

# Adolescents' Understanding of Smoking and Vaping Risk Language: Cognitive Interviews to Inform Scale Development

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## Abstract

**Introduction:** Perceived message effectiveness (PME) is a common metric to understand receptivity to tobacco prevention messages, yet most measures have been developed with adults. We examined adolescents' interpretation of language within candidate items for a new youth-targeted PME measure using cognitive interviewing. We sought to understand the meaning adolescents assigned to our candidate PME items to improve item wording.

**Aims and Methods:** Participants were 20 adolescents, ages 13–17 years from the United States. Cognitive interviews used a structured guide to elicit feedback on comprehension, answer retrieval, and language regarding a set of Reasoned Action Approach-based survey items that assessed the PME of smoking and vaping prevention ads. We employed thematic analysis to synthesize findings from the interviews.

**Results:** Interviews identified three main issues related to survey items: ambiguity of language, word choice (risk and other terminology), and survey item phrasing. Adolescents preferred direct, definitive language over more ambiguous phrasing which they saw as less serious (eg, "will" instead of "could"). For risk terminology, they preferred terms such as "harmful" and "dangerous" over "risky," which was viewed as easy to discount. The term "negative effects" was interpreted as encompassing a broader set of tobacco harms than "health effects." Adolescents said that the term "vape" was preferable to "e-cigarette," and identified ways to simplify item wording for greater clarity.

**Conclusions:** Tobacco risk terms that appear similar differ in meaning to adolescents, and more direct and unambiguous language is preferred. Our findings informed changes to the PME scale items to improve clarity and reduce measurement error.

**Implications:** This study adds to the literature on how adolescents interpret tobacco prevention language. Adolescents may interpret terminology differently than adults, which could lead to ambiguity in meaning and thus measurement error. Through cognitive interviewing, we identified and improved the language in a youth-focused PME measure for tobacco and vaping prevention.

## Introduction

Adolescent cigarette smoking is an ongoing public health problem in the United States and globally, and the use of electronic cigarettes (e-cigarettes) has become an epidemic.<sup>1</sup> In 2020, 4.6% of high schoolers and 1.6% of middle schoolers smoked cigarettes,<sup>2</sup> while 19.6% of high schoolers and 4.7% of middle schoolers reported current e-cigarette use.<sup>3</sup> Smoking and vaping by teens pose immediate risks from nicotine and other chemical exposures that cause addiction and harm health.<sup>4,5</sup> Although e-cigarettes are probably less harmful than combustible tobacco products such as cigarettes,<sup>4</sup> harms still exist, especially for youth whose bodies and brains are still developing.<sup>6</sup>

Tobacco prevention and control campaigns using mass media are an evidence-based approach to prevent tobacco use among youth.<sup>7</sup> Campaigns such as the Truth Initiative and the Food and Drug Administration's *The Real Cost* have been

found to affect beliefs about tobacco use and reduce youth tobacco initiation.<sup>7</sup> Given the concern around increasing rates of vaping among youth, campaigns have increasingly focused on e-cigarette prevention. E-cigarette prevention ads such as those by *The Real Cost* have been found to increase negative perceptions of vaping among teens and lower intentions to vape.<sup>8</sup> However, developing effective ads requires tools that can assess receptivity and identify messages that will be impactful before ad deployment.<sup>8</sup>

A metric commonly used to understand receptivity of tobacco prevention messages is perceived message effectiveness (PME), which is defined as "an estimate of the degree to which a persuasive message will be favorably evaluated—in terms of its persuasive potential—by recipients of that message."<sup>9</sup> PME measures are commonly used to select messages for use in tobacco prevention campaigns.<sup>10,11</sup> Differences

in PME scores identified during experimental testing of ads for *The Real Cost* adolescent tobacco prevention campaign helped determine which version of ads were aired.<sup>12</sup> However, such PME scales were originally developed with adults, not youth, and for tobacco cessation rather than tobacco prevention.<sup>11,13</sup> Using these standard PME scales with adolescents could lead to measurement error if word choice in PME items developed for adults is complex or ambiguous for youth.<sup>14</sup> Additionally, many PME scales assess *message* perceptions, which are general perceptions of an ad. This can be contrasted with *effects* perceptions, which are perceptions of the extent to which an ad will have an impact. In recent studies comparing message and effects perceptions, effects perceptions have emerged as superior to message perceptions in predicting intentions and behavior.<sup>15-17</sup>

Given the limitations of existing PME measures, there is a need for a new rigorously validated, youth-targeted PME measure. However, there are many challenges to developing a measure for vaping prevention, a novel behavior with rapidly evolving language. In the National Youth Tobacco Survey, a question introducing e-cigarettes listed brand names (JUUL, Vuse, blu, and Logic), a definition, and other terms such as “e-cigs, vape-pens, e-hookahs, vapes or mods,”<sup>18</sup> but this is not feasible in brief survey items. Additionally, although some adolescents report negative health effects and social factors as important concerns for e-cigarette use,<sup>19</sup> their interpretation of risk terminology for vaping has been largely unexplored.

Understanding the meaning adolescents bring to vaping and smoking terminology can inform the development of valid survey items, and ensure that researchers’ intended meaning does not differ from how a priority population interprets the items.<sup>20</sup> Cognitive interviewing is a qualitative method to improve questionnaire design by understanding how participants interpret and answer survey items. It has been utilized in the formative phases of scale development in tobacco research to understand phrasing related to tobacco type, quantity, frequency of use, and harm perceptions.<sup>21-23</sup> During cognitive interviewing, participants explain how they interpret questions, provide answers, and explain any difficulties they had with the questions.<sup>21</sup> Cognitive interviewing can also help identify problems with wording that may affect understanding and can help researchers understand how language is used in a specific context or population.<sup>24</sup> Identifying and correcting these potential sources of error, and ensuring items are understood as intended by the researchers, enhances content validity (ie, the extent to which a measure assesses the intended concept).<sup>25,26</sup>

In the current study, we conducted cognitive interviews with adolescents to inform the development of a new effect perception PME measure. The purpose of this study was to understand the meaning of adolescents assigned to our candidate PME items and to improve the wording of the candidate PME items for adolescents. These items were then tested in a national survey of adolescents, leading to the creation of a brief three-item PME scale for youth.<sup>27</sup>

## Methods

### Participants

Participants were 20 US teens ages 13–17 years. We recruited adolescents using various methods, including craigslist, social media, and e-mail listservs. Potential participants completed an eligibility screener online. A staff person confirmed eligibility and scheduled respondents for an individual interview session over the phone.

The participants were diverse with regard to their gender, race, and tobacco use status (Table 1). We defined current cigarette smokers or e-cigarette users as individuals who reported having smoked or vaped in the past 30 days. We categorized participants as susceptible if they reported not using either product in the past 30 days, but answered anything other than “definitely not” to five susceptibility items; participants were nonsusceptible if they answered “definitely not” to all five items.<sup>28</sup>

### Procedures

Trained qualitative interviewers conducted 1-hour cognitive interviews by phone, recording the sessions. After an initial round of 10 interviews, the study team reviewed the audio files, summarized findings, and refined items to be presented in the next round of interviews. We then conducted an additional 10 interviews using the updated interview guide. After conducting these additional interviews, we determined we had reached saturation in terms of new information and themes related to our research questions and concluded data collection. This methodology followed the recommendations of Willis,<sup>29</sup> and sample size aligned with findings about sample size needed to reach saturation from in-depth interviews.<sup>30</sup>

Prior to beginning the interview, participants’ parent or legal guardian gave verbal consent, and participants gave verbal assent and permission to audio-record the session. Participants were assigned to receive either vaping or smoking-focused questions based on tobacco use and susceptibility status. Because fewer teens smoked cigarettes or were susceptible to both smoking and vaping, we assigned these participants to the smoking interview guide. The two interview guides were identical and only varied on whether the ads and survey items were about vaping or smoking cigarettes. Participants received via e-mail a copy of the survey questions also focused on either vaping or smoking matching their interview guide (Supplementary Material).

**Table 1.** Participant Demographics (*N* = 20)

	Cigarette smoking group <i>n</i> (%) or mean (SD)	Vaping group <i>n</i> (%) or mean (SD)
Age (mean in years)	15.0 (1.3)	15.4 (1.5)
Male (%)	6 (60)	5 (50)
Race		
White	5 (50)	6 (60)
Black/African American	4 (40)	1 (10)
Other race	1 (10)	3 (30)
Ethnicity		
Hispanic/Latino	1 (10)	3 (30)
Tobacco use status		
Current smoker/vaper	4 (40)	2 (20)
Susceptible to smoking/vaping	3 (30)	4 (40)
Nonsusceptible	3 (30)	4 (40)

The cigarette smoking group responded to smoking ads and items, while the vaping group responded to vaping ads and items.

In the first part of the interview, participants viewed a *The Real Cost* vaping or smoking ad and then completed the first half of the survey items about the ad. The ad topic (vaping or smoking) matched the interview guide. Ads were 30-second video ads from *The Real Cost* smoking and vaping prevention campaigns chosen based on existing PME data about specific ads, and to represent a variety of harms from tobacco.

Interviewers followed the interview guide with open-ended questions to discuss each survey item, following the recommendations of Willis.<sup>31</sup> After teens watched the first ad and completed the survey items, the interviewers used probes (Table 2) to encourage participants to think aloud, discuss how they interpreted keywords, and describe what they meant by their responses. Interviewers also elicited feedback and suggestions about the language used. Participants then viewed a second different ad and repeated the same process for the remaining survey items. We counterbalanced the order of sections within the interview guide to equally distribute order effects. At the end of each interview, study staff e-mailed participants an informational handout with a link to the FDA's Center for Tobacco Products to learn more about the risks of smoking and vaping. Participants received a \$40 Amazon gift card for participating in the interview. The University of North Carolina Institutional Review Board approved the study procedures.

## Survey Measures

We conceptualized PME as an effects perception measure made up of three theoretical domains from the Reasoned Action Approach<sup>32</sup>: beliefs about the consequences of smoking/vaping, attitudes toward smoking/vaping, and motivation to avoid smoking/vaping. We drafted a preliminary pool of survey items and subsequently winnowed and refined them through an iterative process during several research team meetings. Items from the UNC PME scale were included and dozens of items from prior PME scales from a systematic review helped inform new candidate items.<sup>10,33</sup> Items were written to apply to both adolescent smoking and vaping focusing on broad themes rather than specific attributes and to a broad set of prevention ads. Language choice and reading level were also carefully considered when developing items. Additionally, feedback on the items and content validity assessment were provided by two consultants who are experts in PME and tobacco messaging.

We arrived at 11 closed-ended effects perception PME items to be assessed in the cognitive interviews (Table 3), with multiple items covering each theoretical domain (Table 2). The goal was to identify three potential items in *each* domain for

testing in a national survey. This number was chosen as it would allow multiple items in each theoretical domain to be tested in a national survey in efforts to develop a brief PME measure, with brevity being important given that PME measures are often used in contexts where multiple messages are being rated.<sup>33</sup> The goal of this national survey was ultimately to choose a single item from each theoretical domain to result in a brief three-item scale.<sup>27</sup> All items used the same five-point response scale: *Not at all, Very little, Somewhat, Quite a bit, A great deal*.

## Analysis

Notetakers listened to audio recordings and took detailed notes, recording the main ideas and opinions expressed by the participants and key terms used. A transcription service transcribed the audio files. To synthesize findings from the interviews, we used thematic analysis.<sup>34</sup> First, two team members independently reviewed the transcripts and noted key themes and issues within items. The research team developed themes in an inductive manner through discussion, and coders then applied the themes within each transcript. Finally, coders made recommendations for each item. All changes made to the items are summarized in Table 3.

## Results

Participants generally interpreted the meaning of the survey items according to our intended meaning. Probing on specific terminology and phrasing illuminated key changes to improve the survey items.

### Ambiguity of Language

Two items within the domain “beliefs about consequences” asked participants about what *could* happen to them from smoking/vaping. Participants were probed about changing this phrasing from the ambiguous *could* to the more definitive *will*. Participants preferred the more direct, definitive language. Many adolescents noted they were already aware that smoking or vaping is harmful, and *could* seemed less certain and less serious, whereas *will* communicated more serious risks. One participant stated “‘*Could* do to you.’ I feel like that’s a very broad term.” (Participant #7- Vaping).

Another participant noted the ambiguity of *could* implied uncertainty. “It says like *could* instead of *does*. I think if you’re trying to get a point across, the language shouldn’t be like *unsure*...I feel like saying it’s just bad or it could harm you is sort of downplaying it” (Participant #1—Smoking). To better assess the risks of smoking and vaping, the change from *could* to *will* was made in survey items #1 and #4.

### Risk Terminology

Words used to communicate risk were of particular interest to the research team. Two survey items included risk terminology, specifically *bad for you* and *dangerous*. To understand whether these words communicated risk effectively, or whether others would be more appropriate for this audience, interviewers also probed on the terms *harmful*, *risky*, *bad*, and *health effects*. Adolescents offered a wide variety of perspectives on these words.

*Bad for you* and *risky* were rarely preferred, and interpretation of these terms varied widely. A few participants reported these terms were clear and unambiguous, whereas others viewed these terms as weak and vague. *Risky*, for example, was not perceived as definitive, and participants discussed the

**Table 2.** Example Questions and Probes Used During the Cognitive Interviews

Question/probe
In your own words, what is this question asking?
Was there anything confusing about this question?
How did you decide on your answer?
Was it easy or hard to decide what your answer should be? What made it [easy/hard]?
What does the word [X] mean to you?
In this question, we used the phrase [X]. What does this phrase mean to you?
What other words would you use instead of [X]?

**Table 3.** Changes Made to the Survey Items as a Result of the Cognitive Interviews

Construct	Item	Original survey item	Issue and resolution	Final survey item
Beliefs about consequences	1	How much does this ad make you think vaping [smoking] could harm you?	Participants perceived “could” as less serious, and “will” communicated risk more clearly. Changed to “will”	How much does this ad make you think vaping [smoking] will harm you?
	2	How much does this ad make you concerned about the health effects of vaping [smoking]?	“Health effects” was perceived as only physical harms, and did not include other harms like addiction. Changed to “negative effects”	How much does this ad make you concerned about the negative effects of vaping [smoking]?
	3	How much does this ad make you think vaping [smoking] is bad for you?	“Bad for you” was perceived as weak and something teenagers already knew about tobacco use. Cut item	[Item cut]
	4	How much does this ad make you worry about what vaping [smoking] could do to you?	Participants perceived “could” as less serious, and “will” to be more definitive and clearer. Changed to “will”	How much does this ad make you worry about what vaping [smoking] will do to you?
Attitudes about behavior	5	How much does this ad convince you that vaping [smoking] is dangerous?	“Dangerous” was perceived as a strong word, but one that only applied to physical harms. “Bad” was perceived as clear and direct, and more inclusive of other harms. Changed to “bad”	How much does this ad convince you that vaping [smoking] is bad?
	6	How much does this ad make you think vaping [smoking] is a bad idea?	No issues noted. No change	How much does this ad make you think vaping [smoking] is a bad idea?
	7	How much does this ad make vaping [smoking] seem unpleasant to you?	No issues noted. No change	How much does this ad make vaping [smoking] seem unpleasant to you?
Motivation	8	How much does this ad make you want to avoid using vapes [cigarettes]?	No issues notes. No change	How much does this ad make you want to avoid using vapes [cigarettes]?
	9	How much does this ad motivate you to <i>not</i> vape [smoke]?	The phrase “motivate you to not” was perceived by participants as confusing. Changed to “motivate you to be someone who doesn’t vape/ smoke”	How much does this ad motivate you to be someone who doesn’t vape [smoke]?
	10	How much does this ad make you <i>not</i> want to vape [smoke]?	Meaning of the phrase “make you not want to vape [smoke]” was confusing to some participants. Cut item	[Item cut]
	11	How much does this ad discourage you from wanting to vape [smoke]?	Meaning of the phrase “discourage you from wanting to vape [smoke]” was confusing to some participants. Dropped the phrase “wanting to”	How much does this ad discourage you from vaping [smoking]?

All questions were asked on the response scale: Not at all, Very little, Somewhat, Quite a bit, A great deal.

potential to discount things that are *risky* as not being likely to happen. A vaping participant stated, “‘Risky’, I mean that’s kind of like a 50/50 you may be harmed, you may not be harmed. It’s risky.” (Participant #3—Vaping). A participant in the smoking group echoed this statement, “Risky is like there’s chances.” (Participant #4—Smoking). Participants also reported varying perspectives about *bad for you*. Some noted they already know vaping or smoking is bad for you. A smoking participant stated, “Everyone already knows that it’s bad for you...I feel like saying it’s just bad or it could harm you is sort of downplaying it.” (Participant #1—Smoking). Given this feedback, we cut survey item #3 in the domain “beliefs about consequences.”

In contrast, *dangerous* was perceived as clear and unambiguous. However, *dangerous* did not seem to capture the full spectrum of harms incurred from tobacco use. For example, participants noted while physical harms seem

dangerous, social harms do not. “This one [ad] is focused on how your friends might be affected or how it would affect social situations and stuff like that and doesn’t make you feel like it’s super dangerous to you I guess.” (Participant #16—Vaping). Given this feedback, and our desire to make survey items as broad as possible to capture both physical and other harms from tobacco use, we replaced the word *dangerous* with the word *bad* in item #5. This change was because despite *bad for you* being perceived as weak, the word *bad* by itself was perceived as clear and direct. A smoking participant noted, “If you just say ‘bad’ it will just mean that it’s like flat bad.” (Participant #10—Smoking) This sentiment was reiterated by another smoking participant who simply stated, “‘Bad’ is just bad.” (Participant #4—Smoking). Vaping participants shared similar opinions and also perceived *bad* as a strong word.

The word *harmful* was seen as clear and seemed to be preferred by the majority of participants. As one participant noted “it just really gets the image in your head that you’re harming yourself if you do that.” (Participant #12—Smoking) When asked to describe harms from tobacco, participants noted only physical harms such as lung damage and disease, excluding harms such as addiction and social harms. However, when probed further about the harmful effects of tobacco use, participants did note nonphysical harms. A similar issue was also noted with the phrase *health effects*, which participants rarely thought of as including addiction. The phrase *negative effects* was probed and seen as more serious and broad. When asked about negative effects, participants included physical harms, but also monetary harms, addiction, and social harms like losing friends. Thus, survey item #2 was changed from “health effects” to “negative effects” to more broadly capture potential harms, not just physical harms.

### Other Terminology

Interviewers also probed about participants understanding and interpretation of additional words. One such word was *unpleasant*, which is in the current UNC PME scale developed with adults.<sup>33</sup> The question reads, “How much does this ad make vaping [smoking] seem unpleasant to you?” This question was included to examine whether adolescents understood it and applied the same meaning to the word *unpleasant* as adults. Most participants reported understanding *unpleasant*, and that it communicated something uncomfortable, bad, gross, and not fun. However, some participants noted *unpleasant* was not a word teenagers use and seemed unnatural. One participant noted *unpleasant* “caught me off guard...because nobody ever really talks about [smoking] being unpleasant.” (Participant #6—Cigarettes). Based on this mixed feedback, the item was not changed.

### Vape Versus E-cigarette

Adolescents in the vaping group were additionally asked their thoughts on use of *vape* as opposed to *e-cigarette* in the scale. Participants noted teens do not use the term *e-cigarette*, and *vape* was more common. One participant stated, “Yeah. I mean, I feel like when adults or people say E-cigarettes, it sounds way more like, —no one really says that... So, I feel like vapes is better because it’s more relatable, even though it’s not really supposed to be like relatable...I feel like teens can connect to that more” (Participant #14—Vaping). Another participant noted, “I’ve only known them as vapes” (Participant #20—Vaping). Additionally, participants noted certain devices are referred to by brand name. A participant stated, “I think there’s obviously like different brands and stuff like that so people might call them by the specific brand like obviously Juul is like the biggest one and people just call it a Juul but *vape* is normally the word that’s...most common” (Participant #16—Vaping). Given the many specific *vape* brands and that brands and devices probably will continue to change and evolve, we selected the word *vape* to use in the survey items.

### Item Phrasing

Two survey items were rephrased, and one cut due to phrasing seen as confusing. Two survey items, #10 and #11, originally included the phrase *wanting to vape [smoke]* and participants took issue with this phrase. Participant #2 (vaping) summarized item #10 as “I guess it’s asking how much does this ad make you almost not want to want to

vape...I was sort of stuck between does it mean stop you from wanting to vape or just make you think that you shouldn’t want to vape.” Another participant, Participant #8 (smoking), also noted confusion regarding this phrase and mentioned individuals who are addicted to smoking or vaping may feel a need rather than a want to use tobacco. Given this feedback, survey item #10, which asked about not wanting to vape or smoke, was cut from the survey. Survey item #11 was rephrased as “How much does this ad discourage you from vaping [smoking cigarettes]?”

The second survey item that was rephrased originally asked “How much does this ad motivate you to *not* vape [smoke]?” Although participants reported understanding the word *motivate*, they thought the phrasing was confusing. Participant #9 (vaping) noted, “I feel like it’s a fine question, but motivate you not to do something kind of doesn’t really make sense.” Another participant, a cigarette smoker, noted “motivate to not smoke kind of sounds like—it sounds like a double negative, but it’s not” (Participant #1—Smoker). This survey item, item #9, was changed to “How much does this ad motivate you to be someone who doesn’t vape [smoke cigarettes]?”

### Response Options

Interviewers asked about the response options used for all survey items: (1) *Not at all*, (2) *Very little*, (3) *Somewhat*, (4) *Quite a bit*, and (5) *A great deal*. Participants reported understanding the options, did not find them confusing, and suggested no substantive suggestions to alter the phrasing. Therefore, we made no changes to the response scale.

### Discussion

This study explored adolescents interpretation of PME items for vaping and smoking prevention among adolescents through cognitive interviewing. Our findings illustrate how specific words and phrases are understood in the tobacco prevention context and illustrate the importance of appropriate language in questions about tobacco use for adolescents. Through the interviews, we identified issues with ambiguity of language, word choice, and item phrasing. Based on this feedback, the wording of the initial PME candidate items was revised through an inductive, discussion-based team process (Table 3). Our findings led to changes that are likely to improve the content validity of the survey items, which were subsequently tested in a national survey.<sup>27</sup>

In the current study, adolescents had a preference for more direct and definitive language. Adolescents felt this type of language meant that the issues being asked about were more serious (eg, vaping is *harmful*, not just *risky*). Saff and colleagues reported similar findings for a sample of US adolescents responding to e-cigarette warnings with uncertain language. In their study, adolescents reported disliking uncertain language, which they believed weakened the message and made messages unnecessarily complex.<sup>35</sup> Adolescents’ preference for more definitive language may also lead to the creation of PME items that result in lower mean scores, a positive development since PME items often exhibit positive skew.<sup>33</sup> A PME scale with questions that are more direct and definitive may be more precise in discriminating between more and less effective tobacco prevention messages among adolescents.

An area of particular interest in the cognitive interviews was how adolescents interpreted risk terminology. Adolescents generally engage in riskier behaviors than adults,<sup>36</sup> and how

they interpret risk communication may be different than adults. Adolescents are also more open to novelty, which may make vapes attractive to them even as use of combustible cigarettes declines.<sup>37,38</sup> Little work has been done to explore differences in the meaning adolescents bring to various risk-related terms in the context of tobacco prevention and control. In the current study, there was considerable variation in the interpretation of words that are commonly used to describe risk and harm. *Bad*, *harmful*, and *dangerous* were perceived as clear and *appropriate by most participants while risky* was perceived as vague. Several participants noted *risky* seemed like things that might, but also might not, happen. These findings raise questions about how adolescents perceive widely used smoking and vaping risk language, and whether the current phrasing and terms used effectively convey the intended meaning. This is of growing concern as emerging tobacco products marketed as “reduced risk” such as IQOS enter the market. The FDA evaluates the messages tobacco companies want to put on such products, and our findings may have implications for how adolescents interpret language in these and other such risk messages.

In addition, we found that adolescents interpreted commonly used risk terms in specific ways. For instance, *dangerous* was seen as limited to discussion of physical harms. Messaging around social harms may be particularly important to this age demographic given the social aspect of vaping and the influence of having peers who vape,<sup>39</sup> and it may be important to have measures that capture this aspect of prevention messages. Adolescents respond well to messages about social harms such as missing out or the unpleasantness of vaping, for example.<sup>40</sup> We attempted to solve this problem by using broader terms, such as “harmful,” and strategically ambiguous language, such as our survey item about what smoking/vaping “will do to you,” which tested well. This illustrates the importance of carefully identifying appropriate language and understanding the meaning the target audience draws from that language so a PME measure appropriately assesses the consequences depicted across a series of prevention ads.

Finally, these interviews highlighted the importance of clear, understandable language when creating survey items. Several items that were cognitively tested included phrasing adolescents found slightly difficult to understand, such as “motive you to not” or “discourage you from wanting to.” The words motivate and discourage were themselves understood, but the double-negatives made these items difficult to interpret. This finding echoes work from scale development with adolescents where double-negatives in a measure about recidivism created confusion between questions and their response options and generally elicited the opposite of the intended response.<sup>41</sup> These findings probably have implications far beyond the tobacco prevention realm, as questions that are harder to answer may increase measurement error in a variety of research contexts.

Strengths of this study include systematic development of theory-based survey items and application of robust methodology—cognitive interviewing—to understand responses to those items. One limitation is participants came from the same geographic area, while language use and interpretation could vary across geographic areas. Furthermore, although many different user types were represented in the vaping and smoking groups (user, susceptible, nonuser), we did not examine the use of tobacco products beyond e-cigarettes and cigarettes.

In conclusion, this study applied cognitive interviewing to identify key insights from candidate survey items, allowing the research team to refine the items to reduce potential sources of bias and measurement error. The feedback and insights gained through these cognitive interviews illustrate the importance of cognitive interviewing in the scale development process, and the findings may have implications for the development of risk communication measures for adolescents beyond the current context. Findings from cognitive interviews help refine and improve items in ways that are likely to lead to scales with better measurement properties, in this case for assessing the perceived effectiveness of vaping and smoking prevention ads among adolescents.

## Supplementary Material

A Contributorship Form detailing each author’s specific involvement with this content, as well as any supplementary data, are available online at <https://academic.oup.com/ntr>.

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## Declaration of Interests

*SMN has served as a paid expert witness in government litigation against tobacco and e-cigarette companies; JMS has served as a paid consultant in government litigation against tobacco companies*

## Data Availability

The data underlying this article cannot be shared publicly for the privacy of the adolescents who participated in this study.

## References

1. Johnston LD, Miech RA, O’Malley PM, Bachman JG, Schulenberg JE, Patrick ME. *Monitoring the Future: National Survey Results on Drug Use, 1975–2018*. Institute for Social Research, The University of Michigan; 2019. <https://deepblue.lib.umich.edu/bitstream/handle/2027.42/148123/Overview%202018%20FINAL%20print%201-30.pdf?sequence=1&isAllowed=y>

2. Gentzke AS, Wang TW, Jamal A, *et al.* Tobacco product use among middle and high school students—United States, 2020. *Morb Mortal Wkly Rep.* 2020;69(50):1881–1888.
3. Wang TW. E-cigarette use among middle and high school students—United States, 2020. *MMWR Morb Mortal Wkly Rep.* 2020;69:1310–1312.
4. National Academies of Sciences, Engineering, and Medicine; Health and Medicine Division; Board on Population Health and Public Health Practice, *et al.* *Public Health Consequences of E-Cigarettes.* National Academies Press (US); 2018. <https://www.ncbi.nlm.nih.gov/books/NBK507163/>. Accessed February 11, 2021.
5. U.S. Department of Health and Human Services. *E-Cigarette Use Among Youth and Young Adults. A Report of the Surgeon General.* Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2016.
6. CDC. *Quick Facts on the Risks of E-cigarettes for Young People.* Centers for Disease Control and Prevention. [https://www.cdc.gov/tobacco/basic\\_information/e-cigarettes/Quick-Facts-on-the-Risks-of-E-cigarettes-for-Kids-Teens-and-Young-Adults.html](https://www.cdc.gov/tobacco/basic_information/e-cigarettes/Quick-Facts-on-the-Risks-of-E-cigarettes-for-Kids-Teens-and-Young-Adults.html). Published December 16, 2020. Accessed February 11, 2021.
7. Rath JM, Green MP, Vallone DM, *et al.* The role of emotions and perceived ad effectiveness: evidence from the truth Finishit Campaign. *Am J Health Promot.* 2019;33(8):1152–1158.
8. Noar SM, Rohde JA, Prentice-Dunn H, *et al.* . Evaluating the actual and perceived effectiveness of E-cigarette prevention advertisements among adolescents. *Addict Behav.* 2020;109:106473.
9. Dillard JP, Weber KM, Vail RG. The relationship between the perceived and actual effectiveness of persuasive messages: a meta-analysis with implications for formative campaign research. *J Commun.* 2007;57(4):613–631.
10. Noar SM, Bell T, Kelley D, Barker J, Yzer M. Perceived message effectiveness measures in tobacco education campaigns: a systematic review. *Commun Methods Meas.* 2018;12(4):295–313.
11. Davis KC, Nonnemaker J, Duke J, Farrelly MC. Perceived effectiveness of cessation advertisements: the importance of audience reactions and practical implications for media campaign planning. *Health Commun.* 2013;28(5):461–472.
12. Zhao X, Alexander TN, Hoffman L, *et al.* Youth receptivity to FDA's the real cost tobacco prevention campaign: evidence from message pretesting. *J Health Commun.* 2016;21(11):1153–1160.
13. Davis KC, Duke J, Shafer P, *et al.* Perceived effectiveness of antismoking ads and association with quit attempts among smokers: evidence from the tips from former smokers campaign. *Health Commun.* 2017;32(8):931–938.
14. Viswanathan M. *Measurement Error and Research Design.* 1st ed. SAGE Publications. <https://us.sagepub.com/en-us/nam/measurement-error-and-research-design/book226938>. Accessed December 10, 2021.
15. Baig SA, Noar SM, Gottfredson NC, *et al.* Incremental criterion validity of message perceptions and effects perceptions in the context of anti-smoking messages. *J Behav Med.* 2020. doi:10.1007/s10865-020-00163-0.
16. Rohde JA, Noar SM, Prentice-Dunn H, Kresovich A, Hall MG. Comparison of message and effects perceptions for the real cost E-Cigarette prevention ads. *Health Commun.* 2021;36(10):1222–1230. doi:10.1080/10410236.2020.1749353.
17. Brennan E, Durkin SJ, Wakefield MA, Kashima Y. Assessing the effectiveness of antismoking television advertisements: do audience ratings of perceived effectiveness predict changes in quitting intentions and smoking behaviours? *Tob Control.* 2014;23(5):412–418.
18. Centers for Disease Control and Prevention. *National Youth Tobacco Survey (NYTS).* 2021. [https://www.cdc.gov/tobacco/data\\_statistics/surveys/nyts/index.htm](https://www.cdc.gov/tobacco/data_statistics/surveys/nyts/index.htm).
19. Kong G, Morean ME, Cavallo DA, Camenga DR, Krishnan-Sarin S. Reasons for electronic cigarette experimentation and discontinuation among adolescents and young adults. *Nicotine Tob Res.* 2015;17(7):847–854.
20. Norris AE, Torres-Thomas S, Williams ET. Adapting cognitive interviewing for early adolescent Hispanic girls and sensitive topics. *Hisp Health Care Int.* 2014;12(3):111–119.
21. Hinds JT, Loukas A, Chow S, *et al.* Using cognitive interviewing to better assess young adult E-cigarette use. *Nicotine Tob Res.* 2016;18(10):1998–2005.
22. Land SR, Warren GW, Crafts J, *et al.* Cognitive testing of tobacco use items for administration to cancer patients and survivors in clinical research. *Cancer.* 2016;122(11):1728–1734.
23. Peterson EB, Portnoy DB, Blake KD, *et al.* Item development and performance of tobacco product and regulation perception items for the health information national trends survey. *Nicotine Tob Res.* 2018;21(11):1565–1572.
24. Hofmeyer A, Sheingold BH, Taylor R. Do you understand what I mean? How cognitive interviewing can strengthen valid, reliable study instruments and dissemination products. *J Int Educ Res JIER.* 2015;11(4):261–268.
25. McCaffrey SA, Zdinak JP, Plunkett S, *et al.* Development and validation of behavioral intention measures of an E-vapor product: intention to try, use, dual use, and switch. *Health Qual Life Outcomes.* 2021;19(1):123.
26. Patrick DL, Burke LB, Gwaltney CJ, *et al.* Content validity—establishing and reporting the evidence in newly developed Patient-Reported Outcomes (PRO) instruments for medical product evaluation: ISPOR PRO good research practices task force report: part 1—eliciting concepts for a new PRO instrument. *Value Health.* 2011;14(8):967–977.
27. Noar SM, Gottfredson N, Vereen RN, *et al.* Development of the UNC perceived message effectiveness scale for youth. *Tob Control.* 2021;0:1–6. doi:10.1136/tobaccocontrol-2021-056929.
28. Pierce JP, Choi WS, Gilpin EA, Farkas AJ, Merritt RK. Validation of susceptibility as a predictor of which adolescents take up smoking in the United States. *Health Psychol.* 1996;15(5):355–361.
29. Willis GB. *Cognitive Interviewing: A "How To" Guide.* Research Triangle Institute; 1999. <https://www.hkr.se/contentassets/9ed7b1b3997e4bf4baa8d4eceed5cd87/gordonwillis.pdf>
30. Hennink M, Kaiser BN. Sample sizes for saturation in qualitative research: a systematic review of empirical tests. *Soc Sci Med.* 2021;292:114523. doi:10.1016/j.socscimed.2021.114523.
31. Willis GB. *Cognitive Interviewing: A Tool for Improving Questionnaire Design.* 1st ed. SAGE Publications; 2004. <https://www.amazon.com/Cognitive-Interviewing-Improving-Questionnaire-Design/dp/0761928049>. Accessed January 12, 2021.
32. Fishbein M, Ajzen I. *Predicting and Changing Behavior: The Reasoned Action Approach.* 1st ed. Psychology Press; 2015. <https://www.amazon.com/Predicting-Changing-Behavior-Martin-Fishbein/dp/1138995215>. Accessed December 27, 2021.
33. Baig SA, Noar SM, Gottfredson NC, *et al.* UNC perceived message effectiveness: validation of a brief scale. *Ann Behav Med.* 2019;53(8):732–742.
34. Vaismoradi M, Turunen H, Bondas T. . Content analysis and thematic analysis: implications for conducting a qualitative descriptive study. *Nurs Health Sci.* 2013;15(3):398–405.
35. Safi AG, Kalaji M, Avery R, *et al.* Uncertain language, developing science and e-cigarette warnings. Presented at: *Tobacco Regulatory Science*; 2021; Virtual.
36. Steinberg L. A social neuroscience perspective on adolescent risk-taking. *Dev Rev.* 2008;28(1):78–106.
37. Defoe IN, Semon Dubas J, Romer D. Heightened adolescent risk-taking? Insights from lab studies on age differences in decision-making. *Policy Insights Behav.* 2019;6(1):56–63.
38. Evans-Polce RJ, Patrick ME, Lanza ST, Miech RA, O'Malley PM, Johnston LD. Reasons for vaping among US 12th graders. *J Adolesc Health.* 2018;62(4):457–462.
39. Perikleous EP, Steiropoulos P, Paraskakis E, Constantinidis TC, Nena E. E-Cigarette use among adolescents: an overview of the literature and future perspectives. *Front Public Health.* 2018;6:86. doi:10.3389/fpubh.2018.00086.
40. Lazard AJ. Social media message designs to educate adolescents about e-cigarettes. *J Adolesc Health.* 2021;68(1):130–137.
41. Silva JR, Fera B, Sudula S, Koetzle D, Schwalbe C. Cognitive interviewing to improve questionnaires for justice-involved youth. *Int J Offender Ther Comp Criminol.* 2019;63(10):1931–1951.