pleasant.....0 1 2 3 4 5 6 7 8 9
I will enjoy the flavor of a vape.....0 1 2 3 4 5 6 7 8 9
I will enjoy the feeling of a vape on my lips.....0 1 2 3 4 5 6 7 8 9
By vaping, I risk heart disease and lung cancer.....0 1 2 3 4 5 6 7 8 9
Vapes help me reduce or handle tension.....0 1 2 3 4 5 6 7 8 9
Vaping helps me control my weight.....0 1 2 3 4 5 6 7 8 9
When I'm upset with someone, a vape helps me cope.....0 1 2 3 4 5 6 7 8 9
The more I vape, the more I risk my health.....0 1 2 3 4 5 6 7 8 9
Vapes keep me from eating more than I should.....0 1 2 3 4 5 6 7 8 9
Vaping keeps my weight down.....0 1 2 3 4 5 6 7 8 9
Vaping is hazardous to my health.....0 1 2 3 4 5 6 7 8 9
Vaping calms me down when I feel nervous.....0 1 2 3 4 5 6 7 8 9
When I'm angry a vape can calm me down.....0 1 2 3 4 5 6 7 8 9
Vaping is taking years off my life.....0 1 2 3 4 5 6 7 8

APPENDIX J: CENTER FOR EPIDEMIOLOGIC STUDIES DEPRESSION SCALE

Center for Epidemiologic Studies Depression Scale (CES-D)
Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week.

Answer scale:
1=Rarely or none of the time (less than 1 day)
2=Some or a little of the time (1-2 days)
3=Occasionally or a moderate amount of time (3-4 days)
4=Most or all of the time (5-7 days)

1. I was bothered by things that usually don't bother me.
2. I did not feel like eating; my appetite was poor.
3. I felt that I could not shake off the blues even with help from my family or friends.
4. I felt I was just as good as other people.
5. I had trouble keeping my mind on what I was doing.
6. I felt depressed.
7. I felt that everything I did was an effort.
8. I felt hopeful about the future.
9. I thought my life had been a failure.
10. I felt fearful.
11. My sleep was restless.
12. I was happy.
13. I talked less than usual.
14. I felt lonely.
15. People were unfriendly.
16. I enjoyed life.
17. I had crying spells.
18. I felt sad.
19. I felt that people dislike me.
20. I could not get "going."

APPENDIX K: SELF REPORT NICOTINE VAPE USE

Have you ever used an electronic vapor product containing nicotine (i.e., e-cigarette, juul, dab pen, etc.)? (Choose one)

- Yes
- No

Have you ever used a tobacco product?

- Yes
- No

If you vape, what electronic vapor product do you generally use?

- E-Cigarette
- Juul
- Vape Pen
- Dab Pen

What substances have you vaped (check all that apply)?

- Just Flavoring
- Nicotine
- THC/Cannabis
- Not sure
- Other

When you vape, what substance do you usually use?

- Just Flavoring
- Nicotine
- THC/Cannabis
- Not sure
- Other

If yes, how often do you use an electronic vapor product containing nicotine (i.e., e-cigarette, juul, dab pen, etc.)? (Choose one)

- Never vaped
- Less than 4 times in life
- Vape 1 or 2 times a year
- Vape 3 to 8 times a year
- Vape 1 or 2 times a month
- Vape once a week
- Vape twice a week
- Vape 3 times a week
- Vape 4 times a week
- Vape almost every day
- Vape every day

(If they said vape almost every day, or vape every day)

On days that you use an electronic vapor product containing nicotine, how often do you use it?

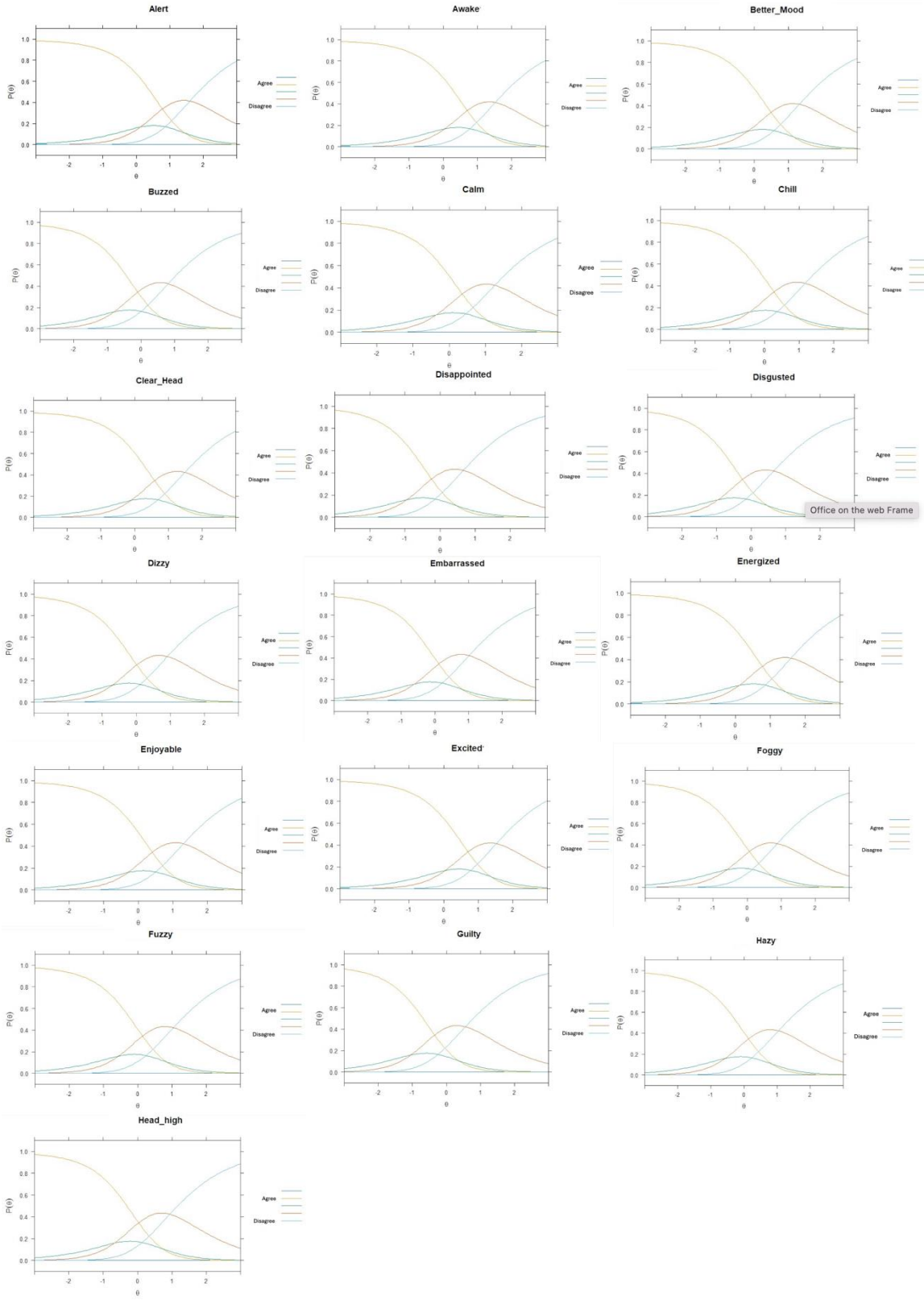
- 1 time

- 2 times
- 3 times
- 4 times
- 5 times
- 6 times
- 7 times
- 8 times
- 9 times
- 10 times
- 11 times
- 12 or more times a day

First think of a **typical week** in the past 30 days. Where did you live? What were your regular weekly activities? How did you spend your free time, etc. After getting a good picture of that time in your life, remember as accurately as you can, on *which days of the week*, and *how long* you used an electronic vapor product **containing nicotine** (i.e., e-cigarette, juul, etc.). How many times a day did you vape during this time in a typical week? Then for each day of a **typical week** in the last 30 days, select the days in the calendar below during which you vaped, and write in the number of hours you vaped.

Days of Week	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
Number of Times Per Day							
Hours Per Day							

APPENDIX L: ICC PLOTS FOR ALL ITEMS


Alert
Awake
Better_Mood
Buzzed
Calm
Chill
Clear_Head
Disappointed
Disgusted
Dizzy
Embarrassed
Energized
Enjoyable
Excited
Foggy
Fuzzy
Guilty
Hazy
Head_high
P(θ)
θ
Agree
Disagree
Office on the web Frame

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