



Original investigation

# Early Subjective Sensory Experiences with “Cigalike” E-cigarettes Among African American Menthol Smokers: A Qualitative Study

Sabrina L. Smiley PhD, MPH, MCHES<sup>1</sup>, Teresa DeAtley MPH<sup>1</sup>,  
Leslie F. Rubin MS<sup>1,2</sup>, Emily Harvey MA<sup>1</sup>, Elexis C. Kierstead<sup>1,3</sup>,  
Monica Webb Hooper PhD<sup>4</sup>, Raymond S. Niaura PhD<sup>1,5,6</sup>,  
David B. Abrams PhD<sup>1,5,6</sup>, Jennifer L. Pearson PhD, MPH<sup>1,5</sup>

<sup>1</sup>Schroeder Institute for Tobacco Research and Policy Studies at Truth Initiative, Washington, DC; <sup>2</sup>Department of Psychology, American University, Washington, DC; <sup>3</sup>Milken Institute School of Public Health, The George Washington University, Washington, DC; <sup>4</sup>Case Comprehensive Cancer Center, School of Medicine, Case Western Reserve University, Cleveland, OH; <sup>5</sup>Department of Health, Behavior and Society, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD; <sup>6</sup>Department of Oncology, Georgetown University Medical Center, Lombardi Comprehensive Cancer Center, Washington, DC

Corresponding Author: Sabrina L. Smiley, PhD, MPH, MCHES, Schroeder Institute for Tobacco Research and Policy Studies at Truth Initiative, 900 G Street NW, Washington, DC 20001, USA. Telephone: 202-454-5928; E-mail: [ssmiley@truthinitiative.org](mailto:ssmiley@truthinitiative.org)

## ABSTRACT

**Introduction:** Despite smoker interest in e-cigarettes as a harm reduction or cessation aid, many smokers prematurely discontinue vaping after trying a product. This study explored the role of early subjective sensory experiences in vaping persistence and desistance.

**Methods:** African American menthol cigarette smokers aged  $\geq 18$  years ( $N = 15$ ;  $M = 54.1$  years;  $SD = 8.2$ ), motivated to quit smoking, and interested in trying e-cigarettes were recruited in Washington, DC. Participants were followed for 3 weeks and provided menthol cigalike e-cigarettes after Week 1. Participants completed three interviews about their vaping experiences. Thematic analysis of responses was designed to understand the sensory aspects of vaping.

**Results:** During the first 2 weeks of vaping, four participants reported a positive vaping experience while 11 reported decreased satisfaction. Salient sensory attributes of dissatisfaction included poor taste, insufficient throat hit, difficulty pulling, and a lack of “whole body” satisfaction compared to their preferred cigarette brand.

**Conclusions:** The sensory experiences with a specific cigalike e-cigarette were related to vaping persistence and desistance. Although this was a small volunteer sample of African American menthol smokers motivated to quit smoking, 27% ( $N = 4$ ) of participants with a positive vaping experience continued using the product, while 73% ( $N = 11$ ) of participants’ vaping experience was unsatisfactory across several experiential categories. In future research of e-cigarettes’ efficacy as a smoking cessation or reduction aid, both device characteristics and smokers’ expectations for these devices should be considered, so vapers do not expect the same taste sensations, throat sensations, and “whole body” satisfaction as they experienced with their menthol cigarettes.

**Implications:** The subjective sensory experiences associated with initial e-cigarette product use are associated with use patterns. Subjective sensory experiences may also help understand the

differences in the appeal, satisfaction, and harm-reduction potential of the rapidly evolving diverse types of products emerging in the marketplace. How products meet the sensory needs of smokers wanting to switch or quit smoking may influence adherence and success rates.

## Introduction

Electronic cigarettes (e-cigarettes) are widely available in the United States, considerably less harmful than tobacco cigarettes, and increasing in use among adult smokers, who most often report use for smoking reduction or smoking cessation.<sup>1-15</sup> Using data from the 2014 National Health Interview Survey, Delnevo et al.<sup>8</sup> found that nearly half (49%) of adult daily smokers reported having ever tried e-cigarettes, and that the highest prevalence of daily e-cigarette use was among current smokers and former smokers who quit within the past year (13% vs. 3.5%). The steep decline in use from 49% among daily smokers who reported having ever tried an e-cigarette, to those who use daily suggest that most smokers do not continue e-cigarette use (commonly called vaping).

The most common type of e-cigarette device in the United States is typically a first-generation "cigalike" e-cigarette,<sup>16,17</sup> although this is a rapidly evolving class of products. Cigalike e-cigarettes can resemble tobacco cigarettes, are disposable or rechargeable with replaceable cartridges, and have smaller batteries than new-generation high-capacity refillable and modifiable devices ("tanks" and "mods").<sup>16,17</sup> While new-generation e-cigarette use may be more strongly associated with daily use, smoking reduction, and smoking cessation studies<sup>17,18</sup> suggest that regular use for a month or more is associated with six times greater chance of cessation, and that trial use on one or two occasions is not associated with cessation. Taken together, these findings indicate that most people try for a very short time.

More information is required to understand how the initial experience of e-cigarette use may encourage or discourage continued use among adult cigarette smokers wanting to quit smoking. Decades of tobacco industry research has been devoted to refining the complex subjective sensory experience of cigarette smoking to facilitate their appeal, satisfaction, and nicotine delivery.<sup>19-21</sup> The sensory experience of smoking has been characterized by three broad categories: taste sensations (eg, sweet or bitter aftertaste), throat sensations (eg, "throat hit") and physiological "whole body" satisfaction.<sup>22,23</sup> "Throat hit" is the sensation felt at the back of the throat by smokers immediately after inhaling a cigarette.<sup>24,25</sup> "Whole body" satisfaction describes the alleviation of nicotine withdrawal symptoms and is experienced as a pleasurable sensation that has no distinct origin in the body.<sup>19</sup> These three aspects of the sensory experience of cigarette smoking are distinct and complex subjective dimensions that may also interact with cigarette branding to enhance customer loyalty.<sup>19-25</sup>

A key question regarding e-cigarette use for public health benefit is to examine in more detail the reasons why a majority of users discontinue use while some users do continue use.<sup>8,17</sup> This discontinuation compromises e-cigarettes' potential role in facilitating smoking abstinence or reduction in the number of cigarettes smoked. Qualitative research methods are useful to advance more in-depth understanding of smokers' subjective sensory experience during their initial early use episodes of vaping. Qualitative methods may help explain why many smokers have tried (primarily first-generation cigalike) e-cigarettes and, despite a desire to quit smoking, nevertheless prematurely discontinue vaping. The objective of this

study was to examine the sensorimotor experiential factors that might explain continued vaping versus early desistance of vaping among adult daily cigarette smokers motivated to quit smoking. A sensory experience framework and coding method was developed to assess the subjective experience of vaping. This method was adapted from the approach used by the tobacco industry and nonindustry researchers to evaluate three components of the subjective experience: taste sensations, throat sensations, and "whole body" satisfaction of cigarette smoking.<sup>19-21</sup> This study examined: (1) How do smokers motivated to quit cigarette smoking describe the initial sensory experience of vaping and (2) How do these descriptions help understand the continued use or desistance of vaping in relation to the experience of smoking the participant's usual brand?

## Methods

### Study Design

Participants were 15 self-identified African American adult daily menthol smokers. Data were drawn from this subsample of African American menthol smokers within a larger program of research (the "Moment Study", described in detail elsewhere<sup>26</sup>). Briefly, the study consisted of a 3-week intensive longitudinal mixed methods design to yield an in-depth understanding of initiating e-cigarette vaping among adult smokers. The Moment Study's design featured concurrent collection of multiple data streams, including: (1) ecological momentary assessment, (2) geotracking, (3) semistructured interviews, and (4) biosamples. Only data from the semi-structured interviews are included in this paper. We focused on African American menthol smokers because they have been substantially underrepresented in e-cigarette research, and because there is brand loyalty among menthol flavored products, and moreover, menthol smokers may have more difficulty quitting smoking.<sup>27,28</sup> There was a unique opportunity to conduct qualitative research that could capture the rich complexity of menthol smokers' early vaping experience with menthol flavored e-cigarettes. Participants completed a baseline and three other in-person visits, followed by an online follow-up survey 30 days after the final visit.

### Study Participants and Recruitment

Participants were recruited via public online postings (eg, Craigslist), paid advertisements (eg, buses/rail stations, newspapers) and flyers. Eligible individuals were English-speaking adults  $\geq 18$  years residing in the Washington, DC area who smoked at least eight cigarettes a day for the past 5 years. Eligible individuals must not have used e-cigarettes in the past 30 days, be interested in trying e-cigarettes, and report considering quitting cigarette smoking in the next 30 days. A complete list of eligibility criteria is available elsewhere.<sup>26</sup>

### Procedure

Potential participants were initially directed to an online screening survey. All participants provided written informed consent and were told they would be compensated up to \$285 if they completed all study activities. The Chesapeake Institutional Review Board

approved all study procedures. Participants identified as eligible via the online screener were rescreened over the phone. Those who continued to meet eligibility criteria were informed that the study was not a smoking cessation intervention and that they could withdraw from the study at any time. Participants were instructed to try cigalike e-cigarettes according to the 3-week protocol. Participants were also provided referrals to community smoking cessation resources. Once enrolled, in-person procedures consisted of four office visits over 3 weeks. Participants in the subsample were provided 10 menthol disposable cigalike e-cigarettes at the end of the 2<sup>nd</sup> and 3<sup>rd</sup> office visits. Additionally, trained research assistants (RAs) conducted three sets of qualitative interviews at the end of the 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> office visits in private rooms. Each interview lasted up to 30 minutes.

### Study Materials

Two disposable NJOY King menthol cigalike e-cigarette five-packs containing 3.0% nicotine were provided to participants after the qualitative interviews at the 2<sup>nd</sup> and 3<sup>rd</sup> office visits. At the 2<sup>nd</sup> visit, participants were instructed to try a minimum of three puffs per day over the course of the week. At the 3<sup>rd</sup> visit, participants received 10 additional five-packs and were instructed to use them as they desired (including not at all).

### Study Instrument

A semistructured interview guide outlined topics in advance for discussion, but permitted interviewers the flexibility to decide the sequence and phrasing of interview questions.<sup>29</sup> At 2<sup>nd</sup> office visit, the interview guide focused on the meaning and utility of cigarette smoking in participants' lives and their perceptions of e-cigarettes. At the 3<sup>rd</sup> and 4<sup>th</sup> office visits, the interview guides investigated participants' experiences using e-cigarettes, including their sensory experience and how participants compare their e-cigarette experience to smoking their usual brand of cigarettes. The interview guide at the 4<sup>th</sup> visit focused on participants' experiences with e-cigarettes compared to the 3<sup>rd</sup> visit and explored whether participants would continue to use e-cigarettes after completing the study. Sample questions included: "I want to get a sense of how things went last week. Can you tell me about the first time you tried an e-cig?" "And how did it go the rest of the week?" "So, now that you've tried e-cigarettes for the last 2 weeks, do you think that you'll continue?"

### Data Analysis

All semistructured interviews ( $n = 45$ ) were digitally recorded, professionally transcribed verbatim, edited to remove identifiers, and checked to ensure deidentification. To begin the thematic analysis,<sup>30</sup> a subset of the transcripts was independently read by the first, second, third, and fourth authors to familiarize them with the data. After multiple readings, transcripts were imported into NVivo 10.0<sup>31</sup> to facilitate organization of the data. The codebook consisted of a mixture of topic codes based on tobacco industry and nonindustry documents<sup>19-21</sup> evaluating sensory effects of cigarettes and inductive codes developed by the coders based on topics that emerged during the interviews. The first, second, third, and fourth authors coded the data in NVivo independently and then discussed and compared coding to assess agreement. Additionally, the first author wrote analytical notes during the coding process, documenting her interpretations and questions about the data in relation to the two research questions. These notes were shared with the coding team to refine codes. Topic codes and definitions included the following: (1) taste

(participant's subjective assessment of their cigarette or e-cigarette sensory experiences in relation to taste sensations), (2) throat (participant's subjective assessment of their cigarette or e-cigarette sensory experiences in relation to throat sensations), and (3) satisfaction (participant's description of their body's positive or negative physical state during or after smoking a cigarette or using an e-cigarette). Excerpts of the narratives from all 15 respondents are presented in the results section. Participants were given a pseudonym to protect confidentiality, and all quotes are verbatim.

## Results

The 15 participants (eight women and seven men) ranged in age from 37 to 65 ( $M = 54.1$  years;  $SD = 8.2$ ). Eleven participants reported smoking their first cigarette before or at age 18. Four reported college degrees, five reported some college or technical school, and six reported a high school degree. Only 3 of the 15 interviewees reported full-time employment, 4 reported part-time employment, and 9 were unemployed.

### Descriptions of Vaping as a Sensory Experience

Table 1 summarizes the three analytical categories that explain the meaning of vaping as a sensory experience in relation to desistance and persistence, with illustrative quotes. During the first 2 weeks of vaping, four participants reported a positive vaping experience while 11 reported decreased satisfaction. Our analysis identified three categories that could help explain vaping as a sensory experience: (1) Evaluating menthol cigalike e-cigarette taste sensations against usual cigarette brand, (2) Associating throat sensations with menthol cigalike e-cigarette acceptance, and (3) Assessing the satisfaction menthol cigalike e-cigarettes deliver to participants across Weeks 2 and 3.

The sensory attributes of cigarette smoking facilitate smoker satisfaction and product acceptance.<sup>19-25,32,33</sup> Similar to both tobacco industry and nonindustry research<sup>19-25,32,33</sup> on cigarettes, participants' narratives about their use of e-cigarettes centered on taste, inhalation, and physiological satisfaction. William described his initial use of e-cigarettes, noting how they taste compared to menthol cigarettes: "The taste...you taste that menthol taste in there, but you know, I'm not going to sit there and say it tastes like a regular cigarette. No, you know, it doesn't because I think that would be defeating the purpose if it tasted like a regular cigarette. Then I would go back to the cigarette."

We interpreted William's reference to "defeating the purpose if it tasted like a regular cigarette," to highlight his perception of e-cigarettes as tobacco cessation aids, because of their contrast to cigarettes. William does not want the e-cigarette to taste like a cigarette. Additionally, his remark "then I would go back to the cigarette," further indicates his motivation to quit smoking and the use of e-cigarettes to facilitate cessation. Ronald said, "The taste ain't bad at all...I think it takes some getting used to...Yeah—the taste is not bad." Similarly, Maxine stated, "The taste is just enough to resemble a cigarette." Conversely, perceptions of an overwhelming and unpleasant taste were omnipresent throughout a majority of the participants' narratives. Tracey noted, "The first puffs, seemed like there was a lot of menthol in them...You could taste it...My honest opinion is that it's a little too much of it in there." Angela described the taste: "So, like I said, the taste is really bad, it's nasty...The taste is like a menthol mixed with Comet or Ajax...I'm telling you, oh God, that's what it tastes like...I'm serious. I don't know what they put in them things, but those is not the ones. It is not."

**Table 1.** The Three Analytical Categories That Explain the Meaning of Vaping as a Sensory Experience in Relation to Desistance and Persistence, with Illustrative Quotes

Category	Participant quotes
<p><b>Evaluating cigalike e-cigarette taste sensations against usual cigarette brand</b></p> <ul style="list-style-type: none"> <li>&gt; Wanting the cigalike e-cigarette to not taste like a menthol cigarette</li> <li>&gt; Perceiving an overwhelming and unpleasant taste</li> </ul>	<p><i>“The taste...you taste that menthol taste in there, but you know, I’m not going to sit there and say it tastes like a regular cigarette. No, you know, it don’t because I think that would be defeating the purpose if it tasted like a regular cigarette. Then I would go back to the cigarette.”</i> William</p> <p><i>“The taste ain’t bad at all...I think it takes some getting used to...Yeah—the taste is not bad.”</i> Ronald</p> <p><i>“The first puffs, seemed like there was a lot of menthol in them...You could taste it...My honest opinion is that it’s a little too much of it in there.”</i> Tracey</p> <p><i>“They nasty...Regular cigarettes nasty too, but at least they do what they did and they relieve you...They not nasty like that...It’s a totally different taste.”</i></p>
<p><b>Associating throat sensations with cigalike e-cigarette acceptance</b></p> <ul style="list-style-type: none"> <li>&gt; Valuing throat hit of usual menthol cigarette brand</li> <li>&gt; Unexpected coughing as a reaction to an unpleasant throat hit</li> </ul>	<p><i>“I think it [e-cigarette] grabs me too hard. Whereas, example, okay Kool cigarette, I can draw in a big puff of smoke and I know the smoke is going to go down smooth and come out. That puff [e-cigarette] goes in strong and it comes out almost like a raspy—like an old Cuban cigar.”</i></p> <p><i>“I had to learn how to take a nice drag so it wouldn’t make me cough.”</i></p>
<p><b>Assessing the satisfaction cigalike e-cigarettes deliver to participants</b></p> <ul style="list-style-type: none"> <li>&gt; 11 participants perceiving decreased satisfaction during the first two weeks of use</li> <li>&gt; 4 participants perceiving a positive vaping experience during the first two weeks of use</li> </ul>	<p><i>“E-cigs are not enough—they are not enough for me to satisfy my craving of smoking.”</i> Diana</p> <p><i>“It [e-cigarette] just didn’t satisfy me like a cigarette.”</i> Gregory</p> <p><i>“From here on out, pretty much my goal, my flat out goal would be to use single, solitary, e-cigarettes only.”</i> Rita</p> <p><i>“I like the e-cigarette... it takes the place of a cigarette that if I really want a cigarette, I could use the e-cigarette.”</i> Eric</p>

Similarly, Pamela noted, “It left a bad taste in my mouth,” and “It’s like eating a sour piece of meat...Or a sour piece of fruit.” When asked by the interviewer, “Well, compare them [e-cigarettes] to your regular cigarettes, what’s the big difference?” Angela responded, “They nasty...Regular cigarettes nasty too, but at least they do what they did and they relieve you...They not nasty like that...It’s a totally different taste.” Angela’s narrative implied that menthol cigarettes taste “nasty,” but nevertheless are satisfying, unlike the e-cigarettes, which are both nasty and unsatisfying.

Similar to the importance of throat sensations emphasized in tobacco industry research<sup>24,25</sup>, respondents frequently used expressions such as, “a hit in the throat,” “it made me cough,” “hard to pull” and “had to inhale more” when describing e-cigarettes. For example, Ronald’s narrative of e-cigarettes implied an unsatisfactory sensation in the throat compared to his preferred brand of menthol cigarettes (Kool): “I think it [e-cigarette] grabs me too hard. Whereas, example, okay Kool cigarette, I can draw in a big puff of smoke and I know the smoke is going to go down smooth and come out. That puff [e-cigarette] goes in strong and it comes out almost like a raspy—like an old Cuban cigar.” Ronald’s narrative is consistent with Dautzenberg et al.<sup>25</sup> who concluded: “An optimal sensorial effect of throat hit is also a determinant of success of switching to an e-cigarette from tobacco use” (p.1). Additionally, mention of coughing as a reaction to “a hit in the throat” was common among most participants. Eric stated: “If you drag too much of it [e-cigarette] then you cough.” Similarly, Joanne noted, “I had to learn how to take a nice drag so it wouldn’t make me cough.” We interpreted coughing as unexpected by participants compared to smoking their preferred cigarettes without coughing. Probed on why he did not like the e-cigarette, Charles explained, “Yeah, because—you know, I got

to [Charles inhales audibly] sure enough pull it [e-cigarette] and not get anything out of it. Then when I get it, it didn’t taste right.” In fact, solely positive descriptions of inhalation/throat impact were rare. As Ronald further explained: “The e-cig...it punches. Whereas my cigarettes flow. Where I can take an inhale and I can hold it awhile and the e-cig you’re like, [Ronald audibly blows out] you know, get out of me.”

Physiological satisfaction was also a common theme among participants. Diana expressed difficulty using e-cigarettes to satisfy nicotine cravings, despite perceiving e-cigarettes as a harm-reduction aid: “E-cigs are not enough—they are not enough for me to satisfy my craving of smoking. Now, health wise, it probably would be better... I see those commercials, you know, the cool guy with the e-cigarette. He’s on his motorcycle or somebody else smoking one [e-cigarette] and it’s like, it’s just like smoking a regular cigarette—no, it is not.”

Similarly, when asked by the interviewer, “Were there ever times that you did feel satisfied just by using the e-cig?” John simply answered, “No.” Continuing this thread, Gregory noted, “It [e-cigarette] just didn’t satisfy me like a cigarette...I guess because I smoke the menthol, I kind of want that more menthol type taste. It [e-cigarette] lasts for a second with the menthol taste then it kind of fades... not really satisfied.”

### Descriptions of Vaping as a Sensory Experience in Relation to Desistance and Persistence

Participants’ sensory reactions affected their use of e-cigarettes in their first and second weeks of use. For example, 11 of the 15 participants noted that they used e-cigarettes less in the second week than the first week. When asked by the interviewer: “So, now that

you've tried e-cigarettes for the last two weeks, do you think that you'll continue?" Sheila said, "I think that I will, but I think it will be a combination with me smoking real cigarettes, because when I get more stressed, I'm craving a real cigarette. I don't think of the e-cigarette or it's going to do it when I'm really stressed." Similarly, Diana noted, "If I'm tense or stressed, I'm not grabbing the e-cig, I'll grab a regular cigarette." Both women's experiences highlight how a lack of physiological satisfaction with cigalike e-cigarettes, likely an indication of poor nicotine delivery, might encourage dual use rather than complete switching from cigarettes to e-cigarettes. Jackie, who in the first week described the e-cigarettes as "yuck," and that "you've got to puff too hard," reflected in her last interview on how they are not for her:

Interviewer: "So, if you had a choice, would you use an e-cigarette or a cigarette?"

Jackie: "A cigarette."

Interviewer: "I'm hearing you...I'm hearing you say that."

Jackie: "I think an e-cigarette is for somebody who just hasn't been a smoker...to me."

Interviewer: "What do you think the difference would be there?"

Jackie: "Because I mean, I've been smoking for so long, I wanted my cigarette."

Interviewer: "All right. I'm hearing you."

Jackie: "But I saw somebody doing it [vaping] before and thought, oh that might be cool, but it's not for me."

Similarly, when asked by the interviewer: "How would you compare them [e-cigarettes] to regular cigarettes?" Charles responded, "I couldn't. I don't know how to compare them. I didn't get anything out of them, so I don't know if I could compare them." Charles's response implied that "anything" equals satisfaction and underscored how he was disappointed that menthol cigalike e-cigarettes were not a direct replacement for menthol cigarettes. Similarly, referring to e-cigarettes as "fake", Angela described her ambivalence and uncertainty about being able to quit this way: "I need help...and those [e-cigarettes] ain't the ones...I don't know. It's really going to be hard for me to stop smoking. It is. I really think, wow...I have no idea. I don't know."

Although participants' narratives were replete with accounts of dissatisfaction, including disappointment in their potential as a cessation device, we found four participants who articulated positive perceptions of e-cigarettes as cessation aids. Tracey, who only described a difference in taste between menthol cigalike e-cigarettes and menthol cigarettes, said the following: "Well, I made it clear, you know, when I first came in here that I did want to stop, or at least cut down and I feel like I'm going to be successful and I feel like the e-cigarettes have a lot to do with that. So, you know, I may just switch to e-cigarettes period. Yeah, uh huh. I may stop smoking real cigarettes altogether. And, I think I am going to do that." Similarly, Rita, who described e-cigarettes as "smoother" and "not as hard on the throat", noted, "From here on out, pretty much my goal, my flat out goal would be to use single, solitary, e-cigarettes only. No occasional Newport here and there." Bernard, who stated, "You don't get the smoky, yucky aftertaste, it's much cleaner" [than a menthol cigarette] also said, "Even though this wasn't a smoking cessation program, I've used it as such."

He further stated, "If I were going to continue on with smoking or doing whatever, it would probably be just the e-cigs, it wouldn't be the cigarettes. I like the e-cigs that much better, okay."

Eric, who stated, "I was satisfied with what they [e-cigarettes] got", added, "I like the e-cigarette but I haven't priced them yet and how much it costs. But it takes the place of a cigarette that if I really want a cigarette, I could use the e-cigarette." The narratives of Tracey, Rita, Bernard, and Eric highlighted how despite perceptions of limited sensory benefits, they had a willingness to use menthol cigalike e-cigarettes as cessation devices post-completion of the study, suggesting that they may have been more motivated to quit smoking, compared to other participants.

## Discussion

The narratives of our 15, e-cigarette naïve menthol smokers revealed that those (about 27%,  $n = 4$ ) who perceived the early experience as relatively more pleasant were more likely to continue vaping during the first 2 weeks of e-cigarette use. The majority (about 73%,  $n = 11$ ) were characterized by perceptions of bad taste, irritating throat hit, difficulty pulling, and both negative and positive satisfaction, compared to their preferred brand of menthol cigarettes. Application of the sensory experience framework<sup>19-21</sup> and qualitative coding method revealed that an additional dimension, namely difficulty pulling, was necessary to describe the relative difference in sensory experience between smoking cigarettes and vaping e-cigarettes.

It is interesting to note that for a few participants, perception that the e-cigarettes did not taste much like a cigarette was an advantage, as they anticipated that tasting like a cigarette would encourage returning to cigarette smoking. However, for most participants, the taste of the e-cigarettes was perceived to be unpleasant and discouraged further use. In future research of e-cigarettes' efficacy as a smoking cessation or reduction aid, smokers' expectations for these devices may need to be considered and expectations may need to be adjusted so that they do not expect a direct replacement of the same satisfying taste as they experienced with their cigarettes.

Indeed, menthol flavoring in cigarettes adds an additional level of complexity to understanding how the sensory experience of smoking affects smoking behavior. Both the taste of menthol and its cooling sensation in the throat masks the harshness of smoking, facilitating inhalation and possibly reinforcing nicotine dependence.<sup>34</sup> Menthol smokers' sensory experiences with e-cigarettes may be unlike traditional cigarette smokers' experiences due to the unique chemosensory characteristics of their products. This is particularly relevant for African American smokers, who disproportionately prefer menthol cigarettes, and are historically less successful at smoking cessation using traditional methods compared to their White counterparts.<sup>34</sup>

In addition to taste, some participants also cited coughing in response to throat hit, a factor that discouraged further e-cigarette use. Coughing was interpreted as unusual or unexpected by participants because they could usually smoke cigarettes without coughing. Participants also identified difficulty pulling on the e-cigarette as a disincentive to further use. Further, among participants, satisfaction with e-cigarettes decreased when they found themselves in perceived stressful situations. Other research shows that smokers find it difficult to abstain when under stress.<sup>35-38</sup> These findings are consistent with previous research<sup>25</sup> suggesting that cigarettes' specific sensory effects and expectancies around these effects have become entrenched from years of smoking, and thus are difficult to break and replace among adult smokers, specifically heavy smokers who have a long smoking history as did most of our participants.

Our analyses demonstrate at least two areas of trustworthiness that are unique to qualitative research, including credibility and

confirmability.<sup>39</sup> “Credibility” involves the use of analytical techniques that increase the likelihood of credible interpretations.<sup>40</sup> The first, second, third, and fourth authors independently met this criterion through prolonged engagement with the data involving multiple readings of the transcripts, intensive coding and code revision to ensure agreement. “Confirmability” refers to the extent that the study’s methods and analyses are described in sufficient detail to allow readers to assess the extent to which the researchers’ interpretations are grounded in the data.<sup>40</sup> We have demonstrated confirmability through the provision of detailed information about our study design, recruitment, procedure, study instruments, data analysis, and extensive verbatim quoting.

Study limitations included the following. We focused on a subsample of African American adult ( $M = 54.1$  years) daily menthol cigarette smokers motivated to quit smoking, who resided in the Washington, DC metro area. This subsample was also predominately low socioeconomic status (SES), as 9/15 (60%) participants reported unemployment. Although smoking prevalence in the United States has been associated with low SES, we are unlikely to capture the diversity of viewpoints of all African American adult daily menthol smokers. Participants were also novice e-cigarette users and were provided with NJOY King mentholated cigalikes, containing 3.0% nicotine, which may seem low for smokers who reported smoking at least eight cigarettes per day. As such, findings may not be transferrable to other cigarette smokers, settings, and most importantly, to individual preferences for other types of e-cigarette devices, brands, flavors, and the newer generation cigalike or tank/mod systems that have come to market. Moreover, improvement in future device characteristics, such as adjusting the flavors and nicotine concentration to enhance a specific user’s taste sensations, throat hit, and whole body experience, may have changed some of the smokers’ negative subjective sensory experiences in a more positive direction. While small, this sample size ( $n = 15$ ) is typical in qualitative research<sup>41</sup> and yielded three repeated measures interviews ( $n = 45$ ) per participant on a novel phenomenon, as the vaping experience unfolded from no use to early use episodes, to continued use or desistance of use. To-date, most of the research on e-cigarette sensory perceptions has been limited to quantitative data in self-report surveys.<sup>42-45</sup> Additionally, qualitative data extends the existing literature on the role of sensory perception in the use of e-cigarettes among adult daily cigarette smokers to provide a more in-depth exploration of how sensory attributes contribute to satisfaction and acceptance of e-cigarettes among smokers motivated to quit.

While 27% ( $n = 4$ ) of adult daily cigarette smokers motivated to quit smoking had a pleasant experience and continued to vape for a longer period, 73% ( $n = 11$ ) discontinued and also discussed unpleasant experiences. Desistance and persistence of vaping may partially be explained by sensorimotor experiences with certain types of ECIG devices. Further prospective research with varying e-cigarette device types, performance characteristics, and flavors is needed to understand how e-cigarette device characteristics may affect individual smokers’ behavior and ultimately the public health impact of this diverse class of devices.

## Funding

Research reported in this publication was supported by the National Institute on Drug Abuse at the National Institutes of Health under grant number 5R21DA036472. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

## Declaration of Interests

None declared.

## Acknowledgments

The authors are grateful to the men and women who participated in this study. Their candor about their experiences is invaluable to this work.

SLS conceptualized the research topic, led and conducted data collection, data analysis, interpretation, and wrote the first draft of the manuscript. TD, LFR, and EH were involved with data collection, data analysis, and interpretation. JLP designed the parent study and contributed to the manuscript. ECK, MWH, RSN, and DBA contributed to the manuscript. All authors reviewed and approved the final draft of the manuscript as submitted.

At the time of the study, SLS was a Scholar with the HIV/AIDS, Substance Abuse, and Trauma Training Program (HA-STTP), at the University of California, Los Angeles; supported through an award from the National Institute on Drug Abuse (R25DA035692).

## References

1. Agaku IT, King BA, Husten CG, et al. Tobacco product use among adults—United States, 2012–2013. *MMWR Morb Mortal Wkly Rep.* 2014;63(25):542–547.
2. Cummins SE, Zhu SH, Tedeschi GJ, et al. Use of e-cigarettes by individuals with mental health conditions. *Tob Control.* 2014;23(suppl 3):iii48–53.
3. King BA, Alam S, Promoff G, Arrazola R, Dube SR. Awareness and ever-use of electronic cigarettes among U.S. adults, 2010–2011. *Nicotine Tob Res.* 2013;15(9):1623–1627.
4. Regan AK, Promoff G, Dube SR, Arrazola R. Electronic nicotine delivery systems: adult use and awareness of the ‘e-cigarette’ in the USA. *Tob Control.* 2013;22(1):19–23.
5. Zhu SH, Gamst A, Lee M, Cummins S, Yin L, Zoref L. The use and perception of electronic cigarettes and snus among the U.S. population. *PLoS One.* 2013;8(10):e79332.
6. Pearson JL, Richardson A, Niaura RS, Vallone DM, Abrams DB. e-Cigarette awareness, use, and harm perceptions in US adults. *Am J Public Health.* 2012;102(9):1758–1766.
7. Adkison SE, O’Connor RJ, Bansal-Travers M, et al. Electronic nicotine delivery systems: international tobacco control four-country survey. *Am J Prev Med.* 2013;44(3):207–215.
8. Delnevo CD, Giovenco DP, Steinberg MB, et al. Patterns of electronic cigarette use among adults in the United States. *Nicotine Tob Res.* 2015. In press.
9. Dawkins L, Turner J, Roberts A, Soar K. ‘Vaping’ profiles and preferences: an online survey of electronic cigarette users. *Addiction.* 2013;108(6):1115–1125.
10. Dockrell M, Morrison R, Bauld L, McNeill A. E-cigarettes: prevalence and attitudes in Great Britain. *Nicotine Tob Res.* 2013;15(10):1737–1744.
11. Etter JF. Electronic cigarettes: a survey of users. *BMC Public Health.* 2010;10:231.
12. Farsalinos KE, Romagna G, Tsiapras D, Kyrzopoulos S, Voudris V. Characteristics, perceived side effects and benefits of electronic cigarette use: a worldwide survey of more than 19,000 consumers. *Int J Environ Res Public Health.* 2014;11(4):4356–4373.
13. Foulds J, Veldheer S, Berg A. Electronic cigarettes (e-cigs): views of aficionados and clinical/public health perspectives. *Int J Clin Pract.* 2011;65(10):1037–1042.
14. Goniewicz ML, Lingas EO, Hajek P. Patterns of electronic cigarette use and user beliefs about their safety and benefits: an internet survey. *Drug Alcohol Rev.* 2013;32(2):133–140.
15. Harrington KF, Hull NC, Akindoju O, et al. Electronic cigarette awareness, use history, and expected future use among hospitalized cigarette smokers. *Nicotine Tob Res.* 2014;16(11):1512–1517.
16. Zhu SH, Sun JY, Bonnevie E, et al. Four hundred and sixty brands of e-cigarettes and counting: implications for product regulation. *Tob Control.* 2014;23(suppl 3):iii3–iii9.
17. Hitchman SC, Brose LS, Brown J, Robson D, McNeill A. Associations between e-cigarette type, frequency of use, and quitting smoking: findings from a longitudinal online panel survey in Great Britain. *Nicotine Tob Res.* 2015;17(10):1187–1194.

18. Biener L, Hargraves JL. A longitudinal study of electronic cigarette use among a population-based sample of adult smokers: association with smoking cessation and motivation to quit. *Nicotine Tob Res.* 2015;17(2):127–133.
19. Ayo-Yusuf OA, Agaku IT. The association between smokers' perceived importance of the appearance of cigarettes/cigarette packs and smoking sensory experience: a structural equation model. *Nicotine Tob Res.* 2015;17(1):91–97.
20. Rose JE, Behm FM. Extinguishing the rewarding value of smoke cues: pharmacological and behavioral treatments. *Nicotine Tob Res.* 2004;6(3):523–532.
21. Perkins KA, Karelitz JL. Sensory reinforcement-enhancing effects of nicotine via smoking. *Exp Clin Psychopharmacol.* 2014;22(6):511–516.
22. Brown & Williamson. The role of smoker-product interaction in subjective assessment, 1981. Bates #689105564. <https://legacy.library.ucsf.edu/tid/amo90f00/pdf?search=%22subjective%20sensory%20experience%20satisfaction%22> Accessed December 20, 2016.
23. Cantrell DV. Brown & Williamson Tobacco Corporation. *Kool Isn t Getting The Starters/236. 1987 February 17.* Brown & Williamson Records; Minnesota Litigation Documents. <https://www.industrydocumentslibrary.ucsf.edu/tobacco/docs/mnbd0132>.
24. Etter JF. Throat hit in users of the electronic cigarette: an exploratory study. *Psychol Addict Behav.* 2016;30(1):93–100.
25. Dautzenberg B, Scheck A, Kayal C, et al. Satisfactory throat-hit is needed to switch from tobacco to e-cigarettes: a lesson from an e-liquid blind test. *Tob Prev Cessation.* 2016;2(April)59.
26. Pearson JL, Smiley SL, Rubin LF, et al. The Moment Study: protocol for a mixed method observational cohort study of the Alternative Nicotine Delivery Systems (ANDS) initiation process among adult cigarette smokers. *BMJ Open.* 2016;6(4):e011717.
27. Tobacco Products Scientific Advisory Committee. *Menthol Cigarettes and Public Health: Review of the Scientific Evidence and Recommendations.* Rockville, MD: Center for Tobacco Products; Food and Drug Administration; 2011.
28. Levy DT, Blackman K, Tauras J, et al. Quit attempts and quit rates among menthol and nonmenthol smokers in the United States. *Am J Public Health.* 2011;101(7):1241–1247.
29. Patton MQ. *Qualitative Research and Evaluation Methods. 3rd ed.* Thousand Oaks, CA: Sage; 2002.
30. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol.* 2006;3(2):77–101.
31. NVivo qualitative data analysis Software; OSR International Pty Ltd. Version 10, 2012. Doncaster, Victoria, Australia.
32. Rees VW KJ, Wayne GF, O Connor RJ, Cummings KM, Connolly GN. Role of cigarette sensory cues in modifying puffing topography. *Drug Alcohol Depend.* 2012;124(1–2):1–10.
33. Carpenter CM, Wayne GF, Connolly GN. The role of sensory perception in the development and targeting of tobacco products. *Addiction.* 2007;102(1):136–147.
34. Giovino GA, Villanti AC, Mowery PD, et al. Differential trends in cigarette smoking in the USA: is menthol slowing progress? *Tob Control.* 2015;24(1):28–37.
35. Weinberger AH, Maciejewski PK, McKee SA, Reutenauer EL, Mazure CM. Gender differences in associations between lifetime alcohol, depression, panic disorder, and posttraumatic stress disorder and tobacco withdrawal. *Am J Addict.* 2009;18(2):140–147.
36. McKee SA, Maciejewski PK, Falba T, Mazure CM. Sex differences in the effects of stressful life events on changes in smoking status. *Addiction.* 2003;98(6):847–855.
37. Husky MM MC, Paliwal P, McKee SA. Gender differences in the comorbidity of smoking behavior and major depression. *Drug Alcohol Depend.* 2008;93(1–2):176–179.
38. Lawless MH, Harrison KA, Grandits GA, Eberly LE, Allen SS. Perceived stress and smoking-related behaviors and symptomatology in male and female smokers. *Addict Behav.* 2015;51(Issue null):80–83.
39. Lincoln YS GE. *Naturalistic Inquiry.* Beverly Hills, CA: Sage; 1985.
40. Merrick E. *An Exploration of Quality in Qualitative Research: Are "Reliability" and "Validity" Relevant?* Thousand Oaks, CA: Sage; 1999.
41. Kvale S. *Interviews: An Introduction to Qualitative Research Interviewing.* Thousand Oaks, CA: Sage; 1996.
42. Rosbrook K, Green BG. Sensory effects of menthol and nicotine in an e-cigarette. *Nicotine Tob Res.* 2016;18(7):1588–1595.
43. Dawkins L, Munafò M, Christoforou G, Olumegbon N, Soar K. The effects of e-cigarette visual appearance on craving and withdrawal symptoms in abstinent smokers. *Psychol Addict Behav.* 2016;30(1):101–105.
44. Dawkins L, Kimber C, Puwanesarasa Y, Soar K. First- versus second-generation electronic cigarettes: predictors of choice and effects on urge to smoke and withdrawal symptoms. *Addiction.* 2015;110(4):669–677.
45. Dawkins L, Corcoran O. Acute electronic cigarette use: nicotine delivery and subjective effects in regular users. *Psychopharmacology (Berl).* 2014;231(2):401–407.