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UNIVERSITY OF CALIFORNIA, MERCED

Perceptions of Nicotine Addiction: Scale Development

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor
of Philosophy

in

Psychological Sciences

by

Allison A. Temourian

Committee in charge:

Professor Anna V. Song, Chair
Professor Anna E. Epperson, co-Chair
Professor Sarah Depaoli

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The Dissertation of Allison A. Temourian is approved, and it is acceptable in quality and form for publication on microfilm and electronically:

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- **Temourian, A. A.**, Song, A. V., Halliday, D. M., Gonzalez, M., & Epperson, A. E. (2022). Why do smokers use e-cigarettes? A study on reasons among dual users. *Preventive Medicine Reports, 29*, 101924.
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Abstract of the Dissertation

Existing literature examining perceptions of nicotine addiction are largely surface level questions or fail to align with diagnostic criteria of tobacco use disorder. The disentanglement of the physical, psychological, and social components of nicotine addiction are needed to better understand what addiction means to people. Understanding how the lay person views and thinks about nicotine addiction may provide insight into non-smokers initiation intentions, smokers consumption habits, and quit intentions. This study developed and validated a novel scale assessing perceptions of nicotine addiction that comprehensively aligns with the clinical dimensions of nicotine addiction. To establish the scale's construct validity, this study utilized cognitive interviews for item development, exploratory and confirmatory factor analysis and psychometric evaluation for scale development, and assessed convergent, discriminant, and criterion validity for scale evaluation. The proposed scale returned adequate diagnostics using psychometric evaluation and its construct validity was established using three assessments of validity. The findings from this study suggest that perceptions of nicotine addiction may not align with clinical dimensions of addiction, and that public health education efforts should focus on the experiences of addiction rather than emphasizing the consequences of addiction.

Chapter 1: Introduction

Prevalence of tobacco use remains problematic (World Health Organization, 2022) and epidemiologically, one of the most common addictions (Diehl & Scherbaum, 2008; Grant et al., 2004; McCrabb et al., 2019) with 85% of daily smokers and 44% of non-daily smokers meeting the diagnostic criteria of addiction (Oliver & Foulds, 2021). Other health consequences associated with tobacco use are well documented, including chronic pulmonary obstructive disorder, various cancers, cirrhosis, and even death (Centers for Disease Control and Prevention, 2020a). Despite decades of research demonstrating the consequences of nicotine addiction, many people (including those with diagnosed substance use disorder/addiction) are unsuccessful in their initial attempts to quit smoking (Quisenberry et al., 2019).

Therefore, it is important to understand the duality of nicotine addiction: 1) not only can addiction lead to negative health outcomes, but 2) addiction is an outcome/disorder that pervades one's social, physical, emotional, and psychological well-being. Thus far, most research has adopted the view of the former and emphasizes the consequences of addiction. This is evidenced by the definition of addiction utilized by the National Institute on Drug Abuse (2018) that classifies addiction as a chronic, relapsing disorder characterized by compulsive drug seeking, continued use despite harmful consequences and long lasting-changes in the brain.

Faced with declining cigarette consumption as a result of strong tobacco control measures, tobacco companies are increasingly promoting alternative methods of nicotine consumption. These products are presented as "risk reductive" primarily because they are reported to allow a consumer to avoid negative consequences of combustion which includes inhalation of particles and hydrocarbons that can cause severe tissue damage (California Air Resources Board, n.d.). However, these alternative products have been shown to hold their own risk (Centers for Disease Control and Prevention, 2023) and do not reduce the harm of addiction itself.

The Rise of E-cigarettes

Whereas cigarette use is at an all-time low (SAMHSA & Office of the Surgeon General, 2020), electronic-cigarette (e-cigarette) use has been steadily climbing (Dai & Leventhal, 2019; Obisesan et al., 2020). As of 2021, an estimated 11.5% of U.S. adults currently use traditional, combustible cigarettes and 4.5% use e-cigarettes (Cornelius et al., 2023), making these two products the most common methods of nicotine consumption (World Health Organization, 2023). Given the changing landscape of tobacco use over the past decade, it is probable that cigarette use may no longer be the prototype of nicotine use for most people; e-cigarette use will be the prototype, particularly among younger generations (United States Department of Health and Human Services, 2016).

Over the past decade, e-cigarettes have garnered much attention from researchers and lay people alike. Initially touted as a cessation tool for combustible cigarette users (United States Department of Health and Human Services, 2016), e-cigarette use has permeated into other groups, including people who have never used combustible cigarettes before (Barrington-Trimis et al., 2016; Bunnell et al., 2015; Schneider & Diehl, 2016). Existing research suggests that most perceive e-cigarettes to be less addictive than traditional cigarettes (Maglia et al., 2018; Perry et al., 2023). Although the addictive

component of tobacco products is nicotine, dual users report fundamental differences in their addictions to cigarettes and e-cigarettes, despite the fact that they both contain nicotine (Morean et al., 2018). However, much of the current research assessing people's perceptions of addiction to e-cigarettes are in comparison to combustible cigarettes (Temourian et al., under review). Thus, it is difficult to meaningfully understand how people perceive nicotine addiction to e-cigarettes as this measure is dependent upon the measure of cigarette addiction. Moreover, assessments of perceptions of nicotine addiction must be distinguished from diagnostic measures of nicotine addiction as the former assesses people's beliefs surrounding addiction whereas the latter assesses addictive behavior.

Nicotine Addiction in Clinical vs Research Settings

There is a large divide in the diagnosis of nicotine addiction between clinicians and researchers. From a clinical standpoint (American Psychiatric Association, 2013), manifestation of tobacco use disorder (i.e., addiction) involves experiencing at least two of 11 dimensions within a 12-month period, with more dimensions experienced equating to more severe addiction. These 11 dimensions include: (1) consuming substance in larger amounts or over a longer period than intended, (2) a persistent desire or unsuccessful efforts to reduce or control substance use, (3) a great deal of time is spent in activities necessary to obtain or use substance, (4) craving of substance, (5) recurrent substance use resulting in failure to fulfill major role obligations, (6) continued substance use despite persistent or recurrent social or interpersonal problems caused or exacerbated by the effects of the product, (7) important social, occupational, or recreational activities are given up or reduced because of substance use, (8) recurrent substance use in physically hazardous conditions, (9) continued substance use despite knowledge and experience of psychological or physical harm associated with substance use, (10) tolerance of substance, and (11) withdrawal from substance.

In contrast, researchers classify others' nicotine addiction using a variety of scales including the Nicotine Dependence Syndrome Scale (NDSS; Shiffman et al., 2004), the 12-item Cigarette Dependence Scale (Etter et al., 2003), or, more commonly, the Fagerström Test for Nicotine Dependence (FTND; Heatherton et al., 1991). The FTND and NDSS are ubiquitous in psychological research, yet items found in these scales are not aligned with clinical guidelines, let alone each other. The FTND determines addiction severity based on items such as the amount of tobacco consumed per day and how quickly after waking one smokes. Conversely, the NDSS assesses addiction severity based on a host of items, including questions related to tolerance and reduced social activity in order to smoke. Though both the FTND and NDSS have been validated to assess addiction severity in research settings, these scales fail to comprehensively align with the dimensions set forth by clinicians (i.e., DSM V). Moreover, there is no overlap in items between the FTND and NDSS, making it difficult to compare scores to one another. The incongruity in measurement of addiction severity and lack of emphasis on how people *conceptualize* addiction has led to a cursory understanding of what addiction means for the lay person, potentially contributing to the detriment of public health.

Theoretical Frameworks

Many theories including the Common Sense Model (Leventhal et al., 1980), Health Belief Model (Becker, 1974), and the Theory of Planned Behavior (Ajzen, 1991),

posit that perceptions are not only critical in understanding health behavior, but that the negative consequences of these health behaviors remain undesired and are generally avoided.

The Health Belief Model argues that one's adoption of a behavior is reliant upon their personal threat assessment and belief in the effectiveness of a recommended health behavior. However, this model fails to account for habitual behavior which informs the decision-making process to adopt a recommended action (i.e., quit smoking). In works examining nicotine addiction using a Health Belief Model framework (Becker, 1974), most of the focus is on perceived susceptibility, with little attention dedicated to perceived severity, benefits, barriers, and self-efficacy. The Theory of Planned Behavior (Ajzen, 1991) posits that behavioral outcomes are contingent upon both motivation and perceived control. However, when assessing motivation, the Theory of Planned Behavior fails to account for other important factors, like threat appraisal. To determine whether developing nicotine addiction is viewed as a threat, measuring perceptions of nicotine addiction as a construct can highlight one's appraisal of severity and susceptibility of its related consequences. Little research has utilized the Common Sense Model to pertain to nicotine addiction. Empirical works investigating tobacco use using the Common Sense Model focus on understanding health consequences such as lung cancer and other diseases, and do not focus on addiction (Browning et al., 2009).

Across these theoretical frameworks is the idea that people work to minimize negative consequences and avoid disease. None of these theories specifically identify addiction as a disease or negative outcome, even if there are negative consequences associated with addiction. In this regard, understanding the construct of nicotine addiction under a threat appraisal framework might help people better understand the cognitive decision-making process for nicotine use.

Threat Appraisal

Perceptions of risk are equivalent to a person's assessment of a threat. Despite decades of research investigating tobacco addiction and its manifestation, researchers have a surprisingly cursory understanding of what addiction looks like to the lay person. For example, does the lay person think that the only sign of nicotine addiction is craving tobacco? Or is a sign of nicotine addiction a confluence of multiple behaviors; if so, what are those problematic behaviors? To assess one's susceptibility of becoming addicted to nicotine as well as their severity, researchers must first understand how the lay person appraises these singular behaviors. Emerging research must align clinical and psychological research to understand the complexity of nicotine addiction to emphasize the importance of risk perceptions and their role in predicting behavior. Thus far, the prioritization of understanding the impact of perceptions of nicotine addiction in line with clinical frameworks has been lacking. Of the empirical works addressing this gap, measures have been surface level items that fail to address the complexity of nicotine addiction (Temourian et al., under review).

Current Assessment of Perceptions of Nicotine Addiction

Single item assessment of perceptions of nicotine addiction are extremely varied between researchers; with select items assessing comparative addictiveness between tobacco products and illicit substances, and other items assessing affective concern (e.g., worry, fear, etc.). Even in cases where item phrasing may be identical, response options

given to participants vary across studies and the lack of standardization of this construct hinders replicability and contributes to the cursory understanding researchers have developed when assessing perceptions of nicotine addiction.

Existent work examining perceptions of nicotine addiction using a scale are not comprehensively aligned with the DSM V. Combined, the addiction subscales of the Perceived Risk Instrument (Cano et al., 2018) and the E-cigarette Use Outcome Expectancies scale (Pokhrel et al., 2014; Pokhrel, Fagan, et al., 2018; Pokhrel, Lam, et al., 2018; Selekoğlu Ok et al., 2020) align with just three of the 11 DSM V dimensions of addiction, which are: 1) persistent desire or unsuccessful efforts to reduce or control substance use, 2) craving of substance, and 3) continued substance use despite knowledge and experience of psychological or physical harm associated with substance use. This disconnect between a standardized comprehensive measure of perceived addictiveness and clinical dimensions of addiction reflects 1) the need to develop a better measure assessing perceptions of nicotine addiction that is in line with clinical dimensions, and may reflect 2) that health communication about the nature of nicotine addiction is inadequate.

Considering how little research exists and the novelty of this work, scales should not only encapsulate the breadth of experiences when addicted to nicotine, but also assess the intensity of those experiences. Thus, by measuring perceptions of nicotine addiction in line with clinical dimensions, researchers can determine how perceptions of these dimensions of addiction contribute to health decision making – both *which* dimensions contribute and *how much* they contribute.

Scale Development

Psychometric development of a scale assessing perceptions of nicotine addiction is necessary to study the construct of perceptions of nicotine addiction and what these perceptions mean for the general population, with the goal of subsequently improving health communication efforts. As such, this dissertation is guided by a pre-existing framework commonly used in health behavior research (Boateng et al., 2018): 1) item development, 2) scale development, and 3) scale evaluation. Item development pertains to the process by which researchers identify domains and themes germane to a construct. In addition, this stage identifies prior attempts to create items that may measure identified domains. Temourian et al., (under review) attempted to identify domains and previously used items using through a systematic review. Their analysis identified three main domains that are assessed in the literature: 1) persistent desire to reduce/quit use, 2) craving, and 3) continued use despite knowledge of harm. Temourian et al. (under review) also found that there have been no attempts of developing a comprehensive scale to assess perceptions of nicotine addiction, let alone in a systematic way that aligns with existing clinical conceptualization.

The purpose of the scale development phase (chapters two – four) is to create a set of items that are 1) understood by a respondent, 2) reliably yields responses, 3) does not over burden the respondent, 4) maximizes parsimony, and 5) is comprised of items that correctly identifies people high or low on a particular dimension. In general, researchers engaging in scale development may employ classical test theory (CTT) or item response theory (IRT). Although both CTT and IRT seek to yield items that accurately test a construct, the two theories differ in their approach. The current study

utilizes IRT rather than CTT because IRT involves an iterative process that allows researchers to determine whether particular items might impact the reliability of the overall diagnostics of the scale. IRT is more appropriate for the current study given there have been no attempts of systematically studying perceptions of nicotine addiction and lay people may not have a concrete understanding of addiction.

The purpose of scale evaluation (chapter five) is to determine whether the items as a whole are reliable and correctly measure the construct it was designed to assess. Reliability can be measured using internal consistency. However, people may use longitudinal methodology to establish test/retest reliability. For the purposes of this dissertation, we utilize McDonald's omega as a measure of scale reliability. Item evaluation also includes attempts to establish construct validity; for the purposes of this study, assessing 1) convergent, 2) discriminant, and 3) criterion validity.

Study Aims

To better understand what addiction means to people, the disentanglement of the physical, psychological, and social components of nicotine addiction are warranted. Specifically, when considering nicotine addiction, do people primarily focus on withdrawal symptoms, craving, or inability to quit smoking despite the social and economic costs? Understanding how the lay person views and thinks about nicotine addiction is instrumental in developing and refining current targeted interventions for both prevention and intervention-based research. In accordance to the scale development framework (Boateng et al., 2018), the dissertation proposed the following aims:

1. Develop an instrument to measure perceptions of addiction that aligns with clinical dimensions across a general audience;
 - a. Hypothesis 1: Most lay understanding will be surrounding the concept of craving, tolerance, and withdrawal.
2. Establish convergent validity of perceptions of addiction with pre-existing measures assessing perceptions of risk;
 - a. Hypothesis 2: Perceptions of nicotine addiction will positively relate to items assessing perceptions of harm to one's own health.
 - b. Hypothesis 3: Perceptions of nicotine addiction will positively relate to items assessing perceptions of harm to others health.
 - c. Hypothesis 4: Perceptions of nicotine addiction will negatively relate to items assessing perceptions of e-cigarettes being a healthier alternative to cigarettes.
 - d. Hypothesis 5: Perceptions of nicotine addiction will positively relate to items assessing perceived likelihood of becoming addicted (if one were to smoke/continue to smoke).
3. Establish discriminant validity of perceptions of addiction with pre-existing measures assessing addiction severity;
 - a. Hypothesis 6: Perceptions of nicotine addiction will have a low to moderate correlation with items from the Fagerström Test for Nicotine Dependence.
 - b. Hypothesis 7: Perceptions of nicotine addiction will have a low to moderate correlation with items from the Nicotine Dependence Syndrome Scale.

4. Establish criterion validity of perceptions of addiction with behavior;
 - a. Hypothesis 8: Smokers with higher perceptions of nicotine addiction will report intention of quitting smoking within the next six months compared to smokers with lower perceptions of nicotine addiction.
 - b. Hypothesis 9: Smokers with higher perceptions of nicotine addiction will report intention of quitting smoking within the next 30 days compared to smokers with lower perceptions of nicotine addiction.
 - c. Hypothesis 10: Non-smokers with higher perceptions of nicotine addiction will report no intention of smoking in the next six months compared to non-smokers with lower perceptions of nicotine addiction.
 - d. Hypothesis 11: Non-smokers with higher perceptions of nicotine addiction will report no intention of smoking in the next 30 days compared to non-smokers with lower perceptions of nicotine addiction.
 - e. Hypothesis 12: Smokers with higher perceptions of nicotine addiction will report having tried to quit smoking at least once in the past 12 months compared to smokers with lower perceptions of nicotine addiction.
 - f. Hypothesis 13: Smokers with higher perceptions of nicotine addiction will report having attempted to quit smoking more often in the past 12 months compared to smokers with lower perceptions of nicotine addiction.
 - g. Hypothesis 14: Smokers with higher perceptions of nicotine addiction will report waiting a longer period of time after waking before using their first e-cigarette compared to smokers with lower perceptions of nicotine addiction.
 - h. Hypothesis 15: Smokers with higher perceptions of nicotine addiction will report taking fewer daily puffs of an e-cigarette compared to smokers with lower perceptions of nicotine addiction.
 - i. Hypothesis 16: Smokers with higher perceptions of nicotine addiction will report using an e-cigarette on fewer days out of the past 30 days compared to smokers with lower perceptions of nicotine addiction.

Chapter 2: Item Development—Cognitive Interviews

Results from a previously conducted systematic review (Temourian et al., under review) suggest assessment of perceptions of nicotine addiction are largely surface level single item questions, or lack comprehensive alignment with diagnostic criteria for tobacco use disorder (as defined by the DSM-V). The first step of scale development involves creating candidate items designed to assess the construct of interest. In preparation, a battery of items was developed to create a survey assessing perceptions of nicotine addiction. Second, cognitive interviews were conducted to determine people's comprehension of items. These interviews are designed to identify any cognitive barriers participants may encounter as they take the survey including misinterpretations, vague language, etc. (Hofmeyer et al., 2015). Non-verbal behaviors by participants (e.g., furrowed brows, frowning, etc.) can also indicate problematic items, which can be addressed during the cognitive interview process. The proposed measure assessing perceptions of nicotine addiction was created in collaboration with an expert in tobacco control research. The development of candidate items involved several rounds of modification, including survey directions.

Methods

Participants. Participants were recruited from the Research Participants System at the University of California, Merced (SONA). To be eligible for inclusion, participants were required to 1) be ≥ 18 years old and 2) consent to being audio recorded. Nine participants were recruited through SONA, an acceptable sample size for cognitive interviews using this methodology (Boateng et al., 2018). Participants were randomly placed into one of two groups: 1) survey prompt A ($n = 3$), or 2) survey prompt B ($n = 6$). This study was deemed exempt by the University of California, Merced Institutional Review Board (UCM2023-28).

Cognitive Interview Procedure. Cognitive interviews were conducted in person to assess barriers faced by participants in the item response process. Iterations of the proposed scale were numbered and alphabetized to maintain an organized record of all implemented changes. The order in which prompts were used were as follows: 1A, 1B, 2A, 2B, 3B, and 4B. Prompts 1A and 2A used first-person language, whereas Prompt B used third person language. Participants accessed the survey via personal smartphone. The cognitive interview guide included questions assessing the participants' overall thoughts of the survey items, content, and readability of survey items and response options. A verbal probing approach was used to elicit feedback to understand participants' opinions on survey directions, items, and response options (Appendix A). Interview time averaged 20 minutes and all interviews were audio recorded so the facilitator could focus on the conversation. Each participant received one SONA credit for participating which could be used for assignment or extra credit in courses. Audio was transcribed for ease of reference. Candidate items that were unclear or misunderstood were revised or removed from subsequent versions of the survey.

Measures.

Nicotine Addiction Perceptions (NAP) scale. Following a comprehensive literature review, 33 candidate items were created to assess perceptions of nicotine addiction with the clinical dimensions of nicotine addiction as a guide (American Psychiatric Association, 2013). The measure was given the name the Nicotine Addiction

Perceptions (NAP) scale. The decision was made to test the candidate items readability using two different prompts which changed candidate item prose from personal (Prompt A) to general (Prompt B). Final scale structure can be viewed in Table 1.

Prompt A. Scale directions asked participants to imagine themselves as someone who is addicted to nicotine and respond with their level of agreement from 1 (*strongly disagree*) to 5 (*strongly agree*). Candidate items followed first-person prose and included the term “I” (e.g., I smoke more now than I used to). Over the course of the cognitive interviews, the language of the survey became specific to e-cigarette/vaping devices (e.g., I vape more now than I used to). For detailed changes to Prompt A, please refer to Table 2.

Prompt B. Scale directions asked participants to think about how important certain behaviors are in determining whether someone is addicted to nicotine from 1 (*not at all important*) to 5 (*very important*). Candidate items used third person language (e.g., Smoking more now than when first started). Similar to Prompt A, we edited the language of the scale and its directions to be specific to e-cigarette/vaping devices (e.g., Vaping more now than when they first started). To compare changes of survey directions and candidate items between the initial and final version, please refer to Table 1.

Results

Demographics. The average age of participants was 20.4 years (SD = 1.34 years). Six participants self-identified as Hispanic/Latinx. Six participants identified as female. Six participants had experience using an e-cigarette. Two of nine participants had never used a tobacco product before.

Themes from Interviews.

Theme 1 – Necessary Clarification of Vocabulary Terms. Participants expressed concerns with item structure, primarily regarding the definition of a given term. More than half (5 participants) of the sample reported not knowing what the term “hindrance” meant:

“Sorry. What does hindrance mean again? Sorry” [Participant 4, Female, has used e-cigarettes]

This indicated that the term “hindrance” may have been too technical, and participants received a definition and/or alternative term to help them answer the question. To ensure this issue did not reoccur in future survey distributions, this item was removed from the final version of the NAP scale.

Theme 2 – Plausibility of Given Scenarios. Participants reported difficulty answering some items because scenarios were either improbable or not applicable. In this regard, item 21, “vaping in places that might cause a fire” was perceived as improbable because e-cigarettes may not pose a physical threat comparable to combustible cigarettes (e.g., starting an accidental fire). However, not all participants felt this way, some reported that they knew of an e-cigarette device posing some sort of physical danger from battery overheating/combustion. To ensure the NAP assessed as many dimensions of tobacco use disorder (as defined by the DSM-V) as possible, this item was retained in the final version.

Some candidate items were perceived as inapplicable by respondents. Specifically, participants reported eating less when a person does not vape is counter-intuitive to what vaping does:

“... if you eat less when you don't [vape] that means you eat more when you do... which is not what vaping does... I feel like it takes away the hunger” [Participant 9, Female, current e-cigarette user]

Nicotine is commonly understood to suppress smoker's appetite. As such, not using nicotine should increase one's appetite. To reduce participant confusion, this item was removed from subsequent versions of the scale.

Theme 3 – Context Specification. In some interviews, participants needed additional context on candidate items to definitively respond. In this regard, participants found the term “frequency” in item 2 (Appendix B – Appendix E) to be too confusing due to its ambiguity. When asked to provide a time frame, some participants reported thinking about people they knew who vaped who:

“sometimes wake up with vapes and vape all day but then later on at night... [they're] out [they're] like just constantly you know hitting [their] vape” [Female, Participant 5, current dual user].

During the interviews, respondents were asked if having an anchor of “per day” would help them answer the item definitively. All respondents favored this change, and thus, the item was anchored with a time frame of “per day”. Additionally, we also changed the language of item 3 to be anchored with this time frame.

Prompts 1A and 1B of the NAP scale broadly assessed addiction perceptions towards *tobacco* use and smoking. Participants responded with difficulty to these versions of the NAP scale:

“When I think about tobacco I think about like hookahs... if you were to put, over time I found myself using more e-cigarettes/vapes...I think that would be more concise” [Male, Participant 1, current e-cigarette user].

This issue occurred in two separate, consecutive cognitive interviews; therefore, the decision was made with an expert in tobacco control to restructure scale directions and candidate items to be specific to nicotine-based e-cigarette devices, given their proliferation over the past decade.

Changes in eating and drinking behaviors was another example of items that required context specification. Initially, these items were general, “[Eating/drinking] [more/less] when they do not vape”. However, some participants expressed needing more information before being able to respond.

“Drink as in like, alcohol? Or like water?” [Female, Participant 5, has used e-cigarettes]

Respondents reported perceiving people who consume more alcohol while abstaining from vaping as being more addicted to nicotine than someone whose alcohol consumption remains the same, as this could be a transference of addictive behavior from one substance to another.

“...so if you're drinking less alcohol when you're vaping it's kind of like I mean both are bad but at least you're decreasing the amount of drinking and you kind of choosing one to like fall back on so as long as you're not doing both I don't think it's that serious you know” [Female, Participant 6, current e-cigarette user].

In contrast, changes in consumption of non-alcoholic beverages were not perceived as a maladaptive behavior as a consequence of nicotine abstinence. To reduce participant burden, we removed items related to non-alcoholic beverage consumption.

Lastly, additional specification was needed regarding types of relationships. For some participants, fighting with family members over one's vaping was seen as a greater indicator of nicotine addiction rather than a conflict with a friend or romantic partner, or vice versa. As a result, we chose to specify these relationships to better understand whether conflict in relationships may inform people's perceptions of nicotine addiction and the extent of its contribution.

Difficulty Understanding Prompt Structure. Participants had difficulty separating their own experiences with nicotine from others' experiences. In Prompt A, candidate items were directed towards the individual (e.g., “I”) and survey directions asked respondents to imagine themselves and respond to items as someone who is addicted to nicotine. However, participants found it difficult to definitively respond to items without portraying themselves as being addicted to nicotine, even though the survey prompt directed them to do so. In this regard, participants would pause and want to justify their answer to the interviewer so they were not perceived as being addicted to nicotine:

Participant 1: *Like the past question “When I can't smoke many of my thoughts about how I can smoke again” ...like [expletive] bruh you a fiend, like [expletive] bruh*

Interviewer: *so you don't feel that way ?*

Participant 1: *oh yeah no most definitely*

Interviewer: *you DO feel that way?*

Participant 1: *oh err I feel like yeah when I think of that I'm like [expletive] I think of the I think about like – other homies who are like itching for like the nic[otine]..and I'm like “oh”*

Participant 1: *when I do not smoke, I become irritable. [PAUSE] I don't know that's just me cause I'm hungry? Nahh that's mostly because I'm hungry. But people DO get irritable, I'm not gonna lie, some people do... I'm like, “chill out”* [Male, Participant 1, current e-cigarette user]

Or in contrast, respondents did not consider themselves addicted to nicotine but answered the questions using their own smoking behavior(s). The interviewer had to remind them

to answer the questions as someone who they would consider being addicted to nicotine, not necessarily themselves:

Participant 4: *so yeah that's why I said I've—I vape less now because I don't have my own. I haven't bought my own in like months*

Interviewer: *so ... you're thinking “me” because you're seeing the word ‘I’*

Participant 4: *Yes*

Interviewer: *OK. But in general, how much would “a person” addicted to vaping agree with the following, not necessarily you.*

Participant 4: *Oh I see, OK* [Female, Participant 4, has used e-cigarettes]

In early versions of prompt B (see Appendix D & E), survey directions asked participants to identify important “markers” of addiction. Some participants noted they could not easily understand this term, and during the cognitive interviews, they either needed to be reminded of the meaning of this term or given alternative (but similar) prompt directions. After conferring with an expert in tobacco control, the decision was made to rephrase scale directions to use more accessible language (e.g., how important these behaviors are in telling whether someone is addicted to nicotine; Table 1).

Discussion

Findings from the cognitive interviews provided invaluable feedback into peoples’ perceptions of nicotine addiction and the NAP Scale. Summaries of each cognitive interview are provided in Appendix F. Results from this study suggest subtle differences in items and response options can make a significant impact in how participants interpret and respond to questions. Specifically, the interviews highlighted that participants had a difficult time separating their own experiences from others’ experiences of nicotine addiction. Those who received prompt A, which asked participants to imagine themselves as someone who was addicted to nicotine, struggled to answer items without first reflecting on their personal behaviors. This difficulty may be attributed to the age of participants (emerging young adults), but this may continue to hold for other age groups. Furthermore, the term *addiction* may carry negative connotations (Larkin et al., 2006), thus, it is not surprising that participants felt the need to rationalize smoking behaviors so as not to be perceived as addicted to nicotine by the study facilitator.

Moreover, results from the cognitive interviews suggest specific contexts may be needed to fully understand perceptions of nicotine addiction; however, these contexts are beyond the scope of this study. To our knowledge, this is the first attempt of creating a scale assessing perceptions of nicotine addiction that comprehensively aligns with the clinical dimensions of addiction. Other works examining perceptions of nicotine addiction are largely single item measurements that lack standardization or are not well aligned to the dimensions found in the DSM-V (Temourian et al., under review). To this end, this work aims to lay a foundation to determine whether people’s perceptions of nicotine addiction naturally align with clinical dimensions. Based on feasibility, teasing out granular data (e.g., types of relationships, frequency of behaviors, etc.) are characteristics of addiction that other researchers may wish to further disentangle.

Early versions of the NAP used the general term *tobacco*, which participants found too ambiguous. Similar to national trends investigating tobacco use (Barrington-Trimis et al., 2016; Dai & Leventhal, 2019), this sample reported greater experience with flavored tobacco products (e.g., vapes, hookah), but little to no experience with other, non-flavored tobacco products (e.g., combustible cigarettes, smokeless, etc.). While this may be attributed to the age group participants were part of, we chose to adapt the language of the NAP scale to the current culture surrounding tobacco use. Although cigarette use may be at an all-time low (SAMHSA & Office of the Surgeon General, 2020), the use of e-cigarettes has been steadily rising, predominantly among young adults (Kramarow & Elgaddal, 2023). For this reason, the term “smoker” may no longer be reflective of a combustible cigarette user; rather this term may now be more applicable to exclusive e-cigarette users or even dual users (i.e., combustible cigarette and e-cigarette users). During the cognitive interviews, participants shared their experiences and knowledge of the harms – or lack thereof – of electronic nicotine delivery systems (ENDS), shining a light on the need to assess how addiction to these products are perceived at a more meaningful level. At the very least, assessing perceived addictiveness of nicotine-based e-cigarettes beyond a comparison to combustible cigarettes given that many people now rarely have experience with the latter.

Cognitive interviews rely on the assumption that participants can accurately describe their thought processes aloud in a cohesive manner. However, addiction is a complex behavior, where people may have difficulty formulating organized rationale for how they chose to answer a question. When this occurred, respondents would pause or make some sort of facial reaction (e.g., eyebrow furrowing, lip pursing). In some cases, they would supplement their answer(s) with filler sounds such as “ummm” or “uhhh”. The facilitator paid special attention to these behaviors and encouraged think-aloud discussion to help identify where respondents found issue. If these behaviors remained unaddressed, it may suggest that the items in the NAP are not appropriately measuring perceptions of nicotine addiction. While these participants had the opportunity to ask the facilitator/scale developer questions regarding language and/or clarity, participants who receive the scale on an online survey platform do not have that luxury. In this regard, it was critical to consider all forms of hesitation when developing the NAP scale. In some cases, pointing out hesitation/behavior directly (e.g., “*why the pause*”?) helped respondents become more comfortable and opened the floor to discussion. In other cases, repeating questions from the verbal probing approach (Appendix A) reoriented participants to the task at hand to provide meaningful feedback for candidate items and responses.

Limitations/Future Directions

Some limitations should be addressed. Data were collected from a college student sample, limiting generalizability to the general population. However, UC Merced is comprised of students from diverse backgrounds, including age and race/ethnicity. Secondly, interviews only included one facilitator, other cognitive interviews may also include a note-taker to help identify emerging themes over the course of interview duration. However, each cognitive interview was audio-recorded so that the facilitator could interact with participants freely without disrupting respondent thought processes and speech in order to take rigorous notes.

The results from the cognitive interviews are part of a larger study creating and validating a new scale; results from cognitive interviews alone do not result in valid survey questions. Additional investigation is needed, particularly related to the psychometric properties of the NAP scale using item analysis procedures (e.g., Item Response Theory). Additionally, future works may choose to examine age differences in perceptions of nicotine addiction to determine whether difficulty answering candidate items as an imagined nicotine addict are specific to emerging young adults, or if this issue remains in a more diverse sample.

Conclusions

This study was the first step in disentangling the psychological, physical, and social components of nicotine addiction. The cognitive interviews provided initial insight into how the lay person perceives nicotine addiction. That is, people's perceptions of nicotine addiction are not identical; some smoking-related behaviors may not be perceived as addictive at all, whereas others may have a degree to which they are perceived as addictive.

Chapter 3: Scale Development – Exploratory Factor Analysis

In the previous chapter, we conducted cognitive interviews among a sample of nine undergraduate students. Some common themes emerged in respondents' feedback: 1) the need to use easily understandable language in scale directions and candidate items, 2) the plausibility of provided scenarios, and 3) context specification. Moreover, these interviews also suggest that perceptions of nicotine addiction may not directly relate to the diagnostic criteria of tobacco use disorder. In this regard, people's perceptions surrounding nicotine addiction may not be identical which warrants further investigation. The cognitive interviews from the previous chapter allowed us to assess the cognitive and linguistic accessibility of a set of questions in a new scale assessing perceptions of nicotine addiction.

In this chapter, we assess the dimensionality of the Nicotine Addiction Perceptions (NAP) scale to help establish within-scale reliability. In line with psychometric assessment guidelines (Boateng et al., 2018; Depaoli & Liu, in press; Raykov & Marcoulides, 2011), we explored the dimensionality of the 36-item NAP scale using exploratory factor analysis (EFA). EFA's are a data reduction technique that can take multiple items and reduce them into smaller, distinct factors (Depaoli & Liu, in press). As part of study aims, we hypothesized there are unique sub-dimensions of perceptions of nicotine addiction that naturally align with the DSM-V dimensions of tobacco use disorder. Specifically, we anticipated these dimensions to center around craving, tolerance, and withdrawal. As recommended by the literature, to conduct an EFA, one should have over 100 participants or a 5:1 participant to item ratio (De Winter et al., 2009; Hatcher, 1994; Kline, 1994; Zygmunt & Smith, 2014). Thus, the obtained sample of $n = 179$ is acceptable.

Methods

Participants. Participants were undergraduate students recruited from the Research Participants System at UC Merced (SONA). To be eligible for inclusion, participants were required to be ≥ 18 years old and received 0.5 SONA credits for their participation which could be used for assignment or extra credit in courses. This study was deemed exempt by the University of California, Merced Institutional Review Board (UCM2023-28).

Measures.

Nicotine Addiction Perceptions (NAP) scale

Participants responded to 36 items assessing perceptions of nicotine addiction. Based on cognitive interviews, directions of the scale used specific language regarding the *nicotine* found in e-cigarette products. Specifically, the survey directions read, "Below we are going to give you a list of behaviors related to **nicotine based vapes/e-cigarettes**. On a scale from 1-5, how important are any of these behaviors in telling you a person is addicted to **vapes/e-cigarettes**?" (See Appendix G). Participants indicated their perceptions of addiction to vaping with items such as "Having difficulty with quitting vaping" and "Giving up hobbies in order to vape" on a 5-point scale from 1 (not at all important) to 5 (extremely important).

Analytic Plan

We conducted an EFA to reduce items and assess factor structure. We assessed the 36 candidate items for missing values, skewness, and item relevancy (Tabachnick et

al., 2013). Our analysis suggested missing responses on the NAP were missing completely at random ($p = 0.991$), thus respondents with missing values ($n = 2$) were able to be omitted from analysis (Kang, 2013). To assess multivariate normality, we used Mardia's test for multivariate normality which evaluates whether data follows a multivariate normal distribution. To determine the proportion of variance caused by underlying factors, we used the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (MSA). The KMO is helpful in determining whether an EFA can be useful for the data. We also checked whether there was redundancy between variables that could be summarized by latent factors using Bartlett's Test of Sphericity. After assessing the normality and suitability of the data for factor analysis, we determined the appropriate number of factors for analysis using Cattell's scree plot and used a principal axis factoring extraction method (Brown, 2015; Costello & Osborne, 2005; Fabrigar & Wegener, 2012; Kline, 1994).

Addiction literature suggests addiction is pervasive and impacts the social, physical, and emotional well-being of people (McMurran, 1994); as such, this pervasiveness should translate to correlations between factors. For this reason, we employed an oblique rotation method (oblimin) which allows for, but does not require, correlations between factors (Fabrigar & Wegener, 2012). Item retainment was dependent upon how well items load onto factors ($>.50$) and their meaningful contribution to the construct of perceptions of nicotine addiction (Worthington & Whittaker, 2006). Items that highly correlated were removed from analysis and to be considered for inclusion based on rephrasing of the item and/or conceptual considerations. Item loadings onto factors were assessed using an iterative process (i.e., one at a time) until all items loaded onto a primary factor with a loading of $.50$ or higher. In total, 11 items were removed either due to multiple factor loadings or they did not meaningfully contribute to the overall construct: 4, 5, 9, 10, 11, 14, 15, 16, 20, 32, and 33. There were three reasons why an item may have been removed during the iterative process: 1) loaded poorly onto one factor, 2) loaded poorly onto two factors, or 3) loaded poorly onto three factors. We describe their removal using these categories. Item loading and reason for removal can be viewed in Table 3. The EFA was run after removal of all 11 items and the model did not significantly change; all items had factor loadings ≥ 0.50 (Table 4). Data were analyzed using Rstudio 2023.06.1.

Results

Demographics. The average age of participants was 20.53 years ($SD = 2.69$ years). Over 65% of the sample self-identified as Hispanic/Latinx. Roughly 80% of the sample identified as female. Almost half (44.13%) reported having ever used an e-cigarette (Table 5).

Exploratory Factor Analysis. Mardia's test of multivariate normality returned significance ($p < 0.001$), suggesting that data did not follow a multivariate normal distribution. The KMO value was 0.94, and Bartlett's sphericity was significant ($\chi^2 = 6181.811$, $df = 630$, $p = 0.000$), suggesting data were suitable for factor analysis. Based on Cattell's Scree test (Figure 1), the EFA of 36 items suggested a six-factor solution (Table 6).

The six factors that emerged were continued use despite negative consequences (Factor 1), withdrawal (Factor 2), tolerance (Factor 3), social impact (Factor 4),

consistent desire to quit/reduce use (Factor 5), and substitution to other behavior (Factor 6).

Omitted due to poor factor loading. Item 10, “Most thoughts are related to how they can vape again” loaded poorly (0.47) and was removed from analysis. Item 20, “Cutting down on hobbies because of vaping”, was removed due to its overlap with item 19, “Giving up hobbies because of vaping”. Although item 20 did have a factor loading of 0.53, item 19 loaded better onto the respective factor (0.66) and thus was retained. Item 32, “Feeling anxious when they do not vape” loaded poorly on Factor 3 (0.37) and was removed.

Omitted due to loading onto 2 factors. Item 11, “Craving a vape when they are not smoking” loaded onto two factors: withdrawal (0.36) and tolerance (0.37). Item 9, “Spending a lot of time thinking about the next time they can vape” loaded similarly onto Factors 1 (0.38) and 3 (0.30) and was removed. Item 14, “Arguing with other people over their vaping” loaded similarly onto Factors 1 (0.37) and 3 (0.47) and was removed. Item 16, “Vaping causes problems with their social circle” loaded similarly onto Factors 1 (0.44) and 3 (0.35). Item 15, “Social life is negatively impacted by their vaping” loaded similarly onto Factors 1 (0.44) and 4 (0.48) and was removed.

Omitted due to loading onto 3 factors. Item 4, “Having difficulty quitting vaping”, was removed because it loaded similarly onto Factors 1 (0.30), 3 (0.28), and 4 (0.38). Item 5, “Having difficulty reducing their vaping” loaded similarly onto Factors 1 (0.26), 3 (0.28), and 4 (0.35) and was removed. Lastly, item 33, “Feeling sad when they do not vape” loaded similarly onto Factors 1 (0.20), 3 (0.22) and 4 (0.20) and was removed.

Variance accounted for by factor. The first factor, continued use despite negative consequences, explained 21% of the total variance. Item loading onto this factor included six items: vaping in places that may cause a fire, continued vaping even though they are aware it is bad for them, experiencing negative health effects from vaping, and experiencing conflict in their familial, friend, or romantic relationships. Factor two, withdrawal, explained 15% of the total variance. Item loading onto this factor included five items including needing to vape more to get the same buzz, becoming irritable when they do not vape, being on edge when they do not vape, having a hard time concentrating when they do not vape, and having trouble sleeping when they do not vape. Factor three, tolerance, explained 14% of the total variance. Item loading onto this factor included three items including vaping more now than when they first started, taking more puffs/hit throughout the day, taking more time per day to vape.

Factor four, social impact, explained 13% of the total variance. Item loading onto this factor included five items including vaping gets in the way of daily life, vaping negatively impacts work productivity, person gives up their social life in order to vape, giving up part of a job because of vaping, and giving up hobbies to vape. Factor five, consistent desire to quit/reduce vaping, explained 12% of the total variance. Item loading onto this factor included three items including often thinking about quitting vaping, reducing vaping, and constantly wanting to quit vaping. Factor six, substitution to other behaviors, explained 9% of the total variance. Item loading onto this factor included three items including eating more when they do not vape, drinking more alcohol when they do not vape, and drinking less alcohol when they do not vape.

The final six-factor solution explained 84% of the total variance. Table 7 displays the correlations between the six factors.

Discussion

As part of Aim 1, we wanted to understand how perceptions of nicotine addiction align with dimensions found in the DSM-V. Specifically, we hypothesized that most lay understanding would surround the concept of craving, tolerance, and withdrawal. The results from the EFA suggest that there are more sub-dimensions than anticipated. Though tolerance and withdrawal did emerge as separate, unique dimensions, the item assessing craving (*Craving a vape when they are not smoking*) did not emerge as its own, separate factor. Rather, it loaded similarly onto both tolerance and withdrawal, suggesting that lay people may have difficulty distinguishing between these two dimensions. Although we removed item 11 in the EFA, this item was retained for the confirmatory factor analysis because we wanted the NAP to encapsulate a majority of the DSM-V dimensions of tobacco use disorder. Additionally, we believe the term “smoking” in item 11 may have confused participants as this usually refers to combustible cigarette use. In this regard, respondents may not have felt this was indicative of addictive behavior, as lay people may operate under the assumption that e-cigarettes are predominantly used to help people quit smoking combustible cigarettes (Harlow et al., 2023). Therefore, craving a vape when one is not smoking may have been interpreted as using a vape to decrease cigarette craving. To remedy this issue, we rephrased this item to read “Craving a vape when they are not vaping” before launching the survey with another sample of participants.

The results from the EFA also suggest that people’s perceptions regarding nicotine addiction are relatively structured. The most definitive constructs were not craving, tolerance, or withdrawal as we anticipated, but rather continuing to vape despite negative consequences. This may not be too surprising given that most definitions of addiction classify addiction as chronic behavior despite harmful consequences (National Institute on Drug Abuse, 2018). Moreover, failed attempts of quitting vaping did not emerge as a cohesive concept, unlike desire to quit vaping. This could mean that lay people do not understand the nuances of addiction – continued smoking despite not wanting to—or there may be something among this particular population (e.g., emerging young adults) who may not yet have experience with addiction.

The results of the EFA also suggest that people’s perceptions regarding nicotine addiction may fall outside the purview of DSM V dimensions of tobacco use disorder (Factor 6). Some people may perceive engaging in maladaptive health behaviors when not vaping (e.g., drinking more alcohol) to be more indicative of someone with nicotine addiction, however, this is not assessed in the DSM V.

Limitations/Future Directions

Some limitations should be addressed. It could be argued that removing item 20 was unnecessary as its factor loading fell above .50. However, during the iterative process, this item consistently scored below the .50 threshold, whereas item 19 (a similar item) consistently loaded well on its respective factor. This, partnered with the overlap in the content of these items, supported the removal of item 20 from the final factor model. Additionally, these findings are based on a sample of emerging young adults who may not yet fully understand/have experienced addiction. Even so, their perceptions

surrounding nicotine addiction remain relatively organized. Future works may examine whether mental schemas surrounding nicotine addiction maintain a similar structure in other populations by conducting confirmatory factor analysis.

Conclusions

This study provided exploratory findings of a novel measure assessing perceptions of nicotine addiction that align with the clinical dimensions of addiction. Mental schemas surrounding nicotine addiction may be more organized than anticipated. Namely, whereas tolerance and withdrawal are perceived as separate, distinct dimensions, craving is grouped within both factors. Moreover, continued vaping despite harm is seen as the most definitive construct. As part of the scale development process, the six-factor solution must be validated using confirmatory factor analysis to further establish its construct validity.

Chapter 4: Scale Development – Confirmatory Factor Analysis & Psychometric Evaluation

In the previous chapter, we explored the dimensionality of the NAP scale among a sample of undergraduate students using exploratory factor analysis (EFA). We hypothesized that perceptions of nicotine addiction would primarily center around craving, tolerance, and withdrawal. Although tolerance and withdrawal emerged as unique dimensions with craving equally contributing to both factors, continued vaping despite harm was perceived as the most definitive construct and accounted for the largest proportion of variance. Additionally, people’s perceptions surrounding vaping cessation are nuanced. In this regard, desire to quit/reduce vaping may be more relevant than facing difficulty when a cessation attempt is made. Furthermore, there may be aspects of addiction that are not reflected in DSM-V dimensions.

In this chapter, we use confirmatory factor analysis (CFA) to explore whether factor structure of the NAP remains stable among a new sample of participants. CFA is a restricted form of EFA which lessens the influence of other, lower factor loadings on their respective latent factors (Depaoli & Liu, in press). Specifically, by not permitting items to load onto every factor, items can relate strongly to their respective factor by increasing their factor loading. Additionally, we also assess the psychometrics properties of the NAP using item difficulty, item discrimination, and reliability.

Methods

Participants. Participants were recruited using a convenience sample via Prolific, a comprehensive survey platform that is extensively used in research and is comprised of active participants that have been screened and verified prior to study participation (Palan & Schitter, 2018). The study was hosted on Qualtrics (2023), an online survey building platform. To be eligible for inclusion, participants were required to be 1) ≥ 18 years old and 2) English speakers living in the United States. Prolific’s panel are comprised of adults (18 years +) from various countries that must complete certain tasks to prove they are real (i.e., not a bot). People are recruited primarily through word of mouth including via social media (Prolific, 2024). For their participation, participants received \$4.00 credit to their Prolific account. Data were collected in late December 2023. This study was deemed exempt by the University of California, Merced Institutional Review Board (UCM2023-28).

Measures.

Nicotine Addiction Perceptions (NAP) scale

Participants responded to 36 items assessing their perceptions of nicotine addiction (See Appendix H). Using data from Prolific, we conducted a CFA to confirm model fit of the factor structure from Chapter 3. All items marked for removal in Chapter 3 (n=10) were omitted from the survey with the exception of item 11. We suspected that item 11 was problematic because of its wording. By using the term “smoking”, participants may have interpreted this to mean using a vape to decrease combustible cigarette use. After editing, item 11 read “Craving a vape when they are *vaping*”. The main prompt read, “Below we are going to give you a list of behaviors related to **nicotine based vapes/e-cigarettes**. On a scale from 1-5, how important are any of these behaviors in telling you a person is addicted to **vapes/e-cigarettes**?”. Participants indicated their perceptions of addiction to nicotine with items such as “ Having difficulty with quitting

vaping” and “Giving up hobbies in order to vape” on a five-point scale from 1 (not at all important) to 5 (extremely important).

Demographics. Participants were asked basic demographic questions such as gender, race and ethnicity, annual income (household income), educational attainment, and age. For *gender*, participants were considered male if they selected male or female-to-male transgender, and female if they selected female or male-to-female transgender. Other gender identities (non-binary or declined to answer) were not included in analyses. Gender was dichotomized and males were the reference group (males = 0, females = 1). For *race and ethnicity*, participants were either coded as non-Hispanic white, African-American/Black, Hispanic/Latinx, or Other. Due to the small number of participants who identified as being part of any Asian or Middle Eastern heritage, this group was combined for analyses. Non-Hispanic white served as the reference group (non-Hispanic white = 0; African-American/Black = 1; Hispanic/Latinx = 2; Other = 3). For *education*, respondents were either coded as having a high school degree or lower, some college education, a Bachelor’s degree, or graduate degree, with Bachelor’s degree serving as the reference group (Bachelor’s degree = 0; high school or less = 1; some college = 2; graduate degree = 3). *Income* was categorized into five groups with up to \$25,000 serving as the reference group (\$25,001-\$50,000 = 1; \$50,001-\$75,000 = 2; \$75,000- \$100,000 = 3; \$100,001+ = 4). Respondents also reported their *age*, which ranged from 18- 76 years. Demographic characteristics of the sample can be found in Table 8.

Analytic Plan

We conducted a confirmatory factor analysis of the six-factor structure from Chapter three using data from a different sample of participants. Respondents with missing values were omitted from analysis ($n = 3$), after ensuring data were missing completely at random ($p = 0.1099$; Kang, 2013). In line with rationale used in the EFA, final factor structure was dependent upon how well items loaded onto their respective factors at a substantive level, not stringent model fit indices. To determine which estimation method would be appropriate, we assessed multivariate normality using Mardia’s test for multivariate normality. As data were non-normal, we utilized a mean- and variance-adjusted weighted least squares (WLSMV) estimation method which is preferred as its properties are less biased and there is small sampling variation in estimated factor loadings compared to other estimation methods (Li, 2016; Muthén et al., 1997). WLSMV based modification indices and associated values can be interpreted in the same manner as CFA with continuous data (Brown, 2015).

With rating scale data, item difficulty can be interpreted as the ease in which respondents can endorse a particular item, rather than the percentage of people who answer an item correctly (Lord, 1952). Item discrimination refers to an item’s ability to distinguish between individuals with lower and higher scores on the latent construct, with higher scores indicating greater relevance of the item being measured by the latent trait (Ebel, 1954; Hurlstone, 2020). Provided data did not follow a normal distribution, we assessed internal consistency of the NAP (i.e., reliability) using McDonald’s omega (ω ; McDonald, 1999) and interpreted findings according to conventional guidelines: 0.9+ = excellent reliability, 0.8 - 0.9 = good reliability, 0.7 – 0.8 = acceptable reliability (George & Mallery, 2003). Data were analyzed using Rstudio 2023.06.1.

Results

Demographics. Respondents from Prolific were middle aged ($M = 39.56$ years, $SD = 12.66$ years; Table 8), and roughly half were male (51.37%). Most identified as non-Hispanic White (62.48%) and a greater proportion reported having a Bachelor's degree (39.89%). More than half (57.2%) reporting making up to \$75,000 annually. The most commonly reported reason for using an e-cigarette device was for enjoyment (29.4%), followed by curiosity (28.39%), to quit smoking (19.6%), to reduce smoking (14.82%), use when one cannot or is not allowed to smoke (6.03%), and other (1.76%). A majority of respondents reported using an e-cigarette that contained nicotine (76.84%), followed by other flavors (66.92%), mint or menthol flavor (44.78%), THC (32.32%), CBD (24.37%), and their own mix (7.89%). Among non-users, 2.18% reported intention to start using e-cigarettes in the next 30 days, and 0.78% reported intention to start using e-cigarettes in the next 6 months.

Confirmatory Factor Analysis.

In a demographically diverse adult sample, the six-factor solution suggested adequate model fit on most CFA indices (see Tables 9 and 10): $\chi^2(284, N = 549) = 766.528, p < 0.001$; robust Standardized Root Mean Square Residual (SRMR) = 0.044 (recommended good fit < 0.08), robust Root Mean Square Error of Approximation (RMSEA) = 0.056 (90% CI = 0.051, 0.060; recommended good fit ≤ 0.06), robust Comparative Fit Index (CFI) = 0.794 (recommended value ≥ 0.90), robust Tucker Lewis Index (TLI) = 0.765 (recommended value ≥ 0.90). After examining standardized item loadings, item 36, "Drinking less alcoholic beverages when they do not vape", loaded very poorly onto Factor 6 (0.250). As this factor was not informed by the DSM-V, we decided to remove the problematic item along with items 34 and 35 as most psychometricians agree that latent factors should consist of a minimum of three items (Kline, 2005).

We re-analyzed the CFA with a five-factor solution, which resulted in better model fit indices (see Tables 10 & 11): $\chi^2(220, N = 549) = 518.808, p < 0.001$, robust SRMR = 0.041, robust RMSEA = 0.050 (95% CI = 0.044, 0.055), robust CFI = 0.854, robust TLI = 0.832.

Psychometric Evaluation

Item Difficulty. Most scores on the 23-item NAP scale fell between three and four. Respondents were likely to answer item 18 using higher response categories ("Giving up part of their job because of vaping"; 4.33; see Table 12). Respondents were less likely to endorse item seven ("Often thinking about reducing their vaping"; 3.11).

Item Discrimination. For the NAP scale, item discrimination values ranged from 0.44 to 0.82 (see Table 12). Items six, seven, and eight had the lowest discrimination scores that ranged from 0.44 to 0.50. These items comprise factor five, consistent desire to quit/reduce use. The two items with the highest item discrimination were item 30 (0.82) and 17 (0.81), which comprised factors two (withdrawal) and four (social impact), respectively.

Reliability Analysis. Using McDonald's omega, the NAP was found to have high internal consistency, with an omega coefficient of 0.958 (Table 13). The omega coefficient for the continued use despite negative consequences subscale (Factor 1) was 0.898, the withdrawal subscale (Factor 2) had a value of 0.934, the tolerance subscale (Factor 3) had a value of .913, the social impact subscale (Factor 4) had a

value of 0.938, and the consistent desire to quit/reduce use subscale (Factor 5) had a value of 0.888.

Discussion

This study sought to validate the six-factor structure of the NAP using confirmatory factor analysis among an online panel sample. We found that the six-factor solution returned adequate model fit on most CFA indices, however, one item returned poor loading onto its respective factor (Item 36 → Factor six). We decided to remove this problematic item along with the other two items in this factor – in line with psychometric guidelines – before re-analyzing the CFA using a five-factor solution (Kline, 2005).

Factor six (Substitution to other behavior) was comprised of items created during the cognitive interview phase, after feedback from participants. During the cognitive interview stage, participants reported perceiving those who experience changes in their eating/drinking behaviors when not vaping to be more indicative of someone with nicotine addiction. Although these perceptions may not have aligned with DSM-V criteria of tobacco use disorder, we considered that not everyone's experiences with addiction look alike and wanted to account for these differences as best as possible. Provided that this factor was not informed by the DSM-V, we did not re-analyze the model using exploratory factor analysis prior to conducting the final 5-factor CFA.

To our knowledge, this is the first study creating and validating a scale assessing perceptions of nicotine addiction that align with DSM V dimensions of tobacco use disorder. As each item within the NAP was created using this framework, item difficulty was generally endorsed (i.e., respondents indicated similar responses for each item as being indicative of nicotine addiction), suggesting that perceptions of nicotine addiction do align with clinicians diagnoses of nicotine addiction.

In regard to item discrimination, three items did not distinguish well between respondents with higher versus lower scores of perceptions of nicotine addiction. These items comprised Factor five (consistent desire to quit/reduce use) which accounted for a small proportion of variance in Chapter three. However, this is an important facet of nicotine addiction according to clinical guidelines, thus, we retained this factor when establishing criterion validity.

Our study results suggest that perceptions of nicotine addiction can be reliably measured in a general, online U.S. sample with adequate validity. To account for the non-normality of the data, we used McDonald's omega (ω) which returned values well above the 0.70 acceptability estimate for the overall NAP scale and its subscales. In this regard, the NAP adequately assesses perceptions of nicotine addiction as a unique construct.

Limitations/Future Directions

Some limitations must be addressed. First, researchers may choose to conduct another CFA without Factor five (desire to quit/reduce use) as these items did not have strong item discrimination. However, as this factor is a dimension within the DSM-V, we had theoretical justification for keeping this factor within our scale. It can be argued that many smokers struggle with their initial cessation attempts, despite having the desire to quit (Quisenberry et al., 2019), thus, people may perceive those who have difficulty quitting smoking to be more addicted than those who face less difficulty quitting or not having attempted quitting at all.

Secondly, other psychometric works creating and validating scales assess item difficulty and discrimination prior to conducting factor analyses (Slaten et al., 2019, 2023). However, we chose to assess factor structure prior to conducting item analysis, in line with existing guidelines for scale development in the health sciences (Depaoli & Liu, in press). Future works can determine whether assessing item functioning of NAP items prior to conducting factor analyses makes a significant difference in model structure and/or fit.

Conclusions

The results from the final five-factor CFA solution provide empirical rationale to further explore the dimensionality of perceptions of nicotine addiction and determine its convergence with similar, single item assessments of risk perceptions, and divergence from diagnostic assessments of nicotine addiction. Additionally, establishing the NAP's criterion validity using vaping-related outcomes may further provide support that perceptions of nicotine addiction are a unique construct that require meaningful investigation. As part of the scale development process (Bhandari, 2023; Boateng et al., 2018), the next chapter discusses the validity of the NAP scale.

Chapter 5: Scale Evaluation – Establishing Construct Validity

In the previous chapter, we conducted confirmatory factor analysis (CFA) and item analysis. The CFA suggested that although a six-factor model returns adequate model fit on most indices, a five-factor solution is more parsimonious and returns better fit. Additionally, respondents endorse most items in a similar manner (i.e., item difficulty), in line with what we expected to find given that the items were informed by the DSM V. Regarding item discrimination, items six, seven, and eight, which center around attempts/desire to quit smoking, were unable to distinguish between individuals with higher and lower scores. Lastly, as a test of internal consistency, the NAP and its subscales score well above the acceptability estimate (George & Mallery, 2003; McDonald, 1999).

In this chapter, we establish construct validity of perceptions of nicotine addiction using convergent, discriminant, and criterion validity (Aims 2 – 4). Convergent validity assesses whether a particular construct correlates with other items/tests that assess the same construct. Discriminant validity assesses whether two theoretically different measures are, in fact, unrelated. Criterion validity evaluates the extent to which a measure is related to an outcome. In this study, we seek to establish convergent validity by assessing whether the NAP is related to single item assessments of risk perceptions commonly used in tobacco research. We establish discriminant validity by assessing whether the NAP is distinguishable from measures of addiction severity (e.g., nicotine dependence). Lastly, we establish criterion validity by assessing whether the NAP is related to e-cigarette related outcomes including intentions and behaviors.

Methods

Participants. Participants were recruited using a convenience sample via Prolific, a comprehensive survey platform that is extensively used in research and is comprised of active participants that have been screened and verified prior to study participation (Palan & Schitter, 2018). The study was hosted on Qualtrics (2023), an online survey building platform. To be eligible for inclusion, participants were required to be 1) ≥ 18 years old and 2) English speakers living in the United States. Prolific's panel are comprised of adults from various countries that must complete certain tasks to prove they are real (i.e., not a bot) and at least 18 years of age. People are recruited primarily through word of mouth including via social media (Prolific, 2024). For their participation, participants received \$4.00 credit to their Prolific account. Data were collected in late December 2023. This study was deemed exempt by the University of California, Merced Institutional Review Board (UCM2023-28).

To determine the minimum number of participants needed to test study hypotheses, an a-priori power analysis was run using G*power (Faul et al., 2007). To achieve 95% power and detect a medium effect size of 0.11, G*power recommends a total sample size of 253. Thus, the obtained sample of $n_{\text{vapers}} = 277$ & $n_{\text{non-vapers}} = 275$, was adequate to test study hypotheses. After removing inconsistent responses in screening items and missing data, the final sample for $n_{\text{vapers}} = 274$.

Measures. The full survey included questions related to nicotine use, previously established measures of dependence for current tobacco users (e.g., FTND and NDSS), quit intentions, initiation intentions, e-cigarette use motivations, e-cigarette device

composition, comparative harm, nicotine knowledge, demographic questions, and the Nicotine Addiction Perceptions (NAP) scale.

Nicotine Addiction Perceptions (NAP) scale

Participants responded to items from the NAP scale (See Appendix I). The main prompt read, “Below we are going to give you a list of behaviors related to **nicotine based vapes/e-cigarettes**. On a scale from 1-5, how important are any of these behaviors in telling you a person is addicted to **vapes/e-cigarettes**?”. Participants indicated their perceptions of addiction to nicotine with items such as “Having difficulty with quitting vaping” and “Giving up hobbies in order to vape” on a five-point scale from 1 (not at all important) to 5 (extremely important). Total scores were calculated by summing scores from the 23 items retained from the previous chapter.

Outcome variables

Quit Intentions. Current e-cigarette users reported their intentions to quit using e-cigarettes in the next 30 days and six months (0 = no, 1 = yes).

Initiation Intentions. Participants who were not e-cigarette users (i.e., have not used an e-cigarette more than 20 times), were asked to report their intentions of using e-cigarettes in the next 30 days and six months (0 = no, 1 = yes).

Quit attempts. E-cigarette users reported whether they have voluntarily attempted to quit using e-cigarettes/vapes in the past 12 months for at least 24 hours (0 = no, 1 = yes). Additionally, participants were asked the number of times they’ve attempted to quit vaping in the past 12 months (0 = 0 times – 12 = 12 or more attempts).

E-cigarette Use Behaviors. Current e-cigarette users were asked to report how soon they use their e-cigarette/vape after waking (1 = within 5 minutes, 2 = 5-30 minutes, 3 = 31-60 minutes, 4 = longer than 60 minutes). Respondents were also asked how many times a day they use an e-cigarette device (0 = 0 times a day – 30 = 30 or more times a day). This was separated into three categories (1 = 1-9 times a day, 2 = 10-24 times a day, 3 = 25 or more times a day). Additionally, current users were asked to report the number of days they vaped in the past 30 days from 0 days to 30 days. This was separated into three categories (1 = 2-10 days, 2 = 11-24 days, 3 = 25 or more days).

Covariates

Harm to health. To measure perceptions of e-cigarette harm to one’s own health, participants were asked, on a five-point Likert type scale with 1 = very unlikely and 5 = very likely, “If you [were to smoke/continue to smoke] e-cigarettes, how likely is it that you will harm your own health?”. Language of this item was modified depending on whether participants self-identified as current e-cigarette users.

Harm to other’s health. To measure perceptions of e-cigarette harm to other’s health, participants were asked, on a five-point Likert type scale with 1 = very unlikely and 5 = very likely, “If you [were to smoke/continue to smoke] e-cigarettes, how likely is it that you will harm someone else’s health with second hand vape smoke?”. Language of this item was modified depending on whether participants self-identified as current e-cigarette users.

Likelihood of becoming addicted. Perceptions of perceived e-cigarette addictiveness was assessed, on a five-point Likert type scale with 1 = very unlikely and 5 = very likely, “If you [were to smoke/continue to smoke] e-cigarettes, how likely is it that

you will become addicted?”. Language of this item was modified depending on whether participants self-identified as current e-cigarette users.

Comparative harm. Adapted from a previous study assessing harm perceptions as predictors of smoking (Song et al., 2009), participants were asked about comparative e-cigarette harm with the question, “Compared with cigarettes, how harmful are e-cigarettes to a person’s health”? Response options followed a Likert scale format from 1 to 5 with 1 = much less harmful than cigarettes and 5 = much more harmful than cigarettes. The referent category was “much less harmful than cigarettes”.

Nicotine Dependence Syndrome Scale. The Nicotine Dependence Syndrome Scale (NDSS) is a 19-item questionnaire that assesses smokers’ nicotine dependence (Shiffman et al., 2004). This scale has been validated in adult populations and yields a single summary score. Participants were asked to select the number that indicates how well the following statements describes them from 1 = not at all true to 5 = extremely true. Example items include, “After not smoking for a while, I need to smoke to relieve feelings of restlessness and irritability” and “I feel a sense of control over my smoking”. Language for the scale was adapted to relate to e-cigarette use.

Fagerström Test of Nicotine Dependence. The Fagerström Test of Nicotine Dependence (FTND) is a six item instrument that assesses the physical intensity of nicotine addiction using a summated score where 0-2 = low dependence, 3-4 = low to moderate dependence, 5-7 = moderate dependence, 8+ = high dependence (Heatherton et al., 1991). E-cigarette users were asked to report how soon they use their e-cigarette/vape after waking (3 = within 5 minutes, 2 = 5 – 30 minutes, 1 = 30 - 60 minutes, 0 = 60+ minutes) and how many times they use their e-cigarette per day (0 = 9 times per day or less, 1 = 10 - 19 times per day, 2 = 20 – 29 times per day, 3 = 30+ times per day). E-cigarette users were asked which e-cigarette they would hate to give up the most (0 = none of the above, 1 = in the morning, 0 = during or after meals, 0 = during or after stressful situations). E-cigarette users were asked if they find it difficult to abstain from smoking in forbidden places (e.g., churches, no-smoke areas), if they use their e-cigarette more frequently in the first two hours of waking than the rest of the day, and if they use their e-cigarette when they are so ill they are in bed most of the day (0 = no, 1 = yes).

E-cigarette use motivations. E-cigarette users were asked their primary reason for using an e-cigarette. Questions were adapted from the Population Assessment of Tobacco and Health study (United States Department Of Health And Human Services, 2021). Participants could only select one option which included: to quit smoking, to reduce smoking, to use when I cannot or am not allowed to smoke, enjoyment, or curiosity. Enjoyment served as the referent category.

E-cigarette composition. To explore the changing landscape of nicotine consumption, participants were asked to describe the composition of e-cigarette product(s) they have used. Participants were asked whether their e-liquids contained nicotine (0 = no, 1 = yes).

Nicotine knowledge. We assessed participants’ knowledge of nicotine with a true or false item, “Nicotine is a highly addictive substance that is found naturally in tobacco leaves and can be produced synthetically in a lab” (Respiratory Health Association, 2023).

Mental Health. Participants completed the PROMIS short-form anxiety and depression questionnaires (Pilkonis et al., 2011). The PROMIS questionnaires utilize a five-point Likert scale ranging from 1 (never) to 5 (always). Depression and anxiety scores were highly correlated (Pearson's $r = 0.80$), so we created a composite score by averaging depression and anxiety scores together. Higher scores indicated experiencing greater mental distress over the previous seven days.

Demographics. Participants were asked basic demographic questions such as gender, race and ethnicity, annual income (household income), educational attainment, and age. For *gender*, participants were considered male if they selected male or female-to-male transgender, and female if they selected female or male-to-female transgender. Other gender identities (non-binary or declined to answer) were not included in analyses. Gender was dichotomized and males were the reference group (males = 0, females = 1). For *race and ethnicity*, participants were either coded as non-Hispanic white, African-American/Black, Hispanic/Latinx, or Other. Due to the small number of participants who identified as being part of any Asian or Middle Eastern heritage, this group was combined for analyses. Non-Hispanic white served as the reference group (non-Hispanic white = 0; African-American/Black = 1; Hispanic/Latinx = 2; Other = 3). For *education*, respondents were either coded as having a high school degree or lower, some college education, a Bachelor's degree, or graduate degree, with Bachelor's degree serving as the reference group (Bachelor's degree = 0; high school or less = 1; some college = 2; graduate degree = 3). *Income* was categorized into five groups with up to \$25,000 serving as the reference group (\$25,001-\$50,000 = 1; \$50,001-\$75,000 = 2; \$75,000- \$100,000 = 3; \$100,001+ = 4). Respondents also reported their *age*, which ranged from 18-76 years. Demographic characteristics of the sample can be found in Table 8.

Analytic Plan

We conducted Pearson's correlations to assess convergent validity between perceived harm to health, harm to other's health, likelihood of becoming addicted, comparative harm, and the NAP. Additionally, we conducted Pearson's correlations between the NDSS, FTND, and NAP to assess discriminant validity. To promote parsimony in our model, a Pearson's correlation was also run between the NDSS and FTND. Preliminary analyses suggested that scores between the NDSS and FTND were not highly correlated; this would suggest controlling for both measures in regression analyses. However, using the FTND would under-power our regression analyses, thus, we opted to use NDSS scores to refer to people's nicotine dependence in the regression models.

To assess criterion validity, we conducted binary logistic regressions to analyze six-month and 30-day quit intentions, six-month and 30-day initiation intentions, and whether a quit attempt occurred over the past 12 months. Initial analyses for the number of quit attempts over the past 12 months indicated some non-normal data, particularly skewed to the right. To ensure we ran appropriate analyses, we verified whether item variance was larger than item mean, as this is an assumption of negative binomial regression analysis. To account for the over-dispersion of the count data (number of quit attempts), we conducted a negative binomial regression in which the Incident Rate Ratio (IRR) refers to the factor change in the outcome variable for each unit increase in the predictor variable (UCLA: Statistical Consulting Group, n.d.). Finally, we conducted

linear regressions to analyze how soon after waking one uses their e-cigarette, daily e-cigarette use, and past 30-day e-cigarette use.

For all regression analyses, we controlled for comparative e-cigarette harm, current combustible cigarette user status (yes/no), mental health, and demographic variables. Additionally, on regressions assessing e-cigarette quit intentions and current use behaviors, we controlled for nicotine dependence (NDSS), e-cigarette use reasons, and e-cigarette composition. We did not control for nicotine knowledge as there was not enough variability in responses; a large majority (98%) answered true on this item. Data were analyzed using StataMP 18.0.

Results

Demographics. Respondents from Prolific were middle aged ($M = 39.56$ years, $SD = 12.66$ years; Table 8), and roughly half were male (51.37%). Most identified as non-Hispanic White (62.48%) and a greater proportion reported having a Bachelor's degree (39.89%). More than half (57.2%) reporting making up to \$75,000 annually. The most commonly reported reason for using an e-cigarette device was for enjoyment (29.4%), followed by curiosity (28.39%), to quit smoking (19.6%), to reduce smoking (14.82%), use when one cannot or is not allowed to smoke (6.03%), and other (1.76%). A majority of respondents reported using an e-cigarette that contained nicotine (76.84%), followed by other flavors (66.92%), mint or menthol flavor (44.78%), THC (32.32%), CBD (24.37%), and their own mix (7.89%). Among non-users, 2.18% reported intention to start using e-cigarettes in the next 30 days, and 0.78% reported intention to start using e-cigarettes in the next 6 months.

Convergent Validity (Aim 2)

Harm to one's own health. A Pearson's correlation determined there was a moderate, positive correlation between the NAP and perceptions that e-cigarettes could harm one's own health, $r(547) = .2893$, $p < 0.001$ (Table 14).

Harm to others' health. A Pearson's correlation determined there was a weak, positive correlation between the NAP and perceptions that e-cigarettes could harm someone else's health via secondhand vape smoke, $r(547) = .2085$, $p < 0.001$.

Comparative harm. A Pearson's correlation determined there was a weak, positive correlation between the NAP and perceptions that e-cigarettes are harmful to a person's health, $r(547) = .1479$, $p = 0.0005$.

Likelihood of becoming addicted. A Pearson's correlation determined there was a negligible, positive correlation between the NAP and perceived likelihood of becoming addicted if they were/continue to use e-cigarettes, $r(547) = .0994$, $p = 0.0198$.

Discriminant Validity (Aim 3)

Fagerström Test of Nicotine Dependence. A Pearson's correlation determined there was no significant correlation between NAP and FTND scores $r(226) = .0372$, $p = 0.5761$ (see Table 14).

Nicotine Dependence Syndrome Scale. A Pearson's correlation determined there was no significant correlation between NAP and NDSS scores, $r(272) = .0807$, $p = 0.1832$.

To promote parsimony in the regression models, we also assessed the correlation between the FTND and NDSS. A Pearson's correlation determined there was no significant correlation between FTND and NDSS scores, $r(226) = .0019$, $p = 0.9776$.

Criterion Validity (Aim 4)

Logistic Regressions

Six month quit intentions. For every unit increase in perceptions of nicotine addiction, intentions to quit using e-cigarettes in the next six months increased (OR = 1.03, 95% CI: 1.01, 1.04; $p = 0.007$; Table 15). For each unit of increased perception of comparative e-cigarette harm, intentions to quit using e-cigarettes in the next six months increased (OR = 1.47, 95% CI: 1.05, 2.06; $p = 0.026$). Among those making between \$50,001- \$75,000 annually, intentions to quit using e-cigarettes in the next six months increased (OR = 3.08, 95% CI: 1.06, 8.98, $p = 0.039$) compared to those making less than \$20,000 annually. Compared to non-Hispanic white adults, African American/Black adults were twice as likely to report intentions of quitting using e-cigarettes in the next six months (OR = 2.14, 95% CI: 1.01, 4.58, $p = 0.048$).

Thirty day quit intentions. For each unit of increased perception of comparative e-cigarette harm, desire to quit using e-cigarettes in the next 30 days increased (OR = 1.89, 95% CI: 1.16, 3.08; $p = 0.010$). Compared to those using e-cigarettes for enjoyment, those using e-cigarettes to cut down on smoking (OR = 3.70, 95% CI: 1.16, 11.75; $p = 0.027$), and curiosity reported desire to quit using e-cigarettes in the next 30 days (OR = 25.09, 95% CI: 3.57, 176.30; $p = 0.001$).

Initiation intentions. A very small proportion of non-e-cigarette users reported intentions of using e-cigarettes in the next 30 days (0.73%) or six months (2.18%). Therefore, planned regression analyses were not computed.

Attempted cessation in past 12 months. For each unit of increased perception of comparative e-cigarette harm, the likelihood of having tried to quit using e-cigarettes in the past 12 months increased (OR = 1.57, 95% CI: 1.12, 2.20; $p = 0.009$; Table X. Logistic Regression Results). Compared to those using e-cigarettes for enjoyment, those using e-cigarettes to use when they cannot or are not allowed to smoke were three times as likely to report having tried to quit using e-cigarettes in the past 12 months (OR = 3.19, 95% CI: 1.11, 9.18; $p = 0.032$). Compared to non-Hispanic White e-cigarette users, Hispanic/Latinx e-cigarette users were three times as likely to report having tried quit using e-cigarettes in the past 12 months (OR = 3.62, 95% CI: 1.49, 8.77, $p = 0.004$).

Negative Binomial Regression

Number of quit attempts in past 12 months. For each unit of increased perception of nicotine addiction, the number of quit attempts over the past 12 months decreased by a factor of 0.99 (95% CI [0.98, 1.00]; Table 16). For each unit of increased perception of comparative e-cigarette harm, the number of quit attempts over the past 12 months increased by a factor of 1.62 (95% CI [1.28, 2.05]). For every unit increase in nicotine dependence, the number of quit attempts over the past 12 months increased by a factor of 1.08 (95% CI [1.03, 1.14]). Compared to those using e-cigarettes for enjoyment, those using e-cigarettes to quit smoking reported increased number of quit attempts over the past 12 months by a factor of 2.00 (95% CI [1.17, 3.40]). For every unit increase in age, the number of quit attempts over the past 12 months decreased by a factor of 0.98 (95% CI [0.96, 1.00]). For every unit increase in mental distress, the number of quit attempts over the past 12 months increased by a factor of 1.24 (95% CI [1.01, 1.53]).

Linear Regressions

Measured time to first use of e-cigarette after waking. Compared to those using e-cigarettes for enjoyment, those using e-cigarettes to quit smoking were likely to

use their first e-cigarette sooner upon waking ($b = -0.67, p < 0.001$; Table 17). Compared to those who use e-liquid that does not contain nicotine, those who use e-liquid that contains nicotine were likely to use their first e-cigarette sooner upon waking ($b = -0.49, p = 0.003$). Compared to non-Hispanic White e-cigarette users, African American/Black e-cigarette users ($b = 0.42, p = 0.010$) were likely to use their first e-cigarette later upon waking. Compared to those with a bachelor's degree, those with a high school education ($b = -0.57, p = 0.007$) and those with some college education ($b = -0.38, p = 0.011$) were likely to use their first e-cigarette sooner upon waking.

Daily e-cigarette use. Compared to those using e-cigarettes for enjoyment, those using e-cigarettes to quit smoking cigarettes were likely to take more e-cigarette puffs per day ($b = 0.28, p = 0.026$; Table X: Linear Regression Results). Compared to non-Hispanic White e-cigarette users, African American/Black e-cigarette users were likely to take less e-cigarette puffs per day ($b = -0.45, p < 0.001$). Compared to those with a bachelor's degree, those with a high school education ($b = 0.55, p = 0.001$) and those with some college education ($b = 0.27, p = 0.019$) were likely to take more e-cigarette puffs per day.

Past 30-day e-cigarette use. For every unit increase in perceptions of nicotine addiction, the number of days vaped in the past 30 days increased ($b = 0.00, p = 0.039$; Table X: Linear Regression Results). For every unit increase in comparative harm, the number of days vaped in the past 30 days decreased ($b = -0.15, p = 0.003$). Compared to those who use e-liquid that does not contain nicotine, those who use e-liquid that contains nicotine were likely to vape on more days out of the past 30 days ($b = 0.50, p < 0.001$). Compared to those using e-cigarettes for enjoyment, those using e-cigarettes to quit smoking were likely to vape on more days out of the past 30 days ($b = 0.25, p = 0.026$). For every unit increase in mental distress, the number of days vaped in the past 30 days decreased ($b = -0.09, p = 0.033$). Compared to non-Hispanic White e-cigarette users, African American/Black ($b = -0.51, p < 0.001$) and Hispanic/Latinx e-cigarette users ($b = -0.34, p = 0.010$) were likely to vape on less days out of the past 30 days. Compared to those with a bachelor's degree, those with some college education were likely to vape on more days out of the past 30 days ($b = 0.28, p = 0.006$).

Discussion

As part of aim two (establishing convergent validity), we anticipated the NAP scale would converge with pre-existing, single item assessments of health risk perceptions used widely in research (Song et al., 2009). Our study found that there are positive relationships between risk perceptions and NAP scores such that higher perceived risk of e-cigarettes posing harm to personal health, and others' health via secondhand smoke were related to higher NAP scores. Regarding comparative harm, responses that e-cigarettes are more harmful than combustible cigarettes were related to higher overall NAP scores. Interestingly, there was a small yet significant correlation between perceived likelihood of becoming addicted to e-cigarettes and NAP scores. This may be attributable to people's underestimation of the addictiveness of e-cigarettes (Hobkirk et al., 2022), or that people do not have a clear understanding of what addiction is. Without this understanding, people may be unable to estimate the likelihood of becoming addicted to nicotine. Thus, using the NAP may provide deeper insight into people's mental schemas surrounding the development of nicotine addiction.

As part of aim three (establishing discriminant validity), we anticipated the NAP would be discernable from existing measures assessing addiction severity. Our findings supported our hypotheses such that the NAP assesses a different construct than that of the FTND and NDSS (perceptions of addiction vs. diagnostic assessment of addiction). Given that the FTND and NDSS are both considered measures of addiction severity, we expected a moderate to large correlation between these two measures. However, within this sample, these scores were not related ($r < .01$). This lends support to the earlier statement that it is difficult to compare scores between the FTND and NDSS as they do not ask comparable questions despite claiming to assess the same construct. Moreover, this exemplifies issues found in research that having non standardized measures assessing one construct may contribute to the detriment of public health due to uncertainty or lack of applicability to the general public (Neugebauer et al., 2021; Scott & Biondillo, 2022).

As part of aim four (establishing criterion validity), we anticipated the NAP to relate to vaping-related behaviors/intentions among people who currently vape and people who have little to no experience using a vape. Due to little variation in intention to start using e-cigarettes in the next six month and 30-days in our sample, we were unable to assess the relationship between the NAP and initiation intentions. However, our hypotheses were informed by existing research in this general area that find those with higher perceptions of tobacco/nicotine addictiveness were less likely to initiate tobacco product use (Chen et al., 2022; Cooper et al., 2018; Strong et al., 2019). Indeed, much of the research surrounding e-cigarette initiation focuses on youth populations given that substance use initiation is common in this age range. However, Cooper et al.'s (2018) work examines this relationship among a U.S. college student sample. Specifically, they found that lower perceptions of addiction were related to greater odds of initiating e-cigarettes among current non-tobacco users.

In regard to perceptions of nicotine addiction and quit intentions, our findings support existing research in this area (Perski et al., 2019) that find those with higher perceptions of addiction are more likely to report intentions of quitting in the near future. Among our sample, intentions to quit vaping within the next six months were significant, but not within the next 30-days, suggesting that this group may be more addicted and thus, have little intention of engaging in immediate change. Empirical research in this area have found that smokers who are concerned about relapsing are less likely to attempt quitting (Xie et al., 2021), which may extend to our sample. In this regard, our sample of e-cigarette users may be interested in quitting in the near future, but not yet prepared to make an actual attempt (i.e., in the next 30 days). Moreover, this may also provide insight into this sample's lack of quit attempts over the past year (56% said zero attempts).

Additionally, we hypothesized that NAP scores would relate negatively to past 30-day e-cigarette use. Within this sample, smokers with higher NAP scores were likely to report using e-cigarettes on more days out of the past month. In line with existing qualitative research, this sample may feel less control over their vaping and thus, use these products daily to satiate their craving/symptoms of addiction (Berg et al., 2013).

The NAP was unrelated to several outcomes of interest including: 30-day quit intentions, number of quit attempts over the past 12 months, time to first e-cigarette upon waking, and daily e-cigarette use. This may be for a number of reasons. First, these

outcomes pertain to people who are active e-cigarette users, therefore, it may not matter what their perceptions of nicotine addiction are, as they are already addicted. It would be interesting to know whether perceptions of addiction are important for people who have not yet initiated use (i.e., youth), or intermittent users who are at risk of escalating to addiction. Secondly, although NAP scores might not be related to these behavioral outcomes among current users, it is possible that other outcomes might be related to perceptions of nicotine addiction for intermittent users. For example, future researchers may examine whether NAP scores relate to empathy towards addicts or being able to recognize addiction. Among our sample, they may already be entrenched in addiction or do not know what addiction is.

Limitations/Future Directions

A limitation of our study is the time period in which data were collected (late December 2023). Nearing the end of the year, people make New Year's resolutions, predominantly related to change health behavior (Davis, 2023). In this regard, respondents may have been more inclined to report having intentions to quit vaping in the near future. However, among our sample, less than 40% had intentions to quit using a vape in the next 30 days; roughly 50% had no intention of quitting vaping at all.

Future works may wish to collect longitudinal data to determine whether people's intentions regarding cessation turn into actionable behavior. Additionally, assessing how people's perceptions of nicotine addiction change across time may be helpful in understanding whether/how perceptions change and their impact on behavior change. Additionally, future research may examine the relationship between perceptions of nicotine addiction and smoking behaviors using structural equation modeling. Using this method, research can examine the relevancy and saliency of NAP subscales to specific vaping related behaviors.

Conclusions

The NAP displays convergence with pre-existing single item assessments of risk perceptions, divergence from measures assessing addiction severity, and relates to cessation intentions and some e-cigarette use behaviors. For researchers who examine the relationship between perceptions and their relationship(s) to e-cigarette outcomes, the NAP can provide more meaningful information surrounding people's understanding of nicotine addiction.

Chapter 6: Discussion

The current study was designed to create and establish the validity of a new scale assessing perceptions of nicotine addiction among a general audience using IRT guidelines. Additionally, we wanted to understand whether people's perceptions surrounding nicotine addiction comprehensively aligned with the clinical dimensions of tobacco use disorder. In this regard, researchers interested in examining perceptions as they relate to smoking-related behaviors can utilize the NAP scale to better understand the relevant dimensions of nicotine addiction in people's cognitive development of risk perceptions. The results from this study also provide additional evidence that existing assessments of perceptions of nicotine addiction are either underestimating and/or inappropriately measuring the impact of addiction cognitions and smoking-related behavior (Cano et al., 2018; Pokhrel et al., 2014; Pokhrel, Fagan, et al., 2018; Pokhrel, Lam, et al., 2018; Selekoğlu Ok et al., 2020; Temourian et al., under review). This, in turn, may be further misaligning clinical and research efforts to educate the public on the nature of addiction, contributing to poor health communication.

Using scale development guidelines (Boateng et al., 2018; Depaoli & Liu, in press), findings from the current study suggest reasonably adequate diagnostics of the NAP scale, but this is compounded by the fact that most people do not know the clinical definition of addiction. The data demonstrate that people's lay understanding of perceptions of nicotine addiction may not align with the DSM V dimensions of what addiction actually is, how it is clinically assessed, and how it impacts people's lives. Therefore, although there is a clinical understanding of addiction, this does not translate to the lay individual as clearly and remains an area where further investigation is needed.

Within this study, the most salient aspect of addiction in participant's cognitions fell in line with the general definition of addiction, that addiction is a chronic behavior despite negative consequences (National Institute on Drug Abuse, 2020). Within the NAP scale, negative consequences included using vaping devices in physically hazardous conditions (dimension eight of DSM-V), social conflict with loved ones (dimension six of DSM-V), and sustained use after explicit knowledge of harm to the self (dimension nine of DSM-V). In contrast, existing qualitative work examining perceptions of nicotine addiction posit that a more relevant aspect of addiction is craving (Berg et al., 2013; Koopman Gonzalez et al., 2022). Moreover, one study using ecological momentary assessment suggested that among those experiencing tobacco addiction, craving plays a central role in their relapse (Fatseas et al., 2015). Thus, our finding that craving did not emerge as a separate, distinct factor was surprising and may indicate education and prevention efforts surrounding nicotine addiction need to be adjusted to highlight this dimension of addiction.

Treating addiction can be difficult, in part due to people's inability to acknowledge they are addicted, or their desire to not be labeled an addict due to the negative connotation surrounding this term (Larkin et al., 2006). Much of the work educating the public has prioritized the *consequences* of nicotine addiction rather than the *experiences* of nicotine addiction. This may help explain why lay people's perceptions of nicotine addiction encompass only five of 11 clinical dimensions. Education efforts should emphasize the dimensions of addiction –rather than a simple definition – so that people can recognize that they, or a loved one, is addicted and seek help prior to

experiencing particularly damaging consequences of addiction (e.g., lung cancer, COPD, death, etc.; Centers for Disease Control and Prevention, 2020b).

Most current preventative and intervention programs highlight the negative consequences of tobacco use, but the lack of emphasis surrounding other dimensions of addiction (e.g., persistent desire to reduce/control use, recreational activities are given up/reduced due to substance use, etc.) may be diminishing the fact that active smokers are using tobacco against their will. This last part, using tobacco against one's will, is a clinically recognized aspect of addiction and is demonstrated epidemiologically that over 70% of current smokers regret initiating in the first place (Nayak et al., 2017). Yet, this aspect of addiction is not well understood by the general public. Future research may choose to examine whether people's knowledge in this area could be used to help prevent future tobacco use.

Limitations and Future Directions

Some limitations must be addressed. First, an EFA and then a CFA were conducted using a college student and a national online participant panel, respectively. It could be argued that a general sample should be used for exploratory analyses and a specific group of people (i.e., young college students) used for confirmatory analyses. However, the methodology we employed was more financially feasible and epidemiologically, the age group that are most likely to use e-cigarettes are those between 18-24 years (Kramarow & Elgaddal, 2023). Future research will need to confirm our findings of the finalized 23-item NAP scale using other specific subgroups, especially those at high risk for use of nicotine products. We also did not examine the relationship between NAP subscales and e-cigarette behavior outcomes and intentions. Specific subscales (e.g., withdrawal) may be more relevant to certain behaviors such as daily e-cigarette use. Future research may choose to examine the relationships between NAP subscales and vaping-related outcomes.

Conclusions

To our knowledge, this is the first study to create a comprehensive scale assessing perceptions of nicotine addiction that align with clinical dimensions of tobacco use disorder. Items in the final NAP scale returned adequate diagnostics using IRT guidelines and construct validity was established using convergent, discriminant, and criterion validity. The findings from this study suggest that for most, perceptions of nicotine addiction may not align with DSM V clinical criteria, and this may be due potentially to the lack of education surrounding addiction. Future research examining perceptions of nicotine addiction can utilize the NAP scale to better understand lay people's understanding of addiction and its relationship to vaping related behaviors. Public health efforts can utilize the scale to adapt curriculum to focus on the experiences of nicotine addiction, rather than just the consequences of nicotine addiction to promote healthy behavior. It would also be interesting to see how treatment programs adapt their curriculum to reflect these dimensions and whether a well-rounded curriculum is related to better outcomes or if certain dimensions are essential over others.

References

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T)
- American Psychiatric Association (Ed.). (2013). *Diagnostic and statistical manual of mental disorders: DSM-5* (5th ed). American Psychiatric Association.
- Barrington-Trimis, J. L., Urman, R., Berhane, K., Unger, J. B., Cruz, T. B., Pentz, M. A., Samet, J. M., Leventhal, A. M., & McConnell, R. (2016). E-Cigarettes and Future Cigarette Use. *Pediatrics*, 138(1), e20160379. <https://doi.org/10.1542/peds.2016-0379>
- Becker, M. H. (1974). The health belief model and sick role behavior. *Health Education Monographs*, 2(4), 409–419. <https://doi.org/10.1177/109019817400200407>
- Berg, C. J., Schauer, G. L., Buchanan, T. S., Sterling, K., DeSisto, C., Pinsker, E. A., & Ahluwalia, J. S. (2013). Perceptions of addiction, attempts to quit, and successful quitting in nondaily and daily smokers. *Psychology of Addictive Behaviors*, 27(4), 1059–1067. <https://doi.org/10.1037/a0033790>
- Bhandari, P. (2023, June 22). *Construct validity | Definition, types, and examples*. <https://www.scribbr.com/methodology/construct-validity/>
- Boateng, G. O., Neilands, T. B., Frongillo, E. A., Melgar-Quiñonez, H. R., & Young, S. L. (2018). Best practices for developing and validating scales for health, social, and behavioral research: A primer. *Frontiers in Public Health*, 6, 149. <https://doi.org/10.3389/fpubh.2018.00149>

- Brown, T. A. (2015). *Confirmatory factor analysis for applied research*. The Guilford Press.
- Browning, K. K., Wewers, M. E., Ferketich, A. K., Otterson, G. A., & Reynolds, N. R. (2009). The self-regulation model of illness applied to smoking behavior in lung cancer. *Cancer Nursing, 32*(4), E15–E25.
<https://doi.org/10.1097/NCC.0b013e3181a0238f>
- Bunnell, R. E., Agaku, I. T., Arrazola, R. A., Apelberg, B. J., Caraballo, R. S., Corey, C. G., Coleman, B. N., Dube, S. R., & King, B. A. (2015). Intentions to Smoke Cigarettes Among Never-Smoking US Middle and High School Electronic Cigarette Users: National Youth Tobacco Survey, 2011–2013. *Nicotine & Tobacco Research, 17*(2), 228–235. <https://doi.org/10.1093/ntr/ntu166>
- California Air Resources Board. (n.d.). *Combustion Pollutants & Indoor Air Quality*.
<https://ww2.arb.ca.gov/resources/documents/combustion-pollutants-indoor-air-quality#:~:text=At%20very%20high%20levels%2C%20brain,and%20other%20serious%20health%20impacts>
- Cano, S., Chrea, C., Salzberger, T., Alfieri, T., Emilien, G., Mainy, N., Ramazzotti, A., Lüdicke, F., & Weitkunat, R. (2018). Development and validation of a new instrument to measure perceived risks associated with the use of tobacco and nicotine-containing products. *Health and Quality of Life Outcomes, 16*(1), Article 1. <https://doi.org/10.1186/s12955-018-0997-5>
- Centers for Disease Control and Prevention. (2020a, April 28). *Smoking & tobacco use: Health effects*.
https://www.cdc.gov/tobacco/basic_information/health_effects/index.htm

- Centers for Disease Control and Prevention. (2020b, April 28). *Smoking & tobacco use: Health effects*.
https://www.cdc.gov/tobacco/basic_information/health_effects/index.htm
- Centers for Disease Control and Prevention. (2023, November 2). *About Electronic Cigarettes (E-Cigarettes)*. https://www.cdc.gov/tobacco/basic_information/e-cigarettes/about-e-cigarettes.html
- Chen, B., Spells, C. E., Bluestein, M. A., Kuk, A. E., Harrell, M. B., & Pérez, A. (2022). The association of perceptions of harmfulness and addictiveness on the age of initiation of cigar product use among youth: Findings from the Population Assessment of Tobacco and Health (PATH) study, 2013–2017. *Frontiers in Public Health, 10*, 882434. <https://doi.org/10.3389/fpubh.2022.882434>
- Cooper, M., Loukas, A., Case, K. R., Marti, C. N., & Perry, C. L. (2018). A longitudinal study of risk perceptions and e-cigarette initiation among college students: Interactions with smoking status. *Drug and Alcohol Dependence, 186*, 257–263. <https://doi.org/10.1016/j.drugaldep.2017.11.027>
- Cornelius, M. E., Loretan, C. G., Jamal, A., Davis Lynn, B. C., Mayer, M., Alcantara, I. C., & Neff, L. (2023). Tobacco Product Use Among Adults – United States, 2021. *MMWR. Morbidity and Mortality Weekly Report, 72*(18), 475–483. <https://doi.org/10.15585/mmwr.mm7218a1>
- Costello, A. B., & Osborne, J. (2005). *Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis*. <https://doi.org/10.7275/JYJ1-4868>

- Dai, H., & Leventhal, A. M. (2019). Prevalence of e-Cigarette Use Among Adults in the United States, 2014-2018. *JAMA*, 322(18), 1824.
<https://doi.org/10.1001/jama.2019.15331>
- Davis, S. (2023, December 18). *New Year's Resolutions Statistics 2024*. Forbes Health.
[https://www.forbes.com/health/mind/new-years-resolutions-statistics/#:~:text=years%20or%20more,-,Most%20Common%20New%20Year%27s%20Resolutions,Improved%20mental%20health%20\(36%25\)](https://www.forbes.com/health/mind/new-years-resolutions-statistics/#:~:text=years%20or%20more,-,Most%20Common%20New%20Year%27s%20Resolutions,Improved%20mental%20health%20(36%25))
- De Winter, J. C. F., Dodou*, D., & Wieringa, P. A. (2009). Exploratory factor analysis with small sample sizes. *Multivariate Behavioral Research*, 44(2), 147–181.
<https://doi.org/10.1080/00273170902794206>
- Depaoli, S., & Liu, R. (in press). *Selecting, developing, and analyzing measures in health psychology*.
- Diehl, A., & Scherbaum, N. (2008). Nicotine dependence as comorbidity of alcohol dependence-epidemiology, etiology and therapy. *Fortschritte der Neurologie · Psychiatrie*, 76(1), 14–18. <https://doi.org/10.1055/s-2007-980076>
- Ebel, R. L. (1954). Procedures for the analysis of classroom tests. *Educational and Psychological Measurement*, 14(2), 352–364.
- Etter, J.-F., Le Houezec, J., & Perneger, T. V. (2003). A self-administered questionnaire to measure dependence on cigarettes: The cigarette dependence scale. *Neuropsychopharmacology*, 28(2), 359–370.
<https://doi.org/10.1038/sj.npp.1300030>

- Fabrigar, L. R., & Wegener, D. T. (2012). *Exploratory Factor Analysis*. Oxford University Press.
- Fatseas, M., Serre, F., Alexandre, J., Debrabant, R., Auriacombe, M., & Swendsen, J. (2015). Craving and substance use among patients with alcohol, tobacco, cannabis or heroin addiction: A comparison of substance- and person-specific cues. *Addiction, 110*(6), 1035–1042. <https://doi.org/10.1111/add.12882>
- Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175–191. <https://doi.org/10.3758/BF03193146>
- George, D., & Mallery, M. (2003). *Using spss for windows step by step: A simple guide and reference*. Allyn & Bacon.
- Grant, B. F., Hasin, D. S., Chou, S. P., Stinson, F. S., & Dawson, D. A. (2004). Nicotine dependence and psychiatric disorders in the United States: Results from the national epidemiologic survey on alcohol and related conditions. *Archives of General Psychiatry, 61*(11), 1107. <https://doi.org/10.1001/archpsyc.61.11.1107>
- Harlow, A. F., Xie, W., Goghari, A. R., Lundberg, D. J., Raquib, R. V., Berlowitz, J. B., & Stokes, A. C. (2023). Sociodemographic Differences in E-Cigarette Uptake and Perceptions of Harm. *American Journal of Preventive Medicine, 65*(3), 356–365. <https://doi.org/10.1016/j.amepre.2023.03.009>
- Hatcher, L. (1994). *A step-by-step approach to using the SAS system for factor analysis and structural equation modeling*. SAS Institute, Inc., Cary.

- Heatherton, T. F., Kozlowski, L. T., Frecker, R. C., & Fagerstrom, K.-O. (1991). The Fagerstrom Test for Nicotine Dependence: A revision of the Fagerstrom Tolerance Questionnaire. *Addiction, 86*(9), 1119–1127. <https://doi.org/10.1111/j.1360-0443.1991.tb01879.x>
- Hobkirk, A. L., Hoglen, B., Sheng, T., Kristich, A., Yingst, J. M., Houser, K. R., Krebs, N. M., Allen, S. I., Bordner, C. R., Livelsberger, C., & Foulds, J. (2022). Intentions and Attempts to Quit JUUL E-Cigarette Use: The Role of Perceived Harm and Addiction. *Preventing Chronic Disease, 19*, 210255. <https://doi.org/10.5888/pcd19.210255>
- Hofmeyer, A., Sheingold, B. H., & Taylor, R. (2015). Do you understand what I mean? How cognitive interviewing can strengthen valid, reliable study instruments and dissemination products. *Journal of International Education Research (JIER), 11*(4), 261–268. <https://doi.org/10.19030/jier.v11i4.9460>
- Hurlstone, M. (2020). *Item Response Theory*. <https://mark-hurlstone.github.io/Week%2010.%20Item%20Response%20Theory.pdf>
- Kang, H. (2013). The prevention and handling of the missing data. *Korean Journal of Anesthesiology, 64*(5), 402. <https://doi.org/10.4097/kjae.2013.64.5.402>
- Kline, P. (1994). *An easy guide to factor analysis*. Abingdon-on-Thames: Routledge.
- Kline, P. (2005). *Principles and practice of structural equation modeling* (2nd ed.). Guilford Press.
- Koopman Gonzalez, S. J., Trapl, E. S., Albert, E. L., Ishler, K. J., Cavallo, D. N., Lim, R., & Flocke, S. A. (2022). “I got a little addiction”: Adolescent and young adult

- cigarillo users' self-perceptions of addiction. *Drug and Alcohol Dependence*, 231, 109235. <https://doi.org/10.1016/j.drugalcdep.2021.109235>
- Kramarow, E. A., & Elgaddal, N. (2023, July). *Current Electronic Cigarette Use Among Adults Aged 18 and Over: United States, 2021*. Centers for Disease Control and Prevention. <https://www.cdc.gov/nchs/products/databriefs/db475.htm>
- Larkin, M., Wood, R. T. A., & Griffiths, M. D. (2006). Towards addiction as relationship. *Addiction Research & Theory*, 14(3), 207–215. <https://doi.org/10.1080/16066350500151747>
- Leventhal, H., Meyer, D., & Nerenz, D. (1980). The common sense model of illness danger. In S. Rachman (Ed.), *Medical Psychology* (Vol. 2, pp. 7–30).
- Li, C.-H. (2016). Confirmatory factor analysis with ordinal data: Comparing robust maximum likelihood and diagonally weighted least squares. *Behavior Research Methods*, 48(3), 936–949. <https://doi.org/10.3758/s13428-015-0619-7>
- Lord, F. M. (1952). The relation of the reliability of multiple-choice tests to the distribution of item difficulties. *Psychometrika*, 17(2), 181–194. <https://doi.org/10.1007/BF02288781>
- Maglia, M., Caponnetto, P., Di Piazza, J., La Torre, D., & Polosa, R. (2018). Dual use of electronic cigarettes and classic cigarettes: A systematic review. *Addiction Research & Theory*, 26(4), 330–338. <https://doi.org/10.1080/16066359.2017.1388372>
- McCrabb, S., Baker, A. L., Attia, J., Balogh, Z. J., Lott, N., Palazzi, K., Naylor, J., Harris, I. A., Doran, C. M., George, J., Wolfenden, L., Skelton, E., & Bonevski, B. (2019). Comorbid tobacco and other substance use and symptoms of anxiety and

- depression among hospitalised orthopaedic trauma patients. *BMC Psychiatry*, 19(1), 28. <https://doi.org/10.1186/s12888-019-2021-y>
- McDonald, R. P. (1999). *Test theory: A unified treatment*. Lawrence Erlbaum.
- McMurrin, M. (1994). Addiction: Misconduct and Disease. In *The Psychology of Addiction* (1st ed.). Taylor & Francis.
- Morean, M., Krishnan-Sarin, S., & O'Malley, S. S. (2018). Comparing cigarette and e-cigarette dependence and predicting frequency of smoking and e-cigarette use in dual-users of cigarettes and e-cigarettes. *Addictive Behaviors*, 87, 92–96. <https://doi.org/10.1016/j.addbeh.2018.06.027>
- Muthén, B. O., du Toit, S. H. C., & Spisic, D. (1997). *Robust inference using weighted least squares and quadratic estimating equations in latent variable modeling with categorical and continuous outcomes*.
- National Institute on Drug Abuse. (2018, July 28). *The science of drug use and addiction: The basics*. <https://archives.drugabuse.gov/publications/media-guide/science-drug-use-addiction-basics>
- National Institute on Drug Abuse. (2020, July 10). *Drug Misuse and Addiction*. <https://nida.nih.gov/publications/drugs-brains-behavior-science-addiction/drug-misuse-addiction>
- Nayak, P., Pechacek, T. F., Slovic, P., & Eriksen, M. P. (2017). Regretting ever starting to smoke: Results from a 2014 national survey. *International Journal of Environmental Research and Public Health*, 14(4), Article 4. <https://doi.org/10.3390/ijerph14040390>

- Neugebauer, J., Tóthová, V., & Doležalová, J. (2021). Use of standardized and non-standardized tools for measuring the risk of falls and independence in clinical practice. *International Journal of Environmental Research and Public Health*, *18*(6), 3226. <https://doi.org/10.3390/ijerph18063226>
- Obisesan, O. H., Osei, A. D., Uddin, S. M. I., Dzaye, O., Mirbolouk, M., Stokes, A., & Blaha, M. J. (2020). Trends in e-Cigarette Use in Adults in the United States, 2016-2018. *JAMA Internal Medicine*, *180*(10), 1394. <https://doi.org/10.1001/jamainternmed.2020.2817>
- Oliver, J. A., & Foulds, J. (2021). Association between cigarette smoking frequency and tobacco use disorder in u.s. Adults. *American Journal of Preventive Medicine*, *60*(5), 726–728. <https://doi.org/10.1016/j.amepre.2020.10.019>
- Palan, S., & Schitter, C. (2018). Prolific.ac—A subject pool for online experiments. *Journal of Behavioral and Experimental Finance*, *17*, 22–27. <https://doi.org/10.1016/j.jbef.2017.12.004>
- Perry, R. N., Girgulis, J. P., Harrison, S. L., & Barrett, S. P. (2023). Dual users' perceptions of the addictive properties of cigarettes versus E-cigarettes. *Addictive Behaviors*, *136*, 107483. <https://doi.org/10.1016/j.addbeh.2022.107483>
- Perski, O., Herd, N., West, R., & Brown, J. (2019). Perceived addiction to smoking and associations with motivation to stop, quit attempts and quitting success: A prospective study of English smokers. *Addictive Behaviors*, *90*, 306–311. <https://doi.org/10.1016/j.addbeh.2018.11.030>
- Pilkonis, P. A., Choi, S. W., Reise, S. P., Stover, A. M., Riley, W. T., Cella, D., & PROMIS Cooperative Group. (2011). Item Banks for Measuring Emotional

Distress From the Patient-Reported Outcomes Measurement Information System (PROMIS®): Depression, Anxiety, and Anger. *Assessment*, *18*(3), 263–283.

<https://doi.org/10.1177/1073191111411667>

Pokhrel, P., Fagan, P., Herzog, T. A., Laestadius, L., Buente, W., Kawamoto, C. T., Lee, H.-R., & Unger, J. B. (2018). Social media e-cigarette exposure and e-cigarette expectancies and use among young adults. *Addictive Behaviors*, *78*, 51–58.

<https://doi.org/10.1016/j.addbeh.2017.10.017>

Pokhrel, P., Lam, T. H., Pagano, I., Kawamoto, C. T., & Herzog, T. A. (2018). Young adult e-cigarette use outcome expectancies: Validity of a revised scale and a short scale. *Addictive Behaviors*, *78*, 193–199. APA PsycInfo®.

<https://doi.org/10.1016/j.addbeh.2017.11.019>

Pokhrel, P., Little, M. A., Fagan, P., Muranaka, N., & Herzog, T. A. (2014). Electronic cigarette use outcome expectancies among college students. *Addictive Behaviors*, *39*(6), Article 6. <https://doi.org/10.1016/j.addbeh.2014.02.014>

Prolific. (2024, March 13). *Who are the participants on Prolific?* <https://researcher-help.prolific.com/hc/en-gb/articles/360009220833-Who-are-the-participants-on-Prolific#:~:text=Participants%20are%20primarily%20recruited%20to,Flyer%20distribution%20on%20university%20campuses.>

Qualtrics. (2023, July). *Qualtrics*. <http://qualtrics.com>

Quisenberry, A. J., Pittman, J., Goodwin, R. D., Bickel, W. K., D’Urso, G., & Sheffer, C. E. (2019). Smoking relapse risk is increased among individuals in recovery. *Drug and Alcohol Dependence*, *202*, 93–103. APA PsycInfo®.

<https://doi.org/10.1016/j.drugalcdep.2019.07.001>

- Raykov, T., & Marcoulides, G. A. (2011). *Introduction to psychometric theory*.
Routledge.
- Respiratory Health Association. (2023). *Understanding tobacco use*.
<https://resphealth.org/healthy-lungs/quit-smoking/i-want-to-quit-smoking/frequently-asked-questions/>
- SAMHSA & Office of the Surgeon General. (2020). *Smoking Cessation: A Report of the Surgeon General*. <https://www.hhs.gov/sites/default/files/2020-cessation-sgr-full-report.pdf>
- Schneider, S., & Diehl, K. (2016). Vaping as a Catalyst for Smoking? An Initial Model on the Initiation of Electronic Cigarette Use and the Transition to Tobacco Smoking Among Adolescents. *Nicotine & Tobacco Research, 18*(5), 647–653.
<https://doi.org/10.1093/ntr/ntv193>
- Scott, C., & Biondolillo, M. (2022, September 8). *Lack of Standardized Data Collection Impedes Efforts to Advance Health Equity*. Premier.
<https://premierinc.com/newsroom/blog/lack-of-standardized-data-collection-impedes-efforts-to-advance-health-equity>
- Selekoğlu Ok, Y., Bektas, M., & Pokhrel, P. (2020). Psychometric properties of Turkish version of the E-cigarette Use Outcome Expectancies Scale. *Journal of Addictions Nursing, 31*(2), Article 2. <https://doi.org/10.1097/JAN.0000000000000338>
- Shiffman, S., Waters, A., & Hickcox, M. (2004). The Nicotine Dependence Syndrome Scale: A multidimensional measure of nicotine dependence. *Nicotine & Tobacco Research, 6*(2), 327–348. <https://doi.org/10.1080/1462220042000202481>

- Slaten, C., Bonifay, W., Sebastian, B., & Williams, M. S. (2023). Measuring Belongingness in Higher Education: Assessing the Relevance of the University Belongingness Questionnaire (UBQ) in Community College Settings. *Community College Journal of Research and Practice*, 1–18.
<https://doi.org/10.1080/10668926.2023.2256262>
- Slaten, C., Rose, C. A., Bonifay, W., & Ferguson, J. K. (2019). The Milwaukee Youth Belongingness Scale (MYBS): Development and validation of the scale utilizing item response theory. *School Psychology*, 34(3), 296–306.
<https://doi.org/10.1037/spq0000299>
- Song, A. V., Morrell, H. E. R., Cornell, J. L., Ramos, M. E., Biehl, M., Kropp, R. Y., & Halpern-Felsher, B. L. (2009). Perceptions of smoking-related risks and benefits as predictors of adolescent smoking initiation. *American Journal of Public Health*, 99(3), 487–492. <https://doi.org/10.2105/AJPH.2008.137679>
- Strong, D. R., Leas, E., Elton-Marshall, T., Wackowski, O. A., Travers, M., Bansal-Travers, M., Hyland, A., White, M., Noble, M., Cummings, K. M., Taylor, K., Kaufman, A. R., Choi, K., & Pierce, J. P. (2019). Harm perceptions and tobacco use initiation among youth in Wave 1 and 2 of the Population Assessment of Tobacco and Health (PATH) Study. *Preventive Medicine*, 123, 185–191.
<https://doi.org/10.1016/j.ypmed.2019.03.017>
- Tabachnick, B. G., Fidell, L. S., & Ullman, J. B. (2013). *Using multivariate statistics* (Seventh edition, Vol. 6). Pearson.
- Temourian, A. A., Halliday, D. M., & Song, A. V. (under review). *What do we know about addiction? A systematic review of nicotine measures.*

UCLA: Statistical Consulting Group. (n.d.). *NEGATIVE BINOMIAL REGRESSION*.

<https://stats.oarc.ucla.edu/stata/dae/negative-binomial-regression/>

United States Department of Health and Human Services. (2016). *E-Cigarette Use*

Among Youth and Young Adults: A Report of the Surgeon General.

https://www.ncbi.nlm.nih.gov/books/NBK538680/pdf/Bookshelf_NBK538680.pdf

United States Department Of Health And Human Services. (2021). *Population*

Assessment of Tobacco and Health (PATH) Study [United States] Public-Use

Files: Version 16 (Version v16) [dataset]. ICPSR - Interuniversity Consortium for

Political and Social Research. <https://doi.org/10.3886/ICPSR36498.V16>

World Health Organization. (2022, May 24). *Tobacco*. World Health Organization.

<https://www.who.int/news-room/fact-sheets/detail/tobacco>

World Health Organization. (2023, July 31). *Tobacco*. [https://www.who.int/news-](https://www.who.int/news-room/fact-sheets/detail/tobacco#:~:text=Cigarette%20smoking%20is%20the%20most,kreteks%2C%20and%20smokeless%20tobacco%20products)

[room/fact-](https://www.who.int/news-room/fact-sheets/detail/tobacco#:~:text=Cigarette%20smoking%20is%20the%20most,kreteks%2C%20and%20smokeless%20tobacco%20products)

[sheets/detail/tobacco#:~:text=Cigarette%20smoking%20is%20the%20most,kreteks%2C%20and%20smokeless%20tobacco%20products](https://www.who.int/news-room/fact-sheets/detail/tobacco#:~:text=Cigarette%20smoking%20is%20the%20most,kreteks%2C%20and%20smokeless%20tobacco%20products).

Worthington, R. L., & Whittaker, T. A. (2006). Scale Development Research: A Content

Analysis and Recommendations for Best Practices. *The Counseling Psychologist*,

34(6), 806–838. <https://doi.org/10.1177/0011000006288127>

Xie, S., Minami, H., Selva Kumar, D., Hecht, J., Litvin Bloom, E., Kahler, C. W.,

Abrantes, A., Price, L. H., Ondersma, S., & Brown, R. A. (2021). Readiness to

quit smoking among smokers in substance use treatment: Associations with stress,

substance use severity, relapse concerns and gender. *Journal of Substance Use*, 26(6), 669–676. <https://doi.org/10.1080/14659891.2021.1879295>

Zygmunt, C., & Smith, M. R. (2014). Robust factor analysis in the presence of normality violations, missing data, and outliers: Empirical questions and possible solutions. *The Quantitative Methods for Psychology*, 10(1), 40–55. <https://doi.org/10.20982/tqmp.10.1.p040>

Appendix A. Verbal Probe

Let me explain how the interview will work. I'm going to have you read some questions, I want you to tell me whatever comes into your mind as you read them and decide on a response.

Prompts

1. *Did you understand what the question was asking?*
2. *Were you able to clearly/definitively select a response?*
3. *Are the number of response options enough?*
4. *Is the quality of response options sufficient?*
5. *Do others agree with your opinion? If not, in what way do you disagree?*

Table 1. NAP Nicotine Addiction Perceptions (NAP) Scale Changes

Initial NAP	Final NAP
<p data-bbox="298 296 837 478">We want to understand what you believe addiction to be. Please indicate what you think are important markers for addiction. (1 = not at all important, 5 = very important)</p> <ol data-bbox="347 516 837 1822" style="list-style-type: none"> 1. <i>Smoking more now than when first started</i> 2. <i>Smoking increases in frequency</i> 3. <i>Smoking sessions get longer</i> 4. <i>Difficulty quitting smoking</i> 5. <i>Difficulty reducing smoking</i> 6. <i>Often thinking about quitting smoking</i> 7. <i>Often thinking about reducing smoking</i> 8. <i>Constantly want to quit smoking</i> 9. <i>Spending a lot of time thinking about the next smoking session</i> 10. <i>Most thoughts are related to how they can smoke again</i> 11. <i>Craving tobacco when not smoking</i> 12. <i>Smoking gets in the way of daily life</i> 13. <i>Smoking is a hindrance to daily life</i> 14. <i>Smoking negatively impacts work productivity</i> 15. <i>Arguing with people over smoking</i> 16. <i>Social life is negatively impacted by smoking</i> 17. <i>Smoking causes problems with one's social circle</i> 18. <i>Giving up a social life in order to smoke</i> 19. <i>Giving up part of a job because of smoking</i> 20. <i>Giving up hobbies because of smoking</i> 21. <i>Cutting down on hobbies because of smoking</i> 	<p data-bbox="862 296 1401 512">Below we are going to give you a list of behaviors related to nicotine based vapes/e-cigarettes. On a scale from 1-5, how important are any of these behaviors in telling you a person is addicted to vapes/e-cigarettes?</p> <ol data-bbox="959 550 1421 1822" style="list-style-type: none"> 1. <i>Vaping more now than when they first started</i> 2. <i>Taking more puffs/hits throughout the day</i> 3. <i>Taking more time per day to vape</i> 4. <i>Having difficulty quitting vaping</i> 5. <i>Having difficulty reducing their vaping</i> 6. <i>Often thinking about quitting vaping</i> 7. <i>Often thinking about reducing their vaping</i> 8. <i>Constantly wanting to quit vaping</i> 9. <i>Spending a lot of time thinking about the next time they can vape</i> 10. <i>Most thoughts are related to how they can vape again</i> 11. <i>Craving a vape when they are not vaping</i> 12. <i>Vaping gets in the way of their daily life</i> 13. <i>Vaping negatively impacts their work productivity</i> 14. <i>Arguing with other people over their vaping</i> 15. <i>Social life is negatively impacted by their vaping</i> 16. <i>Vaping causes problems with their social circle</i> 17. <i>Person gives up their social life in order to vape</i>

<p>22. <i>Smoking in places that might cause a fire</i></p> <p>23. <i>Continued smoking even though they are aware it is bad for them</i></p> <p>24. <i>Continued smoking even after experiencing negative health effects from smoking</i></p> <p>25. <i>Continued smoking even though it causes conflict in social relationships</i></p> <p>26. <i>Continued smoking even though it causes conflict in romantic relationships</i></p> <p>27. <i>Needing to use more tobacco to get the same buzz</i></p> <p>28. <i>Becoming irritable when they do not smoke</i></p> <p>29. <i>Becoming jumpy when they do not smoke</i></p> <p>30. <i>Having a hard time concentrating when they do not smoke</i></p> <p>31. <i>Having trouble sleeping when they do not smoke</i></p> <p>32. <i>Feeling anxious when they do not smoke</i></p> <p>33. <i>Feeling sad when they do not smoke</i></p>	<p>18. <i>Giving up part of their job because of vaping</i></p> <p>19. <i>Giving up hobbies because of vaping</i></p> <p>20. <i>Cutting down on hobbies because of vaping</i></p> <p>21. <i>Vaping in places that might cause a fire</i></p> <p>22. <i>Continued vaping even though they are aware it is bad for them</i></p> <p>23. <i>Continued vaping even after experiencing negative health effects from vaping</i></p> <p>24. <i>Continued vaping even though it causes conflict in their familial relationships</i></p> <p>25. <i>Continued vaping even though it causes conflict in their relationships with friends</i></p> <p>26. <i>Continued vaping even though it causes conflict in their romantic relationships</i></p> <p>27. <i>Needing to vape more to get the same buzz</i></p> <p>28. <i>Becoming irritable when they do not vape</i></p> <p>29. <i>Being on edge when they do not vape</i></p> <p>30. <i>Having a hard time concentrating when they do not vape</i></p> <p>31. <i>Having trouble sleeping when they do not vape</i></p> <p>32. <i>Feeling anxious when they do not vape</i></p> <p>33. <i>Feeling sad when they do not vape</i></p> <p>34. <i>Eating more when they do not vape</i></p> <p>35. <i>Drinking more alcoholic beverages when they do not vape</i></p>
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	<p><i>36. Drinking less alcoholic beverages when they do not vape</i></p>
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Table 2.NAP Prompt A Scale Changes

Prompt A Initial Version	Prompt A Final Version
<p data-bbox="298 296 834 506">Imagine you are a person who is addicted to nicotine. If you were addicted to nicotine, how would you answer the following questions, please answer the following questions as if you are addicted to nicotine.</p> <p data-bbox="298 552 776 621">How much would an addicted person agree with the following statements?</p> <ol data-bbox="347 659 834 1816" style="list-style-type: none"> 1. <i>I smoke more now than I used to</i> 2. <i>Over time, I find myself using tobacco more frequently</i> 3. <i>Over time, my smoking sessions have gotten longer</i> 4. <i>I find it difficult to quit smoking</i> 5. <i>I find it difficult to reduce my smoking</i> 6. <i>I believe I would be successful if I tried quitting smoking</i> 7. <i>I believe I would be successful if I tried to reduce my smoking</i> 8. <i>I often think about quitting smoking</i> 9. <i>I often think about reducing how much I smoke</i> 10. <i>When I am not smoking, I am spending a lot of time thinking about when I will smoke next</i> 11. <i>When I can't smoke, many of my thoughts are about how I can smoke again</i> 12. <i>When I am not smoking, I crave tobacco</i> 13. <i>My smoking gets in the way of my daily life</i> 14. <i>Smoking is a hindrance to my daily life</i> 15. <i>Smoking negatively impacts my ability at work</i> 16. <i>I have gotten into arguments with people over my smoking</i> 	<p data-bbox="873 296 1404 436">Imagine you are a person who is addicted to nicotine. If you were addicted to nicotine, how would you answer the following questions?</p> <p data-bbox="873 478 1349 548">How much would an addicted person agree with the following statements?</p> <ol data-bbox="922 590 1404 1816" style="list-style-type: none"> 1. <i>I vape more now than I used to</i> 2. <i>Over time, I find myself vaping more frequently per day</i> 3. <i>Over time, my vaping sessions have gotten longer</i> 4. <i>I find it difficult to quit vaping</i> 5. <i>I find it difficult to reduce my vaping</i> 6. <i>I believe I would be successful if I tried quitting vaping</i> 7. <i>I believe I would be successful if I tried to reduce my vaping</i> 8. <i>I often think about quitting vaping</i> 9. <i>I often think about reducing how much I vape</i> 10. <i>When I am not smoking, I am spending a lot of time thinking about when I will vape next</i> 11. <i>When I can't vape, many of my thoughts are about how I can vape again</i> 12. <i>When I am not vaping, I crave tobacco</i> 13. <i>My vaping gets in the way of my daily life</i> 14. <i>Vaping is a hindrance to my daily life</i> 15. <i>Vaping negatively impacts my ability at work</i> 16. <i>I have gotten into arguments with people over my vaping</i> 17. <i>Vaping hurts my social life</i> 18. <i>Vaping is a source of problems with those close to me</i>

<p>17. <i>Smoking hurts my social life</i></p> <p>18. <i>Smoking is a source of problems with those close to me</i></p> <p>19. <i>I have given up my social life in order to smoke</i></p> <p>20. <i>I've given up some of my job because of my smoking</i></p> <p>21. <i>I have given up hobbies because of my smoking</i></p> <p>22. <i>I don't participate in my hobbies as much as I used to because of my smoking</i></p> <p>23. <i>I have smoked in places where my smoking might cause a fire</i></p> <p>24. <i>Even though I know smoking is bad for me, I continue to smoke</i></p> <p>25. <i>Even though I experience negative health effects from smoking, I continue to smoke</i></p> <p>26. <i>Even though smoking causes conflict in my relationships, I continue to smoke</i></p> <p>27. <i>I need to use more tobacco to get the same buzz</i></p> <p>28. <i>When I do not smoke, I become irritable</i></p> <p>29. <i>When I do not smoke, I become jumpy</i></p> <p>30. <i>When I do not smoke, I have a hard time concentrating</i></p> <p>31. <i>When I do not smoke, I have trouble sleeping</i></p> <p>32. <i>When I do not smoke, I become anxious</i></p> <p>33. <i>When I do not smoke, I feel sad</i></p>	<p>19. <i>I have given up my social life in order to vape</i></p> <p>20. <i>I've given up some of my job because of my vaping</i></p> <p>21. <i>I have given up hobbies because of my vaping</i></p> <p>22. <i>I don't participate in my hobbies as much as I used to because of my vaping</i></p> <p>23. <i>I have vaped in places where my smoking might cause a fire</i></p> <p>24. <i>Even though I know vaping is bad for me, I continue to smoke</i></p> <p>25. <i>Even though I experience negative health effects from vaping, I continue to vape</i></p> <p>26. <i>Even though vaping causes conflict in my romantic relationships, I continue to vape</i></p> <p>27. <i>Even though vaping causes conflict in my familial relationships, I continue to vape</i></p> <p>28. <i>Even though vaping causes conflict within my friendships, I continue to vape</i></p> <p>29. <i>I need to vape more to get the same buzz</i></p> <p>30. <i>When I do not vape, I become irritable</i></p> <p>31. <i>When I do not vape, I become on edge</i></p> <p>32. <i>When I do not vape, I have a hard time concentrating</i></p> <p>33. <i>When I do not vape, I have trouble sleeping</i></p> <p>34. <i>When I do not vape, I become anxious</i></p> <p>35. <i>When I do not vape, I feel sad</i></p> <p>36. <i>When I do not vape, I eat more</i></p> <p>37. <i>When I do not vape, I eat less</i></p> <p>38. <i>When I do not vape, I drink more</i></p> <p>39. <i>When I do not vape, I drink less</i></p>
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Appendix B. Prompt 1A

Imagine you are a person who is addicted to nicotine. If you were addicted to nicotine, how would you answer the following questions, please answer the following questions as if you are addicted to nicotine.

How much would an addicted person agree with the following statements?

34. *I smoke more now than I used to*
35. *Over time, I find myself using tobacco more frequently*
36. *Over time, my smoking sessions have gotten longer*
37. *I find it difficult to quit smoking*
38. *I find it difficult to reduce my smoking*
39. *I believe I would be successful if I tried quitting smoking*
40. *I believe I would be successful if I tried to reduce my smoking*
41. *I often think about quitting smoking*
42. *I often think about reducing how much I smoke*
43. *When I am not smoking, I am spending a lot of time thinking about when I will smoke next*
44. *When I can't smoke, many of my thoughts are about how I can smoke again*
45. *When I am not smoking, I crave tobacco*
46. *My smoking gets in the way of my daily life*
47. *Smoking is a hindrance to my daily life*
48. *Smoking negatively impacts my ability at work*
49. *I have gotten into arguments with people over my smoking*
50. *Smoking hurts my social life*
51. *Smoking is a source of problems with those close to me*
52. *I have given up my social life in order to smoke*
53. *I've given up some of my job because of my smoking*
54. *I have given up hobbies because of my smoking*
55. *I don't participate in my hobbies as much as I used to because of my smoking*
56. *I have smoked in places where my smoking might cause a fire*
57. *Even though I know smoking is bad for me, I continue to smoke*
58. *Even though I experience negative health effects from smoking, I continue to smoke*
59. *Even though smoking causes conflict in my relationships, I continue to smoke*
60. *I need to use more tobacco to get the same buzz*
61. *When I do not smoke, I become irritable*
62. *When I do not smoke, I become jumpy*
63. *When I do not smoke, I have a hard time concentrating*
64. *When I do not smoke, I have trouble sleeping*
65. *When I do not smoke, I become anxious*
66. *When I do not smoke, I feel sad*

Appendix C. Prompt 2A

Imagine you are a person who is addicted to nicotine. If you were addicted to nicotine, how would you answer the following questions?

How much would an addicted person agree with the following statements?

40. *I vape more now than I used to*
41. *Over time, I find myself vaping more frequently per day*
42. *Over time, my vaping sessions have gotten longer*
43. *I find it difficult to quit vaping*
44. *I find it difficult to reduce my vaping*
45. *I believe I would be successful if I tried quitting vaping*
46. *I believe I would be successful if I tried to reduce my vaping*
47. *I often think about quitting vaping*
48. *I often think about reducing how much I vape*
49. *When I am not smoking, I am spending a lot of time thinking about when I will vape next*
50. *When I can't vape, many of my thoughts are about how I can vape again*
51. *When I am not vaping, I crave tobacco*
52. *My vaping gets in the way of my daily life*
53. *Vaping is a hindrance to my daily life*
54. *Vaping negatively impacts my ability at work*
55. *I have gotten into arguments with people over my vaping*
56. *Vaping hurts my social life*
57. *Vaping is a source of problems with those close to me*
58. *I have given up my social life in order to vape*
59. *I've given up some of my job because of my vaping*
60. *I have given up hobbies because of my vaping*
61. *I don't participate in my hobbies as much as I used to because of my vaping*
62. *I have vaped in places where my smoking might cause a fire*
63. *Even though I know vaping is bad for me, I continue to smoke*
64. *Even though I experience negative health effects from vaping, I continue to vape*
65. *Even though vaping causes conflict in my romantic relationships, I continue to vape*
66. *Even though vaping causes conflict in my familial relationships, I continue to vape*
67. *Even though vaping causes conflict within my friendships, I continue to vape*
68. *I need to vape more to get the same buzz*
69. *When I do not vape, I become irritable*
70. *When I do not vape, I become on edge*
71. *When I do not vape, I have a hard time concentrating*
72. *When I do not vape, I have trouble sleeping*
73. *When I do not vape, I become anxious*
74. *When I do not vape, I feel sad*
75. *When I do not vape, I eat more*

76. *When I do not vape, I eat less*
77. *When I do not vape, I drink more*
78. *When I do not vape, I drink less*

Appendix D. Prompt 1B

We want to understand what you believe addiction to be. Please indicate what you think are important markers for addiction. (1 = not at all important, 5 = very important)

34. *Smoking more now than when first started*
35. *Smoking increases in frequency*
36. *Smoking sessions get longer*
37. *Difficulty quitting smoking*
38. *Difficulty reducing smoking*
39. *Often thinking about quitting smoking*
40. *Often thinking about reducing smoking*
41. *Constantly want to quit smoking*
42. *Spending a lot of time thinking about the next smoking session*
43. *Most thoughts are related to how they can smoke again*
44. *Craving tobacco when not smoking*
45. *Smoking gets in the way of daily life*
46. *Smoking is a hindrance to daily life*
47. *Smoking negatively impacts work productivity*
48. *Arguing with people over smoking*
49. *Social life is negatively impacted by smoking*
50. *Smoking causes problems with one's social circle*
51. *Giving up a social life in order to smoke*
52. *Giving up part of a job because of smoking*
53. *Giving up hobbies because of smoking*
54. *Cutting down on hobbies because of smoking*
55. *Smoking in places that might cause a fire*
56. *Continued smoking even though they are aware it is bad for them*
57. *Continued smoking even after experiencing negative health effects from smoking*
58. *Continued smoking even though it causes conflict in social relationships*
59. *Continued smoking even though it causes conflict in romantic relationships*
60. *Needing to use more tobacco to get the same buzz*
61. *Becoming irritable when they do not smoke*
62. *Becoming jumpy when they do not smoke*
63. *Having a hard time concentrating when they do not smoke*
64. *Having trouble sleeping when they do not smoke*
65. *Feeling anxious when they do not smoke*
66. *Feeling sad when they do not smoke*

Appendix E. Prompt 2B

We want to understand what you believe addiction to be. Please imagine someone who is addicted to e-cigarettes/vapes. Please indicate what you think are important markers for addiction. (1 = not at all important, 5 = very important)

1. *Vaping more now than when first started*
2. *Vaping increases in frequency*
3. *Vaping sessions get longer*
4. *Difficulty quitting vaping*
5. *Difficulty reducing vaping*
6. *Often thinking about quitting vaping*
7. *Often thinking about reducing vaping*
8. *Constantly want to quit vaping*
9. *Spending a lot of time thinking about the next vaping session*
10. *Most thoughts are related to how they can vape again*
11. *Craving a vape when not smoking*
12. *Vaping gets in the way of daily life*
13. *Vaping is a hindrance to daily life*
14. *Vaping negatively impacts work productivity*
15. *Arguing with people over vaping*
16. *Social life is negatively impacted by vaping*
17. *Vaping causes problems with one's social circle*
18. *Giving up a social life in order to vape*
19. *Giving up part of a job because of vaping*
20. *Giving up hobbies because of vaping*
21. *Cutting down on hobbies because of vaping*
22. *Vaping in places that might cause a fire*
23. *Continued vaping even though they are aware it is bad for them*
24. *Continued vaping even after experiencing negative health effects from vaping*
25. *Continued vaping even though it causes conflict in familial relationships*
26. *Continued vaping even though it causes conflict in relationships with friends*
27. *Continued vaping even though it causes conflict in romantic relationships*
28. *Needing to vape more to get the same buzz*
29. *Becoming irritable when they do not vape*
30. *Being on edge when they do not vape*
31. *Having a hard time concentrating when they do not vape*
32. *Having trouble sleeping when they do not vape*
33. *Feeling anxious when they do not vape*
34. *Feeling sad when they do not vape*
35. *Eating more when they do not vape*
36. *Eating less when they do not vape*
37. *Drinking more when they do not vape*
38. *Drinking less when they do not vape*

Appendix F. Cognitive Interviews-Specific Feedback

Prompt 1A. Participant 1 responded neutrally to candidate item 2 which prompted a discussion regarding the word “tobacco” and what that encompassed. Following some discussion, the need to specify tobacco consumption modality was evident (i.e., vapes/e-cigarette, cigarettes, hookah, etc.). Participant 1 responded neutrally to candidate item 26 which prompted a discussion regarding the term “relationships”. During this interview, the need to specify the type of relationship became evident when Participant 1 disclosed they would respond differently across relationships (i.e., romantic vs social/friends).

Prompt 2A. Adjusting the scale language to relate only to vaping products reduced confusion for this group of participants. In the cognitive interview for this prompt, there was no confusion or need for clarification regarding the term “vaping”. Participant 4 needed the term “hindrance” in item 14 to be defined to respond, which suggests the need to use more accessible language in future adaptations of this scale. For candidate item 15, participant 4 reported ambiguity in the term “work” and said they would respond differently between schoolwork and employment. For candidate item 36, the participant also reported the term “drink” to be too ambiguous (i.e., non-alcoholic vs. alcoholic drinks) and said they would respond differently between these two different types of drinks.

Prompt 1B. Participants 2 and 3 requested clarification for item 2 “Smoking increases in frequency”; more specifically, what “frequency” entails. For the purposes of this interview, the facilitator specified a frequency of “per day”. Regarding candidate item 22, participant 2 argued that starting a fire would not relate to e-cigarettes unless people deliberately opened the battery area and connected specific wires to one another in order to ignite a fire. For item 25, participant 3 asked for clarification on the term “social relationship” and disclosed they would respond differently between friendships and familial relationships. Participant 2 suggested that instead of using the term “jumpy” for item 29, the phrase “on edge” be used instead. The facilitator asked whether there were other behaviors they thought would be exacerbated/reduced when not smoking, to which they responded with changes in eating behavior. Following a discussion with an expert in tobacco control, the decision was made to add more items to further specify types of personal relationships and withdrawal symptoms (i.e., eating more or less, drinking more or less).

Prompt 2B. Similar to participants 2 and 3, participant 5 requested clarity for item 2 “Vaping increases in frequency”; as before, the facilitator specified “per day” to provide a reference of time. This led to a discussion of binge behaviors related to vaping; people may vape more over the weekend given they have more time for social activities (e.g., parties) so “per day” may not always apply. Near the beginning of the cognitive interview, participant 4 wanted to discuss the ambiguity in response options; the facilitator suggested thinking about the response options as how important of a marker each item is whether someone is addicted to nicotine (in their opinion). Regarding item 14 “Vaping negatively impacts work productivity”, participant 5 noted that separating between schoolwork and employment would help them select a more definitive response. For items 37 and 38, participant 2 also noted the ambiguity in the term “drinking” and asked whether that encompassed alcoholic or non-alcoholic beverages. During the

cognitive interview, the facilitator asked the participant to respond verbally for both forms of beverages.

Prompt 3B. Hindrance needed to be defined for both participants 6 and 7.

Anchoring candidate items with the term “person” was not favored by participants 6 and 7 so the decision was made to revert back to candidate item phrasing used in prompt 2B for future versions of the survey.

Prompt 4B. Hindrance needed to be defined for participants 8 and 9. Participants 8 and 9 suggested adding the term “their” to candidate item 15 to clarify that a person argues with others over *their* vaping, not just arguing with others over vaping in general. Participants 8 and 9 suggested removing item 36 as eating less when a person does not vape is counter-intuitive to what vaping does (e.g., since nicotine curbs hunger, eating less when they are not vaping did not make sense to them). Though previously separated into alcoholic and non-alcoholic beverages, participants 8 and 9 suggested removing items assessing consumption of non-alcoholic beverages.

Appendix G. Nicotine Addiction Perceptions (NAP) scale

Below we are going to give you a list of behaviors related to **nicotine based vapes/e-cigarettes**. On a scale from 1-5, how important are any of these behaviors in telling you a person is addicted to **vapes/e-cigarettes**?

1. *Vaping more now than when they first started*
2. *Taking more puffs/hits throughout the day*
3. *Taking more time per day to vape*
4. *Having difficulty quitting vaping*
5. *Having difficulty reducing their vaping*
6. *Often thinking about quitting vaping*
7. *Often thinking about reducing their vaping*
8. *Constantly wanting to quit vaping*
9. *Spending a lot of time thinking about the next time they can vape*
10. *Most thoughts are related to how they can vape again*
11. *Craving a vape when they are not smoking*
12. *Vaping gets in the way of their daily life*
13. *Vaping negatively impacts their work productivity*
14. *Arguing with other people over their vaping*
15. *Social life is negatively impacted by their vaping*
16. *Vaping causes problems with their social circle*
17. *Person gives up their social life in order to vape*
18. *Giving up part of their job because of vaping*
19. *Giving up hobbies because of vaping*
20. *Cutting down on hobbies because of vaping*
21. *Vaping in places that might cause a fire*
22. *Continued vaping even though they are aware it is bad for them*
23. *Continued vaping even after experiencing negative health effects from vaping*
24. *Continued vaping even though it causes conflict in their familial relationships*
25. *Continued vaping even though it causes conflict in their relationships with friends*
26. *Continued vaping even though it causes conflict in their romantic relationships*
27. *Needing to vape more to get the same buzz*
28. *Becoming irritable when they do not vape*
29. *Being on edge when they do not vape*
30. *Having a hard time concentrating when they do not vape*
31. *Having trouble sleeping when they do not vape*
32. *Feeling anxious when they do not vape*
33. *Feeling sad when they do not vape*
34. *Eating more when they do not vape*
35. *Drinking more alcoholic beverages when they do not vape*
36. *Drinking less alcoholic beverages when they do not vape*

Table 3. Removed items from EFA and reasoning

Item	Reason for Removal	Loading(s) & Factor(s)
10. Most thoughts are related to how they can vape again	poor factor loading	0.47 (Withdrawal)
20. Cutting down on hobbies because of vaping		0.53 (Social impact)
32. Feeling anxious when they do not vape		0.37 (Withdrawal)
9. Spending a lot of time thinking about the next time they can vape	Loads poorly onto two factors	0.38 (Withdrawal) 0.30 (Tolerance)
11. Craving a vape when they are not smoking		0.36 (Withdrawal) 0.37 (Tolerance)
14. Arguing with other people over their vaping		0.37 (Withdrawal) 0.47 (Tolerance)
15. Social life is negatively impacted by their vaping		0.44 (Withdrawal) 0.48 (Persistent desire to quit/reduce use)
16. Vaping causes problems with their social circle		0.44 (Withdrawal) 0.35 (Tolerance)
4. Having difficulty quitting vaping	Loads poorly onto three factors	0.30 (Withdrawal) 0.28 (Tolerance) 0.38 (Persistent desire to quit/reduce use)
5. Having difficulty reducing their vaping		0.26 (Withdrawal) 0.28 (Tolerance) 0.35 (Persistent desire to quit/reduce use)
33. Feeling sad when they do not vape		0.20 (Withdrawal) 0.22 (Tolerance) 0.20 (Persistent desire to quit/reduce use)

Table 4. Results From a Factor Analysis of the Nicotine Addiction Perceptions (NAP) Scale- Best Fitting Model

NAP item	Factor loading					
	1	2	3	4	5	6
Factor 1: Continued use despite negative consequences						
21. Vaping in places that might cause a fire	0.81	-0.16	0	0.09	0.06	0.06
22. Continued vaping even though they are aware it is bad for them	0.85	0.03	0.05	-0.16	0.02	0.14
23. Continued vaping even after experiencing negative health effects from vaping	0.66	0.11	0.07	0.05	0.04	0.1
24. Continued vaping even though it causes conflict in their familial relationships	0.82	0.04	0.03	0.08	0.06	-0.04
25. Continued vaping even though it causes conflict in their relationships with friends	0.79	0.11	0	0.13	0.03	-0.06
26. Continued vaping even though it causes conflict in their romantic relationships	0.67	0.19	0.1	0.05	0.03	-0.06
Factor 2: Withdrawal						
27. Needing to vape more to get the same buzz	0.27	0.51	0.16	-0.05	-0.07	0.1
28. Becoming irritable when they do not vape	0.03	0.79	0.02	0.15	0.09	0
29. Being on edge when they do not vape	0.01	0.81	0.05	0.1	0.07	0.05
30. Having a hard time concentrating when they do not vape	0.14	0.50	0.14	0.13	0	0.19
31. Having trouble sleeping when they do not vape	0.27	0.53	0.12	0.03	-0.05	0.15
Factor 3: Tolerance						
1. Vaping more now than when they first started	-0.01	0.07	0.91	-0.09	0.06	-0.04
2. Taking more puffs/hits throughout the day	0.01	-0.09	0.93	0.07	-0.01	0.05
3. Taking more time per day to vape	0.03	0.03	0.85	0.05	0	-0.01
Factor 4: Social Impact						
12. Vaping gets in the way of their daily life	0.01	0.24	0.18	0.58	0.08	0.04
13. Vaping negatively impacts their work productivity	0.09	0.1	0.21	0.55	0.02	0.11
17. Person gives up their social life in order to vape	0.16	0.13	0.08	0.64	0.05	0.06
18. Giving up part of their job because of vaping	0.17	0.17	0.06	0.60	0.06	0.08
19. Giving up hobbies because of vaping	0.09	0.17	0.08	0.56	0.09	0.14
Factor 5: Consistent desire to quit/reduce use						

6. Often thinking about quitting vaping	0.01	-0.01	-0.01	-0.02	0.92	0.04
7. Often thinking about reducing their vaping	-0.04	0.02	0.05	-0.06	0.96	0.03
8. Constantly wanting to quit vaping	0.1	-0.02	-0.02	0.13	0.80	-0.05
Factor 6: Substitution to other behavior						
34. Eating more when they do not vape	-0.03	0.09	0.02	0.01	0.05	0.84
35. Drinking more alcoholic beverages when they do not vape	0.12	-0.09	0.11	0.29	0.03	0.59
36. Drinking less alcoholic beverages when they do not vape	0.1	0.01	-0.07	-0.1	0.14	0.60

Note. $N = 177$. The extraction method was principal axis factoring with an oblique rotation (oblimin). Factor loadings above .50 are in bold.

Table 5. SONA Sample Descriptive Statistics (%)

	Current Non-Vapers (n = 154)	Current Vapers (n= 25)	Total Sample (n = 179)
Gender			
Female			79.78
Male			16.85
Other			3.37
Age (Mean, SD)			20.53 (2.69)
Race/Ethnicity			
Asian American			21.23
Hispanic/Latinx			65.17
White Non-Hispanic			10.11
Other			3.49
Annual Income			
Up to \$10,000			12.36
\$11,000 - \$25,000			12.36
\$25,001 - \$50,000			17.98
\$50,001 - \$75,000			11.24
\$75,001 - \$100,000			10.11
\$100,001 - \$200,000			8.43
Over \$200,000			1.69
Unsure			25.84
Parent owns home			52.25
Ever e-cigarette user			44.13
Current cigarette user			1.68
Primary reason for using e-cigarettes			
To quit smoking			8.00
To cut down smoking			--
To use when cannot or are not allowed to smoke			8.00
Enjoyment			28.00
Curiosity			48.00
Other			8.00
E-cigarette Initiation Intentions			
No intention	99.35	--	--
Within next 6 months, but not 30 days	0.65	--	--
Within next 30 days	--	--	--
E-cigarette Cessation Intentions			
No intention	--	40.00	--
Within next 6 months, but not 30 days	--	32.00	--
Within next 30 days	--	28.00	--
E-cigarette Composition			
Nicotine	--	76.00	--

Mint or Menthol flavor	--	31.82	--
Some other flavor	--	59.09	--
CBD	--	33.33	--
THC	--	52.17	--
Own mix	--	--	--
Daily E-cigarette Use			
1-9 times per day	--	61.90	--
10-24 times per day	--	23.81	--
25+ times per day	--	14.29	--
Monthly E-cigarette Use			
1-10 days per month	--	62.50	--
11-24 days per month	--	16.67	--
25 + days per month	--	20.83	--

Figure 1. Exploratory Factor Analysis Scree Plot

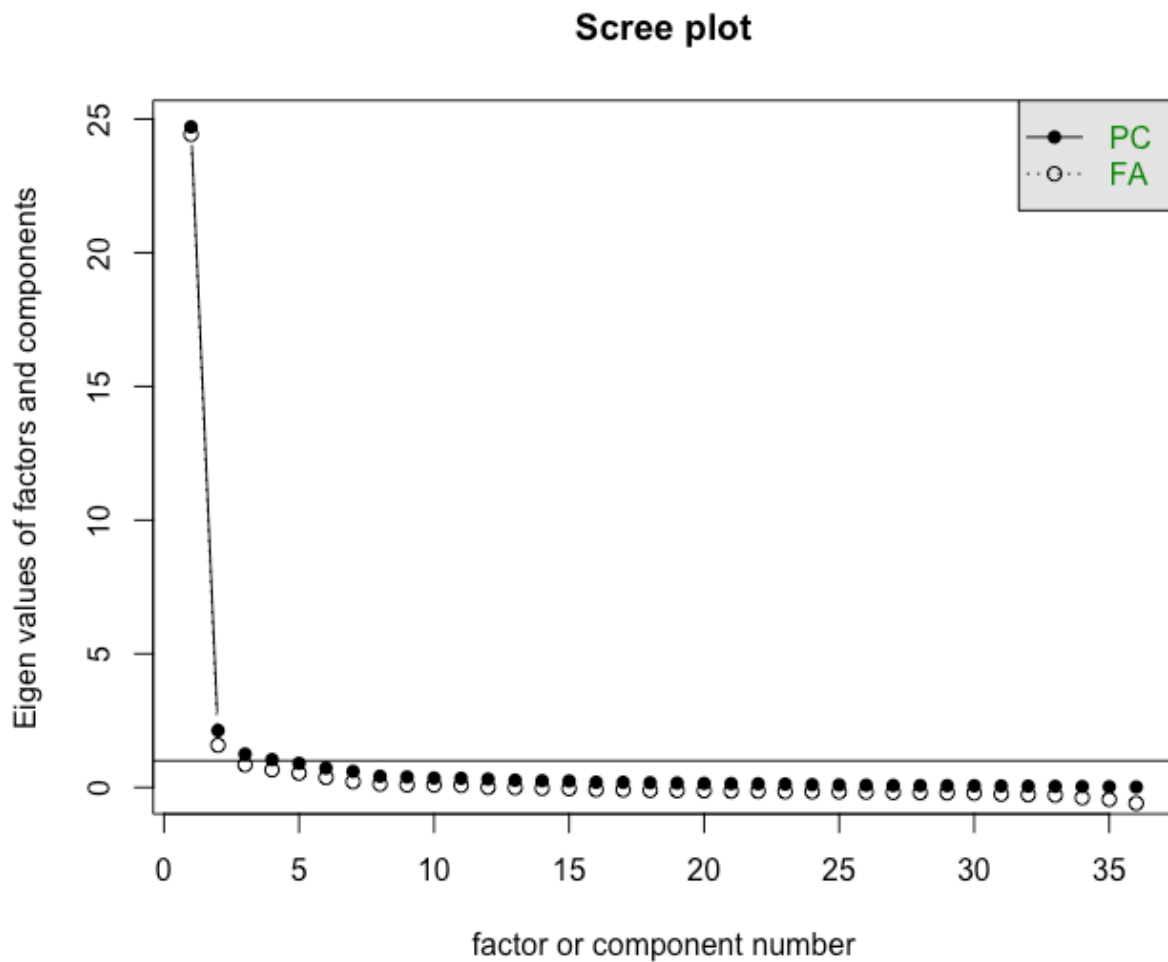


Figure 1. Exploratory Factor Analysis Scree Plot

Table 6. Results From a Factor Analysis of the Nicotine Addiction Perceptions (NAP) Scale- All items

NAP item	Factor loading					
	1	2	3	4	5	6
Factor 1: Withdrawal						
9. Spending a lot of time thinking about the next time they can vape	0.38	0.04	0.3	0.22	0.07	0.05
10. Most thoughts are related to how they can vape again	0.48	0.14	0.21	0.2	0.03	0.05
11. Craving a vape when they are not smoking	0.36	0.05	0.37	0.2	0.06	0
27. Needing to vape more to get the same buzz	0.49	0.24	0.16	-0.03	0.1	-0.03
28. Becoming irritable when they do not vape	0.79	0.05	0.02	0.11	0	0.11
29. Being on edge when they do not vape	0.75	0.05	0.05	0.09	0.06	0.08
30. Having a hard time concentrating when they do not vape	0.52	0.14	0.13	0.08	0.22	0.02
31. Having trouble sleeping when they do not vape	0.61	0.23	0.11	-0.05	0.17	-0.03
32. Feeling anxious when they do not vape	0.51	0.2	0.11	0.03	0.25	-0.01
Factor 2: Continued vaping despite negative consequences						
14. Arguing with other people over their vaping	0.06	0.46	0.02	0.38	0.13	0
15. Social life is negatively impacted by their vaping	-0.05	0.51	0.1	0.48	0.08	0.02
16. Vaping causes problems with their social circle	-0.02	0.49	0.24	0.31	0.08	-0.01
21. Vaping in places that might cause a fire	-0.13	0.76	0.02	0.07	0.08	0.11
22. Continued vaping even though they are aware it is bad for them	0.08	0.72	0.06	-0.16	0.15	0.09
23. Continued vaping even after experiencing negative health effects from vaping	0.26	0.54	0.07	-0.08	0.15	0.1
24. Continued vaping even though it causes conflict in their familial relationships	0.14	0.71	0.06	0.01	0	0.12
25. Continued vaping even though it causes conflict in their relationships with friends	0.18	0.7	0.04	0.08	-0.01	0.08
26. Continued vaping even though it causes conflict in their romantic relationships	0.19	0.62	0.13	0.05	-0.03	0.06
Factor 3: Craving/Tolerance						
1. Vaping more now than when they first started	0.02	0.01	0.92	-0.09	-0.05	0.06
2. Taking more puffs/hits throughout the day	-0.09	0.01	0.94	0.02	0.07	0
3. Taking more time per day to vape	0.04	0.02	0.87	0.02	0	0.01

11. Craving a vape when they are not smoking	0.36	0.05	0.37	0.2	0.06	0
Factor 4: Social Impact						
4. Having difficulty quitting vaping	0.28	0	0.27	0.39	0	0.14
5. Having difficulty reducing their vaping	0.24	-0.07	0.28	0.39	0.1	0.21
12. Vaping gets in the way of their daily life	0.31	0.03	0.18	0.49	0.08	0.1
13. Vaping negatively impacts their work productivity	0.15	0.12	0.21	0.47	0.16	0.03
17. Person gives up their social life in order to vape	0.25	0.19	0.06	0.49	0.11	0.08
18. Giving up part of their job because of vaping	0.31	0.16	0.05	0.45	0.12	0.1
19. Giving up hobbies because of vaping	0.25	0.09	0.06	0.48	0.19	0.11
20. Cutting down on hobbies because of vaping	0.23	0.17	0.17	0.38	0.14	0.04
Factor 5: Substitution to other behavior						
33. Feeling sad when they do not vape	0.27	0.12	0.2	-0.1	0.48	0
34. Eating more when they do not vape	0.03	-0.07	-0.01	-0.03	0.95	0.04
35. Drinking more alcoholic beverages when they do not vape	-0.06	0.08	0.09	0.18	0.68	0.05
36. Drinking less alcoholic beverages when they do not vape	-0.12	0.13	-0.08	-0.05	0.59	0.14
Factor 6: Unsuccessful quitting/reduction						
6. Often thinking about quitting vaping	-0.03	0	-0.03	-0.03	0.02	0.96
7. Often thinking about reducing their vaping	-0.03	-0.03	0.03	-0.05	0.01	0.97
8. Constantly wanting to quit vaping	0.03	0.07	-0.02	0.06	-0.03	0.82

Note. $N = 177$. The extraction method was principal axis factoring with an oblique (oblimin) rotation. Factor loadings above .35 are in bold.

Table 7. Six Factor Correlation Table

Factor	1	2	3	4	5	6
1. Continued use despite negative consequences	-					
2. Withdrawal	.69	-				
3. Tolerance	.68	.68	-			
4. Social Impact	.62	.66	.61	-		
5. Consistent desire to quit/reduce use	.57	.36	.51	.35	-	
6. Substitution to other behavior	.61	.46	.51	.41	.53	-

Appendix H. Final Nicotine Addiction Perceptions (NAP) scale

Below we are going to give you a list of behaviors related to **nicotine based vapes/e-cigarettes**. On a scale from 1-5, how important are any of these behaviors in telling you a person is addicted to **vapes/e-cigarettes**?

1. *Vaping more now than when they first started*
2. *Taking more puffs/hits throughout the day*
3. *Taking more time per day to vape*
4. *Having difficulty quitting vaping*
5. *Having difficulty reducing their vaping*
6. *Often thinking about quitting vaping*
7. *Often thinking about reducing their vaping*
8. *Constantly wanting to quit vaping*
9. *Spending a lot of time thinking about the next time they can vape*
10. *Most thoughts are related to how they can vape again*
11. *Craving a vape when they are not vaping*
12. *Vaping gets in the way of their daily life*
13. *Vaping negatively impacts their work productivity*
14. *Arguing with other people over their vaping*
15. *Social life is negatively impacted by their vaping*
16. *Vaping causes problems with their social circle*
17. *Person gives up their social life in order to vape*
18. *Giving up part of their job because of vaping*
19. *Giving up hobbies because of vaping*
20. *Cutting down on hobbies because of vaping*
21. *Vaping in places that might cause a fire*
22. *Continued vaping even though they are aware it is bad for them*
23. *Continued vaping even after experiencing negative health effects from vaping*
24. *Continued vaping even though it causes conflict in their familial relationships*
25. *Continued vaping even though it causes conflict in their relationships with friends*
26. *Continued vaping even though it causes conflict in their romantic relationships*
27. *Needing to vape more to get the same buzz*
28. *Becoming irritable when they do not vape*
29. *Being on edge when they do not vape*
30. *Having a hard time concentrating when they do not vape*
31. *Having trouble sleeping when they do not vape*
32. *Feeling anxious when they do not vape*
33. *Feeling sad when they do not vape*
34. *Eating more when they do not vape*
35. *Drinking more alcoholic beverages when they do not vape*
36. *Drinking less alcoholic beverages when they do not vape*

Table 8. Prolific Sample Descriptive Statistics (%)

	Non-Vapers (n = 275)	Vapers (n= 274)	Total Sample (n = 549)
Gender			
Female	49.09	43.07	46.08
Male	47.27	55.47	51.37
Other	3.64	1.46	2.55
Age (Mean, SD)	38.68 (13.49)	40.44 (11.72)	39.56 (12.66)
Race/Ethnicity			
African-American/Black	8.36	21.17	14.75
Hispanic	10.18	13.14	11.66
White Non-Hispanic	68.36	56.57	62.48
Other	13.09	9.12	11.11
Education Level			
High school or lower	12.36	12.77	12.57
Some college or Associate's degree	29.45	38.69	34.06
Bachelor's degree	38.55	41.24	39.89
Graduate or Professional degree	19.64	7.30	13.48
Annual Income			
Up to \$10,000	3.64	2.92	3.28
\$11,000 - \$25,000	10.55	12.41	11.48
\$25,001 - \$50,000	22.55	22.63	22.59
\$50,001 - \$75,000	20.73	18.98	19.85
\$75,001 - \$100,000	16.36	13.87	15.12
\$100,001 - \$200,000	18.18	27.37	22.77
Over \$200,000	7.64	1.82	4.74
Current cigarette user	8.00	47.84	34.62
Primary reason for using e-cigarettes			
To quit smoking	7.26	25.18	19.60
To cut down smoking	3.23	20.07	14.82
To use when cannot or are not allowed to smoke	1.61	8.03	6.03
Enjoyment	2.42	41.61	29.40
Curiosity	83.06	3.65	28.39
Other	2.42	1.46	1.76
E-cigarette Initiation Intentions			
No intention	97.09	--	--
Within next 6 months, but not 30 days	0.73	--	--
Within next 30 days	2.18	--	--
E-cigarette Cessation Intentions			
No intention	--	49.27	--
Within next 6 months, but not 30 days	--	13.14	--

Within next 30 days	--	37.59	--
E-cigarette Composition			
Nicotine	64.71	82.12	76.84
Mint or Menthol flavor	28.57	51.82	44.78
Some other flavor	65.55	67.52	66.92
CBD	26.05	23.72	24.37
THC	36.97	30.29	32.32
Own mix	0.84	10.95	7.89
Daily E-cigarette Use			
1-9 times per day	--	46.52	--
10-24 times per day	--	28.21	--
25+ times per day	--	25.27	--
Monthly E-cigarette Use			
2-10 days per month	--	18.98	--
11-24 days per month	--	20.80	--
25 + days per month	--	60.22	--

Note. SD = standard deviation.

Table 9. Six Factor CFA Solution

Factor	Item	Factor Loading
Continued use despite negative consequences	21	0.622
	22	0.734
	23	0.817
	24	0.814
	25	0.831
	26	0.852
Withdrawal	11	0.798
	27	0.780
	28	0.864
	29	0.855
	30	0.882
Tolerance	31	0.849
	1	0.847
	2	0.883
Social Impact	3	0.917
	12	0.888
	13	0.861
	17	0.899
	18	0.858
Consistent desire to quit/reduce use	19	0.828
	6	0.834
	7	0.818
Substitution to other behavior	8	0.895
	34	0.812
	35	0.859
	36	0.250

Note. Factor loadings are standardized

Table 10. Fit indices for CFA

Model	χ^2 (df)	RMSEA (90% CI)	CFI	TLI	SRMR
6 factor model	766.528 (284)*	0.056 (0.051, 0.060)	0.794	0.765	0.044
5 factor model	518.808(220)*	0.050 (0.044, 0.055)	0.854	0.832	0.041

Note: $N = 549$. All values are robust. RMSEA = root mean-square error of approximation; CI; Confidence Interval; CFI = Comparative fit Index; TLI = Tucker Lewis Index; SRMR = standardized root mean-square residual.

* $p < 0.001$

Table 11. Five Factor CFA Solution

Factor	Item	Factor Loading
Continued use despite negative consequences	21	0.611
	22	0.728
	23	0.829
	24	0.820
	25	0.829
	26	0.857
Withdrawal	11	0.803
	27	0.780
	28	0.866
	29	0.856
	30	0.881
	31	0.841
Tolerance	1	0.843
	2	0.885
	3	0.919
Social Impact	12	0.892
	13	0.860
	17	0.899
	18	0.860
	19	0.824
Consistent desire to quit/reduce use	6	0.833
	7	0.815
	8	0.898

Note. Factor loadings are standardized

Table 12. Item Analysis

	Sample.SD	Item.total	Item.Tot.woi	Difficulty (Mean)	Discrimination	Item.Reliab	Item.Rel.woi
NAP_1	1.08	0.67	0.63	3.72	0.67	0.72	0.68
NAP_2	1.04	0.70	0.66	3.84	0.70	0.72	0.69
NAP_3	1.06	0.72	0.69	3.81	0.72	0.77	0.74
NAP_6	1.13	0.46	0.40	3.15	0.46	0.52	0.46
NAP_7	1.10	0.44	0.39	3.11	0.44	0.48	0.43
NAP_8	1.20	0.50	0.44	3.33	0.50	0.60	0.53
NAP_11	1.08	0.76	0.73	4.08	0.76	0.82	0.79
NAP_12	1.08	0.80	0.78	4.28	0.80	0.87	0.84
NAP_13	1.07	0.78	0.75	4.23	0.78	0.83	0.80
NAP_17	1.08	0.81	0.78	4.24	0.81	0.87	0.85
NAP_18	1.08	0.78	0.75	4.33	0.78	0.84	0.81
NAP_19	1.12	0.75	0.72	4.14	0.75	0.84	0.81
NAP_21	1.31	0.61	0.56	3.72	0.61	0.80	0.73
NAP_22	1.17	0.70	0.67	3.70	0.70	0.82	0.78
NAP_23	1.04	0.78	0.75	4.16	0.78	0.81	0.79
NAP_24	1.09	0.77	0.74	3.95	0.77	0.84	0.81
NAP_25	1.10	0.78	0.75	3.88	0.78	0.86	0.83
NAP_26	1.07	0.80	0.78	3.96	0.80	0.86	0.83
NAP_27	1.14	0.73	0.70	3.97	0.73	0.84	0.80
NAP_28	1.02	0.80	0.78	4.12	0.80	0.82	0.80
NAP_29	1.05	0.79	0.77	4.07	0.79	0.84	0.81
NAP_30	1.06	0.82	0.80	4.02	0.82	0.87	0.85
NAP_31	1.08	0.79	0.76	4.05	0.79	0.85	0.82

Note. Mean inter-item-correlation = 0.480

Table 13. Scale Reliability Estimates

	Continued use despite negative consequences	Withdrawal	Tolerance	Social impact	Consistent desire to quit/reduce use	Full Scale
Macdonald's omega coefficient (ω)	.8976	.9337	.9133	.9378	.8879	.9581

Table 14. Correlation Table

Variable	1	2	3	4	5	6	7
1. NAP	-						
2. Harm to health	.2893**	-					
3. Harm to others' health	.2085**	.5862**	-				
4. Comparative harm	.1479*	.4029**	.3732**	-			
5. Likelihood of becoming addicted	.0994*	.3172**	.1838**	-.0564	-		
6. FTND	.0372	-.0348	-.0312	-.1679*	.3316**	-	
7. NDSS	.0807	-.0220	.1720	-.0914	.1862*	.0019	-

Note. NAP = Nicotine Addiction Perceptions; FTND: Fagerström Test of Nicotine Dependence; NDSS = Nicotine Dependence Syndrome Scale

* $p < .05$. ** $p < .001$

Table 15. Logistic Regression Results

Variable	Six-month Quit Intentions (n = 268)	Thirty day Quit Intentions (n = 268)	Tried Quitting in Past 12 Months (n = 270)
Odds Ratio (95% CI)			
Predictors			
Current cigarette user	0.83 (0.45, 1.55)	0.78 (0.30, 2.04)	0.75 (0.41, 1.37)
Uses e-liquid that contains nicotine	1.90 (0.84, 4.29)	1.78 (0.51, 6.21)	1.55 (0.73, 3.30)
Comparative harm	1.47 (1.05, 2.06)	1.89 (1.16, 3.08)	1.57 (1.12, 2.20)
Nicotine Addiction Perceptions (NAP)	1.03 (1.01, 1.04)	1.02 (0.99, 1.04)	0.99 (0.98, 1.01)
Nicotine Dependence (NDSS)	1.00 (0.93, 1.08)	1.05 (0.94, 1.17)	1.02 (0.95, 1.10)
Reason for using e-cigarettes (ref: enjoyment)	1.00	1.00	1.00
To quit smoking	2.10 (0.98, 4.49)	2.23 (0.68, 7.31)	0.90 (0.43, 1.88)
To cut down on smoking	2.08 (0.97, 4.48)	3.70 (1.16, 11.75)	1.63 (0.77, 3.44)
To use when cannot or are not allowed to smoke	1.45 (0.49, 4.31)	3.22 (0.68, 15.13)	3.19 (1.11, 9.18)
Curiosity	2.05 (0.48, 8.74)	25.09 (3.57, 176.30)	0.51 (0.12, 2.23)
Some other reason	-	-	2.32 (0.13, 42.58)
Mental Health Status	1.27 (0.95, 1.70)	1.07 (0.70, 1.63)	1.20 (0.90, 1.59)
Age	1.00 (0.97, 1.03)	0.96 (0.92, 1.00)	0.98 (0.95, 1.00)
Gender (ref: male)	0.60 (0.33, 1.08)	1.19 (0.50, 2.82)	0.97 (0.55, 1.71)
Annual Income (ref ≤ \$25,000)	1.00	1.00	1.00
\$25,001- \$50,000	1.29 (0.49, 3.44)	0.97 (0.27, 3.48)	1.02 (0.40, 2.62)
\$50,001- \$75,000	3.08 (1.06, 8.98)	0.19 (0.03, 1.18)	1.63 (0.57, 4.63)
\$75,001- \$100,000	2.04 (0.65, 6.43)	0.80 (0.15, 4.18)	1.41 (0.47, 4.25)
\$100,000 +	1.96 (0.68, 5.64)	0.70 (0.16, 3.10)	1.09 (0.38, 3.11)
Race/Ethnicity (ref: non-Hispanic White)	1.00	1.00	1.00
African-American/Black	2.15 (1.01, 4.58)	1.74 (0.60, 5.10)	1.10 (0.53, 2.29)
Hispanic/LatinX	1.07 (0.44, 2.59)	0.84 (0.23, 3.04)	3.62 (1.49, 8.77)

Other	2.37 (0.88, 6.35)	0.10 (0.01, 1.19)	0.94 (0.35, 2.48)
Education (ref: ≤ bachelor's degree)	1.00	1.00	1.00
High school or less	2.27 (0.86, 5.99)	0.64 (0.15, 2.83)	0.76 (0.29, 2.00)
Some college	1.04 (0.52, 2.09)	0.92 (0.30, 2.76)	0.54 (0.28, 1.08)
Graduate level degree	2.91 (0.89, 9.52)	0.18 (0.01, 2.44)	2.00 (0.62, 6.51)
Constant	<0.01 (<0.01, 0.06)	0.01 (<0.01, 0.39)	0.51 (0.05, 5.58)

Note. All variables are controlled for in overall model; CI = confidence interval; NDSS = Nicotine Dependence Syndrome Scale; Bolded values are significant at $p < .05$.

Table 16. Negative Binomial Regression Results

Variable	Number of Quit Attempts Over Past 12 Months (n = 270)
Incident Rate Ratio (95% CI)	
Predictors	
Current cigarette user	1.00 (0.66, 1.52)
Uses e-liquid that contains nicotine	0.82 (0.48, 1.38)
Comparative harm	1.62 (1.28, 2.05)
Nicotine Addiction Perceptions (NAP)	0.99 (0.98, 1.00)
Nicotine Dependence (NDSS)	1.08 (1.03, 1.14)
Reason for using e-cigarettes (ref: enjoyment)	1.00
To quit smoking	2.00 (1.17, 3.40)
To cut down on smoking	1.15 (0.67, 1.97)
To use when cannot or are not allowed to smoke	1.75 (0.83, 3.68)
Curiosity	1.04 (0.39, 2.72)
Some other reason	< 0.01 (0, <0.01)
Mental Health Status	1.24 (1.01, 1.53)
Age	0.98 (0.96, 1.00)
Gender (ref: male)	0.76 (0.51, 1.14)
Annual Income (ref ≤ \$25,000)	1.00
\$25,001- \$50,000	1.08 (0.50, 2.12)
\$50,001- \$75,000	1.17 (0.54, 2.51)
\$75,001- \$100,000	1.40 (0.63, 3.11)
\$100,000 +	1.30 (0.62, 2.73)
Race/Ethnicity (ref: non-Hispanic White)	1.00
African-American/Black	1.40 (0.82, 2.39)
Hispanic/LatinX	1.58 (0.88, 2.85)
Other	0.86 (0.43, 1.73)
Education (ref: ≤ bachelor's degree)	1.00
High school or less	0.98 (0.48, 2.00)
Some college	0.72 (0.43, 1.20)
Graduate level degree	1.87 (0.87, 4.01)
Constant	0.46 (0.08, 2.76)

Note. All variables are controlled for in overall model; CI = confidence interval; NDSS = Nicotine Dependence Syndrome Scale; Bolded values are significant at $p < .05$.

Table 17. Linear Regression Results

Variable	Time to First E-cigarette After Waking (n = 270)	Daily E-cigarette Use (n = 269)	Monthly E-cigarette Use (n = 270)
Unstandardized b (95% CI)			
Predictors			
Current cigarette user	0.08 (-0.18, 0.33)	-0.05 (-0.25, 0.15)	0.01 (-0.17, 0.18)
Uses e-liquid that contains nicotine	-0.49 (-0.81, -0.17)	0.24 (-0.01, 0.49)	0.50 (0.28, 0.72)
Comparative harm	0.09 (-0.06, 0.23)	-0.10 (-0.21, 0.01)	-0.15 (-0.25, -0.05)
Nicotine Addiction Perceptions (NAP)	< 0.01 (-0.00, 0.01)	< 0.01 (-0.00, 0.01)	<0.01 (<0.01, 0.01)
Nicotine Dependence (NDSS)	-0.03 (-0.06, <0.01)	-0.01 (-0.03, 0.02)	-0.01 (-0.03, 0.01)
Reason for using e-cigarettes (ref: enjoyment)	1.00	1.00	1.00
To quit smoking	-0.67 (-0.98, -0.35)	0.28 (0.03, 0.52)	0.25 (0.03, 0.46)
To cut down on smoking	-0.29 (-0.61, 0.03)	-0.03 (-0.27, 0.22)	0.09 (-0.13, 0.31)
To use when cannot or are not allowed to smoke	-0.33 (-0.79, 0.13)	0.06 (-0.30, 0.41)	0.08 (-0.23, 0.40)
Curiosity	-0.52 (-1.16, 0.12)	0.17 (-0.34, 0.69)	0.11 (-0.33, 0.55)
Some other reason	-0.70 (-2.05, 0.64)	0.76 (-0.27, 1.79)	0.68 (-0.24, 1.60)
Mental Health Status	-0.07 (-0.19, 0.05)	0.04 (-0.06, 0.13)	-0.09 (-0.18, -0.01)
Age	0.00 (-0.01, 0.01)	-0.00 (-0.01, 0.01)	-0.01 (-0.01, <0.01)
Gender (ref: male)	-0.08 (-0.32, 0.16)	0.16 (-0.03, 0.34)	-0.06 (-0.22, 0.11)
Annual Income (ref ≤ \$25,000)	1.00	1.00	1.00
\$25,001- \$50,000	0.06 (-0.34, 0.46)	-0.04 (-0.35, 0.26)	-0.09 (-0.36, 0.18)
\$50,001- \$75,000	0.23 (-0.22, 0.67)	0.03 (-0.31, 0.37)	0.03 (-0.27, 0.34)
\$75,001- \$100,000	0.24 (-0.23, 0.72)	-0.24 (-0.60, 0.13)	-0.19 (-0.52, 0.13)

\$100,000 +	0.22 (-0.22, 0.66)	-0.06 (-0.39, 0.28)	0.21 (-0.51, 0.09)
Race/Ethnicity (ref: non-Hispanic White)	1.00	1.00	1.00
African-American/Black	0.42 (0.10, 0.74)	-0.45 (-0.69, -0.21)	-0.51 (-0.72, -0.29)
Hispanic/LatinX	0.24 (-0.13, 0.61)	-0.28 (-0.57, 0.00)	-0.34 (-0.59, -0.08)
Other	-0.00 (-0.44, 0.43)	0.02 (-0.32, 0.35)	0.12 (-0.18, 0.41)
Education (ref: ≤ bachelor's degree)	1.00	1.00	1.00
High school or less	-0.57 (-0.99, -0.16)	0.55 (0.23, 0.86)	0.26 (-0.02, 0.54)
Some college	-0.38 (-0.67, -0.09)	0.27 (0.04, 0.49)	0.28 (0.08, 0.48)
Graduate level degree	-0.35 (-0.85, 0.16)	0.16 (-0.23, 0.55)	0.26 (-0.08, 0.61)
Constant	3.08 (2.05, 4.10)	1.61 (0.83, 2.40)	2.42 (1.72, 3.13)

Note. All variables are controlled for in overall model; CI = confidence interval; NDSS = Nicotine Dependence Syndrome Scale; Bolded values are significant at $p < .05$.