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EMPIRICAL ARTICLE

The e-cigarette assessment for youth—Revised (EAsY-R): Preliminary results of a pilot study of measure refinement via cognitive interviewing

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Abstract

The prevalence of youth vaping has, in a relatively short time, become an "epidemic." In the wake of such labeling by the Surgeon General, a number of important examinations of vaping have been conducted. These have largely focused on high school and college-age youth as this demographic shows the greatest prevalence of use. Nonetheless, no measure has been made available which might allow for the comprehensive assessment of quantity and frequency of vaping among this age group, thus aiding in standardization across settings. The current study utilized cognitive interviews with high school and college-age youth who use vaping devices to inform the preliminary development of such an assessment. The sample consists of eight students between the ages of 15 and 24 (M_{age} = 18.75, SD = 2.73, 62.5% female, 75.0% Hispanic/Latino/a/x, 100.0% White). Interviewing and measure refinement were conducted in a two-phase iterative fashion. Suggestions made during cognitive interviews resulted in the refinement of assessed content type, updated categories and pictures of vaping devices, as well as updated and age-relevant terminology. Further, instructions were streamlined, and assessment items and multiple-choice options were refined to maximize clarity and to minimize participant confusion. The result of this study, the *E-Cigarette Assessment for Youth Revised*, is a unique tool for standardizing examinations of the quantity and frequency of vaping behaviors among high school students and college-age youth.

KEYWORDS
assessment, cognitive interviewing, e-cigarette, measure, vaping, youth

INTRODUCTION

In less than two decades, electronic (e-)cigarettes, or vaping devices, have become the most popular nicotine product among youth (Office of the Surgeon General, 2018). Indeed, over four million high school students (Wang et al., 2019) and more than 1 in 4 college students (Holt et al., 2022) endorse the current use of a vaping device. Moreover, nearly one-third of U.S. high school students report finding little to no harm in intermittent use of these devices (Wang et al., 2019). Yet, nicotine, which is found in most vaping devices (CDC, 2021), is both addictive and associated with potentially long-term changes in brain structure and function (Park et al., 2020). Unfortunately, there exists very little standardization regarding the assessment of this complex risk behavior despite its high popularity among high school students and college-age youth, the developmental periods during which prior research has shown vaping to be the most prevalent (Birdsey et al., 2023; National Center for Health Statistics, 2023). Given this, a comprehensive, standardized measure of vaping behaviors tailored to this age group appears warranted and necessary.

Current difficulties in assessment

The lack of extant vaping assessments is understandable given the inherent complexity in the measurement of quantity and frequency of use. This may be further complicated by age-specific patterns and attitudes associated with the use of e-cigarettes, which have been shown to be most similar between high school students and college-age individuals compared to earlier and later developmental periods (Dvorsky & Langberg, 2019). For example, vaping trends among this

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demographic include unique terminology, which if not taken into consideration during measurement design/revision may cause participant confusion during assessment completion resulting in inaccurate data. Further, vaping devices and their contents (e.g., e-liquids; Kong, Bold, et al., 2019a; Kong, LaVallee, et al., 2019b) have become available in a seemingly unending variety. Devices currently include those that are disposable (Gaiha et al., 2020), rechargeable (Romberg et al., 2019), and refillable (Trucco et al., 2020). Each type of device is associated with differing terminology, as well as purchasing and use behaviors, all of which must be accurately assessed. Moreover, e-liquid contents vary widely with regard not only to flavor (over 7000; Groom et al., 2020) but to the concentration of nicotine (0%–6%; Kong, Bold, et al., 2019a; Kong, LaVallee, et al., 2019b), which influences quantity and frequency of use, as well as health impacts. This product variety has been shown to be highly appealing to adolescents, particularly among high school students (Morean et al., 2018); thus, exacerbating the complexity in assessing this risk behavior among youth.

Furthering the difficulty in accurately assessing vaping habits, quantification is measured in a variety of manners, including by individual puffs or portion of the device/e-liquid consumed (e.g., ¼ of a disposable device, 10 mL bottle of e-liquid). Moreover, the frequency of vaping is unique in that the entirety of a unit of measurement (e.g., a combustible cigarette, an alcoholic beverage) is not consumed at one time. Challenges to the successful assessment of quantity and frequency of vaping during the high school and college years are evident, potentially resulting in misleading, and/or inconsistent data across studies.

In addition to assessing the quantity and frequency of vaping among this youth demographic, knowledge of product content (e.g., nicotine concentration) and the ease of purchasing these products regardless of age is imperative. With the overwhelming variety of products available, it is important to clarify which types and brands of devices are most frequently used during this developmental period. Further, understanding the influence of preferred nicotine strength and flavor may facilitate prevention and intervention efforts. Knowledge of patterns of use and purchasing may also help to inform parental monitoring and policies aimed at reducing the availability of vaping products to underage youth. Yet, no standardized measure of vaping tailored to this age group is currently available. This may speak to the use of singular questions for the assessment of youth vaping behaviors (e.g., "Have you ever used an e-cigarette like the ones pictured above, even 1 or 2 times?"; Audrain-McGovern et al., 2021).

Current study

The current study utilized cognitive interviews with high school and college-age youth who had previously vaped to further refine an existing vaping questionnaire, the E-Cigarette Assessment for Youth (EAsY; Cristello & Trucco, 2020), as a measure of quantity and frequency of vaping. The focus is on high school and college-age youth as these are the ages during which prior research has shown vaping to be the most prevalent (Birdsey et al., 2023; National Center for Health Statistics, 2023). Hispanic/Latino/a/x (H/L) participants were oversampled, as previous work has found H/L-identifying adolescents to endorse greater use of vaping devices than their non-H/L-identifying peers (Kann et al., 2018). The EAsY is an assessment of youth vaping behaviors throughout multiple timeframes (e.g., lifetime, past month) that was developed for a parent study on substance use among high school students. To develop this assessment, authors reviewed existing measures of e-cigarette use, including the Population Assessment of Tobacco and Health (HHS, 2016) and Monitoring the Future (Johnston et al., 2020), as well as prior qualitative studies, focused on e-cigarette use patterns and behaviors (Ayers et al., 2017; Coleman, 2016). In addition to drawing from existing measures, authors also visited websites (e.g., VaporShark) that sold vaping products to examine devices and vape content (i.e., e-liquids), thereby informing how use could best be quantified. Three content categories were assessed by the EAsY: (1) nicotine and marijuana (at the same time, in the same device), (2) nicotine (with or without flavoring), and (3) flavoring only (without nicotine). Follow-up items assessing frequency and quantity were specifically provided for each content type and time period (i.e., past year/since last assessment, past month) endorsed. Approximately 22 questions were posed for each content category and time period of interest. Vaping of THC oil (i.e., marijuana/cannabis oil) exclusively was examined in the parent study, but these questions were part of another questionnaire. Therefore, this content was not specifically examined within the current study.

Qualitative data acquisition in the current study was completed through cognitive interviews (CI), which are a suggested method for the refinement of a questionnaire, aided by information provided by members of the target population (Bakker-van Gijssel et al., 2020). Immediately following questionnaire completion, participants are interviewed regarding the clarity of the tool, as well as their perceived ability to answer the questions with certainty (Fowler Jr. et al., 2016). This information allows researchers a better understanding of how respondents interpret the measure (e.g., items, choice options, instructions), as well as how to better construct the assessment tool (DeMaio & Rothgeb, 1996). The overarching goal of the current study was to develop a comprehensive, standardized measure capable of successfully assessing quantity and frequency of vaping behaviors among high school students and college-age youth across studies and settings.

METHODS

Training of research team

The primary investigator and study interviewer conducted an extensive literature search regarding qualitative methodology, analysis, and reporting, with particular attention paid to instructions regarding CI and measurement development.

Additionally, two experienced outside qualitative researchers from the fields of clinical psychology and social work were consulted by the primary investigator and study interviewer throughout the course of the current study. Two study coders were then trained by the study interviewer. The primary investigator oversaw all transcription.

Participants

The recommended sample size for CI studies is not standardized. While small sample sizes have been suggested by some (Peterson et al., 2017; Willis, 2005), others maintain that a larger sample size has the potential to identify a greater number of the issues inherent to a questionnaire (Meitinger & Behr, 2016). Moreover, though it is widely accepted that saturation (i.e., all relevant qualitative data has been offered/collected) is the desired endpoint of the CI process, the necessary depth of saturation has been an object of some debate. There are those who recommend reaching data saturation, effectively interviewing until no relevant and unique information is provided (Hodiamont et al., 2021; Sarda et al., 2019). Conversely, saturation has also been delineated as the collection of data to a point where the research team concludes that further interviewing could not provide enough additional data to be deemed time- or cost-effective (theoretical saturation; Kokorelias et al., 2022; Simler et al., 2022). Given that the primary aim of the study was to gather preliminary data to inform the development and refinement of an assessment measure specifically for high school and college-age youth, the researchers sought to recruit approximately 10 interviewees. This sample size is consistent with preliminary phases of measure development within recent studies (Durgam et al., 2023; Ramirez et al., 2023; Sinha et al., 2023).

Ultimately, participants were eight high school and college-age youth between the ages of 15 and 24 (M_{age} = 18.75, SD = 2.73, 62.5% female, 75.0% H/L, 100.0% White). Participant demographics and vaping background are provided in Table 1. This includes participant codes reflecting both the age and biological sex (e.g., 24M represents a 24-year-old male participant) of each participant. These participant codes will be included as parenthetical notations within the text to indicate who suggested each change to the measure. Participants were recruited via two methods. First, participants who had endorsed prior use of a vaping device during participation in a recently completed parent study were contacted regarding interest in the current study. Second, participants were recruited through community recruitment efforts (e.g., school recruitment, word of mouth) in a large southeastern U.S. metropolitan area. Participants were initially screened by phone for English language fluency and willingness to be recorded (for transcription purposes). Additionally, all participants met enrollment criteria of having taken a minimum of 25 puffs from a vaping device in their lifetime and having used within the past 6 months.

Procedure

Study procedures were completed via the online Zoom meeting platform (Banyai, 1995). Participants under the age of 18 were joined by a legal guardian for the consent process, where study staff obtained written permission from the guardian and informed assent from the adolescent. Participants over the age of 18 completed the consent process alone. Each participant's CI appointment took approximately 1 h to complete and included the consent process (~5 min), completion of a demographic questionnaire (~5 min), completion of the vaping questionnaire (i.e., EAsY; Cristello & Trucco, 2020; ~15 min), follow-up probing regarding the vaping questionnaire (~30 min; see Table 2), and a short debriefing (~5 min). Questionnaires were administered via an online survey completion tool, REDCap (Harris et al., 2019), where branching of questionnaire items provided a personalized questionnaire

TABLE 1 Demographics and vaping history of cognitive interview participants.

Participant code	Age	Biological sex	School status	Race	Ethnicity	Past 30-day use?	Age first vaped	Lifetime use in puffs
Phase 1								
17F[1]	17	F	High school (11th)	White	Non-H/L	Yes	15	3000 puffs
15F	15	F	High school (9th)	White	H/L (C)	Yes	14	13,920 puffs
18F	18	F	College	White	H/L (C)	Yes	16	380 puffs
18M	18	M	College	White	H/L (Other)	Yes	16	960 puffs
Phase 2								
17F[2]	17	F	High school (12th)	White	H/L (Other)	Yes	16	4900 puffs
19F	19	F	College	White	H/L (M/PR)	Yes	16	38,400 puffs
21M	21	M	College	White	H/L (C/PR)	Yes	18	820 puffs
24M	24	M	College	White	Non-H/L	Yes	21	43,200 puffs

Abbreviations: C, Cuban; F, female; H/L, Hispanic/Latino/a/x; M, male; M, Mexican; Non-H/L, Non-Hispanic/Latino/a/x; Other, of a Hispanic/Latino heritage other than Cuban, Mexican, or Puerto Rican; PR, Puerto Rican.

TABLE 2 Question path of standardized probing conducted during the cognitive interviews.

Question path	All general assessment instructions	All assessment pictures/captions	Questionnaire item/provided answer options
Participant left item blank/did not answer			• "Did you leave this item blank on purpose?" • (if yes) "Why did you choose to leave this item blank?" • (if no [1]) "Is there a reason that you might have missed this item?" • (if no [2]) "Please answer this item now, if you can."
Participant answered "Don't know"			• "Why did you choose *Don't know* for this item?"
Participant's answer does not match that for similar questions			• "Please explain your thought process when answering this item."
First standard probe	• "Are these set of instructions understandable?" • (if no) "What do you find unclear?"	• "Do you recognize all of the pictured/captioned products as ones used by you and/or your friends?" • (if no) "Which of the pictured/captioned products are commonly used by you and/or your friends and which are not?"	• "Are this item and the provided answer options understandable?" • (if no) "What do you find unclear?"
Second standard probe	• "Please summarize this set of instructions in your own words." • (if participant is unable to summarize or summary does not match what was conceptualized by measurement developers) Interviewer summarizes instructions as conceptualized by developers	• "What suggestions, if any, do you have about how to improve this picture/caption?"	• "Please summarize this item and the provided answer options in your own words." • (if participant is unable to summarize or summary does not match what was conceptualized by measurement developers) Interviewer summarizes item and provided answer options as conceptualized by developers
Third standard probe	• "Do you find this set of instructions to be necessary and helpful?" • (if no) "What do you find unnecessary/unhelpful?"		• "Are there any missing, extra, or incorrect answer options among those provided?"
Fourth standard probe	• "What suggestions, if any, do you have about how to improve this set of instructions?"		• "What suggestions, if any, do you have about how to improve this item or the provided answer options?"

for each individual. Participant thoughts and questions posed aloud while completing the questionnaire, as well as the follow-up probing portion of the appointment, were recorded through Zoom. Upon completion of the remote appointment, participants were compensated with a $20 electronic gift card. The university's Institutional Review Board approved all study procedures.

CI appointments occurred during two study phases. Half of the study participants completed interviews during the first phase and half of the participants completed interviews during the second phase, the point at which theoretical saturation was determined. Participants were assigned to phase 1 or phase 2 according to scheduling availability. Data collected during the first four interviews warranted a significant revision to the measure. As an iterative approach to cognitive interviewing is suggested (with revision after each phase of interviewing; Willis, 2005), the research team decided that each phase of interviews would consist of four participants. Initial revisions to the questionnaire were completed utilizing qualitative data collected during the first phase of interviews. During each appointment, the investigator followed along in real-time as the participant completed the online vaping questionnaire, noting potential errors in comprehension. Participants were then encouraged, during the interview portion of the appointment, to verbalize the thought processes they had utilized while completing the questionnaire. Specific queries on seemingly problematic items (i.e., a participant's answer did not match either other answers provided or the item as conceptualized by

the researchers) and follow-up probes (see Table 2) were posed during the CI portion of the appointment. Queries and probes regarding question comprehension, question difficulty, and relevance of answer options were predetermined by the research team and outside consultants.

A single trained investigator (co-developer of the EAsY-R) conducted each of the remote CIs, while two additional trained study staff (i.e., [1] volunteer post-baccalaureate research assistant, [2] paid masters-level research assistant) iteratively transcribed the Zoom recordings. Transcription began with the rudimentary transcription provided by the Zoom platform. Next, the first research assistant [1] corrected transcription errors while listening to the Zoom recording. The second draft of the transcript was then edited by a second research assistant [2] while listening to the Zoom recording. Lastly, all transcripts were checked for accuracy by the study interviewer while listening to the Zoom recording.

As measurement revisions were completed in an iterative manner, initial updates to the questionnaire were based upon first-phase suggestions, with final edits to the questionnaire made after examining the phase 2 transcripts. All revisions were decided upon and completed by the four team members (i.e., primary investigator, study interviewer, paid masters-level research assistant [2], additional masters-level member of the development team), as a whole and in consultation with the outside qualitative researchers, after all disagreements regarding coding were resolved.

Measures

Demographic information

Demographic information (i.e., age, biological sex, race, ethnicity) was assessed.

Vaping behavior

The EAsY (Cristello & Trucco, 2020; see Current Study section of this manuscript for full description of the measure) was completed by all participants.

RESULTS

To address crucial concepts of questionnaire refinement (Söderholm et al., 2021), the present CI process focused on maximizing questionnaire clarity and participant comprehension, while minimizing questionnaire complexity and participant confusion. Unlike many adult CI studies, which appear to solely examine potential changes to questionnaire items (i.e., revision, addition, or elimination of questions and answers; Goodman et al., 2019; Hinds III et al., 2016), the current study also led to changes regarding the questionnaire's general formatting and instructions.

General edits made to the original measure (EAsY) during participant-informed revisions

Pictures

During the first phase of CI, each participant (17F[1], 15F, 18F, 18M) reported that the provided pictures of vaping devices did not resemble devices they were accustomed to using and that the associated categorical terms of "open- and closed-systems" (see Table 3A) were not utilized among their peers. As such, pictures were updated prior to the second phase of CI. The updated pictures were categorized as "pods," "disposables," and "tanks/mods" (see Table 3B). All second-phase CI participants (17F[2], 19F, 21M, 24M) stated that the updated pictures and categories were representative of current devices used among their peers.

Terminology

All first-phase CI participants (17F[1], 15F, 18F, 18M) revealed that the terms "ENDS" and even "e-cigarette" were not commonly used. Some participants (15F, 18F) reported misunderstanding these terms altogether. Participants in the first phase provided the alternative terms of "vape (17F[1], 15F, 18F, 18M)/disposable device(s; 15F, 18M)," which were included in the revised questionnaire. This was found to be wordy by each participant in the second phase (17F[2], 19F, 21M, 24M), all of whom agreed that the term "vaping device" would suffice for all products (see Table 3C).

Similarly, all participants in the first phase (17F[1], 15F, 18F, 18M) reported that although they understood the term "puffs" they were more accustomed to the term "hits." As such, the second-phase questionnaire utilized the string "hits/puffs." Again, participants in the second phase (17F[2], 19F, 21M, 24M) found this string to be unnecessarily wordy. Although all study participants utilized the term "hits" more often than "puffs," all participants reported easily understanding the meaning of "puffs." As such, the final questionnaire update returned to the original term, "puffs," (see Table 3D) for standardization across the questionnaire, as number of "puffs" is typically advertised on the packaging of disposable vaping devices to denote the 'size' of the specific device.

Highlighting

A common theme throughout phase 1 was participant confusion as to which content type and timeframe (e.g., past year, past month) items were referring. Though content type and timeframe were originally specified within each item, as well as in the instructions at the beginning of each section (sections divided by endorsed content type), participants (17F[1], 15F, 18M) stated not reading closely enough to absorb these details. It was suggested (15F, 18M) that such necessary details be highlighted and bolded to draw attention. As such, between phases, content type and

TABLE 3 General edits made to the original measure (EAsY) during participant-informed revisions

	Original version	Final version
(A)	*The following was provided as an explanation within the original measure:* A "closed-system" device, also known as a first-generation model, a "cigalike" or Juul, uses disposable e-liquid or oil pods/cartridges that require replacement. An "open-system" device, also known as a second and third-generation model, is more modifiable: users can refill the e-cigarette tank, variable voltage batteries are available, and users can modify airflow.	*N/A (left out of the final version)*
(B)		 **Pods** **Disposables** **Tanks/mods**
(E)	The following questions ask you about your use of an ENDS product that contained (specific content type) in the (timeframe of interest).	For this next section you will be answering questions about your USE of a vaping device containing (SPECIFIC CONTENT TYPE) in the (TIMEFRAME OF INTEREST).
(F)	*N/A (not included in the original version)*	You said you HAVE used: *(endorsed categories will autopopulate here)* Is this correct? YES NO *(if participant clicks "YES," these categories will then each populate separate set of questions identical to those shown below for each SPECIFIC CONTENT TYPE and each TIMEFRAME OF INTEREST; if participant clicks "NO," they will be instructed to review and correct their answers before moving forward and being provided with correct items throughout the remainder of the questionnaire)*

	Original version	First revision	Final version
(C)	…your ENDS use…	…Your USE of a vape/disposable device(s)…	…your USE of a vaping device…
(D)	…I probably have about 2 or 4 puffs…	…I take 15 hits/puffs…	…how many total puffs they took that day…

timeframe were highlighted within both instructions and items. Highlighting included placing instruction boxes at the top of *each* page of the questionnaire, as well as using all capitalization and bolded red font for the content type and timeframe within both instruction boxes and questionnaire items (see Table 3E). These changes appeared to improve overall questionnaire clarity for phase 2 participants (17F[2], 19F, 21M, 24M), who stated that the capitalized, bolded, colorful font sufficiently drew their attention to the highlighted details.

Endorsement check statement

Three (17F[1], 18F, 18M) of the four participants in the first phase incorrectly reported which content types they had used. As such, they were subsequently administered incorrect items throughout the questionnaire. When these participants were asked why they thought they had incorrectly answered this question, all reported having read the categories too fast or having not read the categories with a sufficient level of detail. As such, the second-phase questionnaire added an endorsement check statement, in large and bright font, at the bottom of the initial page stating, "You said you HAVE used … (the participant's responses). Is this correct?" (see Table 3F). Participants were required to click "Yes" (whereupon they were allowed to proceed to the next page) or "No" (whereupon they were instructed to review and correct their answers). Two of the four participants in phase 2 (17F[2], 19F) clicked "No," whereupon they reviewed and corrected their answers before moving forward and being provided with correct items throughout the remainder of the questionnaire.

Streamlining

Participants across both phases of CI (17F[1], 15F, 19F, 21M, 24M) indicated that the instructions were too wordy. As such, each questionnaire revision further streamlined the information contained within the instruction boxes (e.g., removing transition words, "clarifying" words, and extraneous examples; see Table 4).

TABLE 4 Edits to General Measure Instructions Made to the Original Measure (EAsY) During Participant-Informed Revisions

Original version	Final version
The following questions ask you about your ENDS use within the time since your last visit. Please only indicate yes if you have used the following substances with an ENDS product. Consider the (time of interest). We are interested in WHICH of these TYPES of products YOU have USED in your ENDS device(s): NICOTINE/MARIJUANA COMBINED (in the same cartridge/pen/pod), NICOTINE (with or without flavoring), FLAVORING ONLY (without nicotine).	The following questions ask you about your vaping device use in the (TIMEFRAME OF INTEREST). We are interested in WHICH of these PRODUCTS you have used in your vaping device: NICOTINE, FLAVORING ONLY (without nicotine).
On the first page, you will answer whether or not you have used each of these products in an ENDS device. For example, if you usually use an ENDS device with nicotine (with or without flavoring), but you have also tried an ENDS device with nicotine/marijuana combined, you would select YES for nicotine/marijuana combined AND YES for nicotine (with or without flavoring), and NO for flavoring only. You will then be asked a separate set of questions for each type of product you have used. For example, the first set of questions will ask you about your use of ENDS devices with nicotine/marijuana combined (only if you checked that you have used this type of product). Then, the next set of questions will ask you about your use of ENDS devices with nicotine (with or without flavoring) (only if you checked that you have used this type of product). Finally, the third set of questions will ask you about your use of ENDS devices with flavoring only (only if you checked that you have used this type of product).	
ENDS users often describe their patterns of use differently than regular cigarette users. For example, a cigarette user may smoke a certain number of cigarettes per occasion (e.g., two cigarettes after a meal), whereas ENDS users often do not describe a fixed period of use. An example of an ENDS user's pattern of use is the following: "I probably have about 2 or 4 puffs, once every 30–45 minutes throughout the day."	For this next section you will be answering questions about your PATTERN of using a vaping device containing (SPECIFIC CONTENT TYPE) in the(TIMEFRAME OF INTEREST). Users of vaping devices sometimes remember their daily use in different ways. For example, one user may remember how many times that day they took their device out to use, whereas another may remember how many total puffs they took that day.

Edits to questionnaire items made to the original measure (EAsY) during participant-informed revisions

Initial content categories

The first item on the EasY (Cristello & Trucco, 2020) asked participants to report whether or not they have used each of three categories of vaping content. Initially, these categories were "both nicotine and marijuana at the same time," "nicotine (with or without flavoring)," and "flavoring only (without nicotine)." As mentioned above, three of the four participants in the first phase (17F[1], 18F, 18M) misidentified the content type they had used. When probed about the misidentification, these participants provided additional information for clarifying two of the three content categories.

First, each of the three participants (17F[1], 18F, 18M) who mistakenly endorsed which content type they had vaped endorsed use of "both nicotine and marijuana at the same time," when what they had in fact vaped was THC oil (i.e., marijuana/cannabis oil) alone. Each participant reported that they assumed that the category was referring to any content type that included THC oil (i.e., marijuana/cannabis oil) and suggested that the intended category (both nicotine and marijuana at the same time) either be included last in the list or removed entirely, as they had never heard of vaping nicotine e-liquid and THC oil together, at the same time, in the same device. Upon further review of the associated literature, it became apparent that, in almost all instances, co-administration of tobacco (i.e., nicotine) and marijuana/cannabis (i.e., THC) through vaping occurs through the use of personal vaporizers, where dry herbs are heated (rather than burned) to release the active ingredients (Malouff et al., 2014; Spillane et al., 2021). This use is quite different than the vaping of liquids (i.e., nicotine e-liquids, THC oils) specifically examined within the current study. Therefore, this content category (i.e., both nicotine and marijuana at the same time) was removed from the questionnaire.

Additionally, participants in the second phase (21M, 24M) suggested that one of the categories could be worded more succinctly. Each participant stated that all retail nicotine-based contents are flavored. As such, each suggested that the clarification "with or without flavoring" could be eliminated from the nicotine category description.

As such, the final iteration of the measure includes the two content categories of "nicotine" and "flavoring only (without nicotine)" (see Table 5A).

Items changed/removed for clarification

Two participants in the first phase (17F[1], 18M) reported difficulty understanding an item regarding ever/lifetime use. As such, the item was reworded (see Table 5B) and no

difficulties with the item were reported by participants in the second phase.

Additionally, a series of items were initially posed regarding the participant's pattern of use. That is, participants were asked to differentiate between "vaping sessions" (number per day, typical length, number of puffs per session) and number of puffs per day. All study participants reported that they and their peers do not identify specific "vaping sessions;" therefore, all participants stated confusion regarding this series of items. Aided by suggestions from participants in the second phase (17F[2], 19F, 21M, 24M), items regarding "vaping sessions" were reworded as "times you take your device out to use" (see Table 5C, D). An item regarding the length of "vaping sessions" was discarded from the questionnaire (see Table 5E) and the word "TOTAL" was added to the item regarding total number of puffs per day (bolded and capitalized; see Table 5F). Instructions for this series of items were also updated to reflect the changes (see Table 4).

Item added to address new vaping products

Six of the eight participants (17F[1], 15F, 18F, 18M, 19F, 21M) reported quantifying their use based on number of disposable devices used. When clarifying the following questionnaire item, "… how many disposables did you use?" each of these participants reported that disposable devices differ in size, thus impacting their answer. As such, the final version of the

TABLE 5 Edits to questionnaire items made to the original measure (EAsY) during participant-informed revisions.

	Original version	Final version
(A)	• Both nicotine and marijuana at the same time • Nicotine (with or without flavoring) • Flavoring only (without nicotine)	• NICOTINE • FLAVORING ONLY (without nicotine)
(B)	Was this your FIRST time trying a vape/cartridge (cart)/disposable device(s) containing (specific content type)?	Was THIS the FIRST TIME in your LIFE that you used a vaping device containing (SPECIFIC CONTENT TYPE)?
(C)	In the (timeframe of interest), on the days you used an ENDS product that contained (specific content type), how many sessions/vaping periods did you have per day? (e.g., 3 sessions/vaping periods)	In the (TIMEFRAME OF INTEREST), on the days you used a vaping device containing (SPECIFIC CONTENT TYPE), how many TIMES, on average, did you TAKE IT OUT to use PER DAY?
(D)	In the (timeframe of interest), on the days you used an ENDS product that contained (specific content type), approximately how many puffs did you take on your device during each bout (e.g., session/vaping period)? (e.g., 3 puffs)	In the (TIMEFRAME OF INTEREST), on the days you used a vaping device containing (SPECIFIC CONTENT TYPE) approximately how many PUFFS did you take on your device EACH TIME you TOOK IT OUT to use?
(E)	In the (timeframe of interest), on the days you used an ENDS product that contained (specific content type), how long were your bouts (e.g., sessions/vaping periods) on average? (Please select a number as well as a unit of time [e.g., second, minutes, hours].)	*N/A (left out of the revision)*
(F)	In the (timeframe of interest), on the days you used an ENDS product that contained (specific content type), approximately how many puffs did you take on your device per day? (e.g., 3 puffs)	In the (TIMEFRAME OF INTEREST), on the days you used a vaping device containing (SPECIFIC CONTENT TYPE) approximately how many PUFFS TOTAL did you take on your device(s) PER DAY?
(G)	*N/A (not included in the original version)*	In the (TIMEFRAME OF INTEREST), on the days you used a disposable vaping device containing (SPECIFIC CONTENT TYPE) what SIZE DISPOSABLE DEVICE did you typically use? 300 puffs included (Cuvie/original/traditional) 600–800 puffs included (HQD super/super/plus) 1000–1200 puffs included (HQD plus/plus) 1300–1600 puffs included 1700–2000 puffs included 2100–2500 puffs included 2600–3000 puffs included 3100–4000 puffs included more than 4000 puffs included
(H)	*N/A (not included in the original version)*	How OFTEN have you been ASKED FOR YOUR ID/CARDED/ID'ed when PURCHASING vaping products from a MALL or SHOPPING CENTER kiosk/stand?

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questionnaire now includes an additional item, placed between the aforementioned items, asking the individual to specify which size disposable device they typically use (see Table 5G).

Items added to collect additional data

Two (17F[1], 15F) of four participants in the first phase endorsed buying vaping products from a vape shop despite being minors and having never been asked for identification. This information promoted the creation of additional items inquiring how often they were 'IDd/carded' by specific types of retailors (see Table 5H).

On an item that assessed how participants typically measure their use, participants in the first phase (15F, 18F, 18M) notified the interviewer that the response choice of "pods/disposables" should be separate choices. These participants reported that they never use pod-based devices, whereas they primarily use disposable devices. As such, between phases, the answer choices were separated to include separate options for "pods" and "disposables." Phase 2 participants verbalized no issues with the newly updated answer choices, but rather all (17F[2], 19F, 21M, 24M) found the question itself to be confusing. Upon probing, it was identified that each participant was comprehending the item as, "What type of vaping device do you normally use?", whereas the item was posed as "How do you normally measure your use?" As such, the final iteration of the measure additionally updated the wording of the item as suggested by phase 2 participants (17F[2], 19F, 21M, 24M; see Table 6A).

Edits to response options made to the original measure (EAsY) during participant-informed revisions

Response options changed to better reflect available products

All phase 1 participants (17F[1], 15F, 18F, 18M) were unsure how to answer, "What nicotine concentration do/did you

TABLE 6 Edits to response options made to the original measure (EAsY) during participant-informed revisions.

	Original version	Final version
(A)	In the (timeframe of interest), how did you typically measure your usage when you used an ENDS product that contained (specific content type)? Pods/disposables Tanks/mods E-liquids/oils	In the (TIMEFRAME OF INTEREST), HOW did you MEASURE HOW MUCH product you USED in a vaping device containing (SPECIFIC CONTENT TYPE)? # or % of a Disposable used # or % of a Pod used # or % of a Tank used # or % of a Bottle of E-liquid/Oil/Wax used
(B)	What nicotine concentration do/did you typically use with your ENDS product? If you use Juul please select the Juul answer choice. If you are not sure, please take your best guess. Less than 3 mg 3 mg 6 mg 9 mg 12 mg 15 mg 18 mg 21 mg 24 mg More than 24 mg Juul 3% nicotine Juul 5% nicotine	What NICOTINE CONCENTRATION did you typically use with your vaping device containing (SPECIFIC CONTENT TYPE)? 0% 3% 5% 6% 0 mg 3 mg 6 mg 9 mg 12 mg 18 mg 24 mg More than 24 mg
(C)	In the (TIMEFRAME OF INTEREST), on the days you used an ENDS product that contained (SPECIFIC CONTENT TYPE), how many tanks/mods did you use? If you are not sure, please take your best guess. 1/4 or less of a tank/mod per day 1/3 of a tank/mod per day 1/2 of a tank/mod per day 1 tank/mod per day 2 tanks/mods per day 3 tanks/mods per day 4 tanks/mods per day 5 tanks/mods per day 6 tanks/mods per day	In the (TIMEFRAME OF INTEREST), on the days you used a vaping device that uses this size tank containing (SPECIFIC CONTENT TYPE) how MANY TANKS did you typically use? 10 or less puffs per day 1/4 of a tank per day 1/3 of a tank per day 1/2 of a tank per day 1 tank per day 2 tanks per day 3 or more tanks per day

typically use in your vaping device containing nicotine?" with the original response options. Original response options all reflected milligrams of nicotine. Answer choices specific to JUUL products were the exception, as these reflected percentage of nicotine options. Each participant in the first phase reported that they did not use JUUL pods but that they were only aware of the percentage, as opposed to the milligrams, of nicotine contained in the disposable devices they use. Upon verification of this claim, phase 2 questionnaires included response options in both milligrams and percentages for all products (see Table 6B). During phase 2, no further confusion was noted regarding the associated answer choices.

Response options changed to better reflect use among the target population

When asked about the amount of the vaping content typically used per day, all participants in the first phase (17F[1], 15F, 18F, 18M) stated that the quantity reflected by the lowest response option was not small enough to differentiate between those individuals who use occasionally and those who use sparingly. Conversely, they reported that the top half of the response options reflected large quantities that would rarely, if ever, be vaped in a single day. As such, the response choices for phase 2 questionnaires were altered to reflect use of smaller quantities, while removing the response choices reflecting the largest quantities (see Table 6C).

DISCUSSION

The current study represents a preliminary, yet comprehensive, participant-informed effort to refine the EAsY (Cristello & Trucco, 2020) that was developed to assess vaping among high school students and college-age youth. As findings of the present study suggest, the complexity of assessing vaping products and behaviors may be matched by the intricacies of developing a self-report questionnaire capable of accurately capturing vaping behavior within this demographic group. Qualitative data provided by current study participants highlighted both the pace with which the vaping landscape has evolved and the limited focus and attention given to accurately assessing self-reported vaping behaviors among this population. Up-to-date pictures of devices, developmentally relevant terminology, and items/response options that address the current vaping landscape in a comprehensive manner appear important in the accurate and comprehensive assessment of vaping behaviors among high school and college-age youth. Further, efficient wording and highlighting (i.e., capitalization, bolded font, red font) of important words, as well as endorsement checks were recommended to aid in the successful comprehension and completion of the questionnaire by youth. The result of this study, the *E-Cigarette Assessment for Youth Revised* (*EAsY-R*; see supplementary material), is a uniquely developed tool for standardizing examinations of vaping behavior among high school students and college-age youth.

Limitations

The *EAsY-R* provides a necessary standardized inventory for comprehensively examining youth vaping behaviors during the high school and college years; yet, some limitations should be noted. Although theoretical saturation was reached at the study's final participant count of eight adolescents, the sample size of the current study, though convergent with similar work in measure development (Sinha et al., 2023), is small. Future associated work on the subject may find a larger sample size to reveal additional concerns that could provide additional clarity within the questionnaire. Further, because there is a paucity of prior work regarding the prevalence of youth vaping by biological sex (Kong et al., 2017), the present study attempted to recruit a participant sample equally split on biological sex. Yet, participant availability resulted in an oversampling (62.5%) of female participants. As such, future work may benefit from a sample more equally split by biological sex. Additionally, although the racial/ethnic makeup of the current sample (i.e., predominantly White, H/L) was representative of the population from whence it came and reflects an ethnic group that is disproportionately at risk for e-cigarette use (i.e., H/L adolescents; Kann et al., 2018), it is nonetheless a relatively homogeneous subgroup of youth who vape. Thus, findings may not generalize to youth from other ethnic backgrounds or across geographic regions. Moreover, as the *EAsY-R* was developed to primarily assess quantity and frequency of vaping behaviors among high school students and college-age youth, other important and relevant aspects of vaping among this population (e.g., motivations, consequences, group vs. individual use, vaping environment) are not addressed in the current assessment.

When deciding to remove the original nicotine/marijuana content category from the *EAsY-R*, the authors discussed adding the content category, "THC oil (i.e., marijuana/cannabis oil)," to the final version of the questionnaire. The addition was ultimately decided against, as it was reasoned that items from the parent study regarding vaping of THC oil had not been refined/updated through the current CI process and therefore did not meet the standards of the present measure. Nonetheless, it is suggested that future versions of the *EAsY-R*, or other comprehensive vaping measures tailored to this demographic, include this content type due to its high prevalence among youth who vape (Slomski, 2022) and the health risks common to vaping of all liquid-based content (e.g., inhalation of metal fragments from the vaping device, Fels Elliott et al., 2019; inhalation of PG/VG, Song et al., 2020).

Finally, although the present assessment may not be best suited to many traditional psychometric tests of validity, there is opportunity for future work in this general area. For example, test–retest reliability of the measure can and should be examined. Additionally, the potential utility of

adding timeline follow-back calendars within the measure should be further considered and possibly examined. Lastly, it may be useful to place attention check items throughout the present assessment to potentially gauge understanding and accuracy within an individual assessment.

CONCLUSION

Although the constantly changing nature of the vaping landscape will require frequent updates to the *EAsY-R*, we hope that this preliminary participant-informed inventory may provide a current, relevant, comprehensive, and efficient starting point from which to begin more accurately assessing vaping behavior among high school and college-age youth. Ultimately, this will lead to a more standardized assessment of vaping that reflects developmentally appropriate vernacular unique to this demographic group.

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CONFLICT OF INTEREST STATEMENT

None.

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