



## Associations between perceived source credibility, e-cigarettes, and e-cigarette ad perceptions

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### ABSTRACT

The use of e-cigarettes among U.S. adults remains high, and aggressive industry advertising is a contributor. Consumer opinions of the e-cigarette industry's credibility can influence e-cigarette product and ad perceptions. The purpose of this study was to examine the association of perceived source credibility of e-cigarette ads and consumer attitudes toward e-cigarette ads and product use. In October 2021, we conducted a survey using an online convenience sample ( $N = 497$ ,  $M_{age} = 31.9$ ). Participants viewed two randomly selected e-cigarette ads and were asked questions regarding source credibility, perceptions of the ads, and e-cigarette use. Linear mixed effects models with random intercepts were used to estimate associations between perceived source credibility with perceived ad relevance, effectiveness, liking, product use interest, and e-cigarette harms perceptions. We also tested whether associations between perceived source credibility and ad and e-cigarette perceptions were moderated by e-cigarette use. Models controlled for cigarette smoking status, age, sex, race, ethnicity, sexual orientation, and income. Perceived source credibility was positively associated with increased perceived ad relevance, effectiveness, liking, and product use interest ( $ps < 0.001$ ). E-cigarette use moderated associations of perceived source credibility and perceived ad relevance, perceived ad effectiveness, and interest in using e-cigarettes, with associations being strongest among never users. Findings suggest that tobacco control messaging aiming to reduce the credibility of the e-cigarette industry might be most effective among adults who have never used e-cigarettes.

### 1. Introduction

In the United States, electronic cigarettes (e-cigarettes) are the most commonly used non-cigarette tobacco products among adults (Cornelius et al., 2020). While e-cigarettes demonstrate lower health harm compared to cigarettes (National Academies of Sciences, 2018), e-cigarette use is associated with adverse health effects (Overbeek et al., 2020; Skotsimara et al., 2019) and may increase uptake of combustible tobacco use among nonsmokers (Hair et al., 2021; Khouja et al., 2021; Soneji et al., 2017). Aggressive e-cigarette marketing is a contributor to e-cigarette use prevalence (Noel et al., 2011; Huang et al., 2014; Banerjee et al., 2015; Mantey et al., 2016). E-cigarette advertisements (ads)

emphasizing product appeal (i.e., glamor, social desirability, flavor) (Londerée et al., 2018; Pokhrel et al., 2019) and lower health harms (Wang et al., 2021) of e-cigarettes (vs. cigarettes) have been found to influence positive attitudes toward e-cigarette ads and increase e-cigarette use among younger and older adults.

According to source credibility theory (Hovland et al., 1953), expert and relatable sources are the main types of sources that guide individuals' health message processing. Specifically, individuals' perceived credibility of a source can influence their perceptions, attitudes, and beliefs about health topics (Case et al., 2018). Perceived source credibility increases the persuasiveness of ads (Pornpitakpan, 2004) by influencing positive attitudes toward the ads and their

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advertised products (Hovland and Weiss, 1951). The tobacco industry takes advantage of this tactic by designing messaging to increase source credibility (Freeman and Chapman, 2009; Grana and Ling, 2014; Watts et al., 2021). Historically, e-cigarette companies have used credible (e.g., experts) and trusted sources (e.g., young models, social influencers) in their advertising to increase appeal (Grana and Ling, 2014; Padon et al., 2017). These advertising strategies are concerning because perceived credibility of a source influences e-cigarette use and risk perceptions (Alcalá and Shimoga, 2020; Erku et al., 2021; Vereen et al., 2020). For example, individuals who trust e-cigarette companies more than health professionals have 87% greater odds of using e-cigarettes (Vereen et al., 2020) and they report lower e-cigarette harm perceptions (Case et al., 2018; Alcalá and Shimoga, 2020). In response, tobacco control communication campaigns have focused on countering tobacco-industry credibility by exposing the industry's deceptive advertising tactics (Malone et al., 2012). Evidence from several counter-industry campaigns inferred that instilling distrust in the tobacco industry can reduce smoking prevalence, initiation, and use intentions, while increasing support toward tobacco industry regulations among young adults (Malone et al., 2012). However, most research on counter-industry campaigns targeting the tobacco industry's credibility has focused on combusted tobacco (Farrelly et al., 2002; Niederdeppe et al., 2004; Hershey et al., 2005).

To date, limited research has examined the role of perceived source credibility on consumer perceptions of e-cigarette ads and health harms. Some past research has tangentially touched on the topic, however. For instance, an experimental study about the effect of e-cigarette ads on social media found that ads with celebrity endorsements increased positive attitudes and use intentions more effectively than ads with non-celebrity endorsements (Phua et al., 2018). Another social media ad study found that adolescents reported greater attention, perceived norms, and favorable attitudes toward e-cigarettes when viewing an industry-promoted ad compared to peer-generated posts (Vogel et al., 2020). However, e-cigarette harm perceptions did not differ between adolescents who viewed industry-promoted or peer-generated posts (Vogel et al., 2020). This contrasts survey findings that adults who trust the e-cigarette industry are less likely to believe that e-cigarettes are harmful to one's health (Case et al., 2018; Alcalá and Shimoga, 2020). Together, these studies suggest that source credibility may be associated with e-cigarette ad and harm perceptions. However, more research is needed that examines how perceived source credibility is related to e-cigarette ad perceptions (perceived ad relevance, effectiveness, and liking) and product perceptions (use interest and harm perceptions). Because these ad and product perceptions are antecedents to product use intentions and actual use behaviors, understanding the role of perceived e-cigarette industry credibility on consumers' e-cigarette ad and product perceptions provides a target for e-cigarette prevention interventions (Iles et al.; Lienemann et al., 2018; Moran et al., 2017; Noar et al., 2020; Pavlou and Stewart, 2000; Pechmann and Stewart, 1990; Moran et al., 2021). Furthermore, as e-cigarettes may be used as a harm reduction tool for adults who smoke (Wang et al., 2021; Zhu et al., 2017; Levy et al., 2018; Biener and Hargraves, 2015), it is important to understand how this population perceives e-cigarettes (Owusu et al., 2019) and the source of health information related to e-cigarettes (i.e., source credibility) (Wackowski et al., 2020). The goal of this study was to examine how perceived source credibility is associated with individuals' perceptions of e-cigarette ads and interest in using the advertised product. Based on prior research from the cigarette literature, we hypothesized that greater perceived source credibility would be associated with greater perceived e-cigarette ad relevance, effectiveness, liking, interest in using e-cigarettes, and lower e-cigarette harm perceptions (Moran et al., 2021; Schmidt et al., 2016; Guttman and Peleg, 2003; Zagona and Harter, 1966). We also hypothesized that these associations would be strongest among e-cigarette users as past research has shown that use of the product decreases product harm perceptions (Choi and Forster, 2014; Villanti et al., 2015; Wackowski and Delnevo, 2016; Leavens

et al., 2019). Finally, given the growing evidence that e-cigarettes may be a potential harm reduction tool for smokers (Wang et al., 2021; Zhu et al., 2017; Levy et al., 2018; Biener and Hargraves, 2015), we examined whether cigarette smoking status moderated the association between perceived source credibility of e-cigarette ads and outcome variables.

## 2. Methods

### 2.1. Sample

This study was part of a larger study examining e-cigarette advertising and e-cigarette use among adults living in the United States. In October 2021, we used Prolific ([prolific.co](https://prolific.co)), an international crowdsourcing platform for behavioral research studies, to recruit a convenience sample of participants. Participants were eligible to participate in the study if they were 18 years or older and resided in the United States. Sexual minority adults (i.e., lesbian, gay, bisexual, or other non-heterosexual people) were oversampled for the parent study.

### 2.2. Study design

Participants were prescreened for the eligibility criteria via Prolific. Potential participants meeting eligibility criteria reviewed a brief study description on Prolific, which included information about viewing e-cigarette product ads. During the consent process, participants were also informed that they would view e-cigarette ads currently on the market. After providing consent, participants were asked to complete several measures related to tobacco product use. Then, they were randomized to view two e-cigarette ads, selected from a pool of 173 real-world ads (from 2019 and 2020) coded for containing e-cigarette ad features (Liu et al., 2018). Full information on the ads has been published elsewhere (Liu et al., 2018). After viewing each ad, participants completed measures on perceived source credibility, perceptions of the ads, interest in using the product, and e-cigarette harm perceptions. After study completion, participants were compensated via Prolific's policies. All procedures were approved by the host institution's Institutional Review Board.

### 2.3. Measures

**Demographics.** Participants reported their age (treated as continuous), gender (collapsed to female, male, non-binary), race and ethnicity (collapsed to Non-Hispanic White, Non-Hispanic Black, other/multiple, Hispanic), sexual orientation (defined as self-reported sexual identity, collapsed to straight, gay/lesbian, bisexual, other), and individual income (coded in \$10,000 increments from \$0 to >\$100,000 and treated as continuous).

**E-cigarette use.** Participants were asked to report their e-cigarette use. Participants were categorized as current users if they used e-cigarettes in the past 30 days, ever users if they had ever used e-cigarettes but not in the past 30 days, and never users if they had never used e-cigarettes (not even a puff).

**Cigarette Smoking.** Participants were asked to report their cigarette smoking status. Participants were categorized as current smokers if they smoked cigarettes in the past 30 days and non-smokers if they did not smoke cigarettes in the past 30 days.

**Perceived source credibility.** Perceived source credibility was assessed by using an adapted semantic differential scale (McCroskey and Teven, 1999). We included seven items measuring participant perceptions of the e-cigarette company viewed in each ad (e.g., cares about me – doesn't care about me; dishonest – honest; untrustworthy – trustworthy). Scores were on a scale from 1 to 5, and one item was reverse coded. Items were summed and averaged (Cronbach's alphas > 0.91). Higher scores indicated higher perceived source credibility.

**Perceived ad relevance.** Perceived ad relevance was assessed using two

items: “The ad seemed to be written personally for me” and “The ad was very relevant to my situation.” (Jensen et al., 2012) Scores ranged from 1 (Strongly disagree) to 5 (Strongly agree). Items were summed and were averaged (Cronbach’s alphas > 0.90) with higher scores indicating greater perceived ad relevance.

**Perceived ad effectiveness.** Perceived effectiveness of the ad was assessed using five items about whether participants thought the ad was worth remembering, grabbed their attention, was powerful, convincing, meaningful, and informative (Davis et al., 2013). Scores ranged from 1 (Strongly disagree) to 5 (Strongly agree). Items were summed and averaged (Cronbach’s alphas > 0.93).

**Ad liking.** Liking of the ad was assessed using a single item: “I liked this ad” on a scale of 1 (Strongly disagree) to 5 (Strongly agree) (Moran et al., 2021).

**Product use interest.** Product use interest was assessed using a single item: “This ad made me want to use the product” on a scale of 1 (Strongly disagree) to 5 (Strongly agree) (Moran et al., 2021).

**Perceived e-cigarette harm.** Absolute perceived health harm of e-cigarettes was assessed using a single item measure on a scale of 0 (not at all harmful) to 10 (extremely harmful) (Tackett et al., 2015).

#### 2.4. Statistical analysis

All analyses were conducted using R [version 1.1.456]. Descriptive statistics were used to describe the distributions of perceived source credibility, ad relevance, ad effectiveness, liking, product use interest, and perceived e-cigarette harm. Next, we estimated unadjusted associations between covariates and perceived source credibility. We used linear mixed models with random intercepts, fit using restricted maximum likelihood, to estimate unadjusted associations between each covariate and perceived source credibility. In separate models, we also examined whether (1) e-cigarette use status and (2) cigarette smoking status moderated the effect of perceived source credibility on e-cigarette ad and product perceptions using interaction terms. Models controlled for covariates (age, sex, race and ethnicity, sexual orientation, and income), as well as cigarette smoking (in the e-cigarette interaction model) and e-cigarette use (in the cigarette interaction model). When statistically significant interactions were detected using partial F-tests, we reported stratified results. An alpha of 0.05 was used to assess statistical significance. We adjusted the alpha for multiple comparisons using Tukey’s test following detection of a statistically significant interaction.

### 3. Results

#### 3.1. Participants

On average, participants (N = 497) were 31.9 years old (SD = 10.6) and self-identified as female (45.1%) or male (47.9%), straight or heterosexual (54.3%), Non-Hispanic White (71.2%), and reported individual incomes below \$100,000 (76.5%; Table 1).

We detected several statistically significant associations between perceived source credibility and participant characteristics (Table 2). Participants who were older (b = 0.02, 95% CI: [0.01, 0.03], p < 0.001), male (b = 0.91, 95% CI: [0.68, 1.13], p < 0.001), current e-cigarette users (b = 0.70, 95% CI: [0.44, 0.96], p < 0.001), current smokers (b = 0.89, 95% CI: [0.66, 1.12], p < 0.001), Non-Hispanic Black (b = 0.44, 95% CI: [0.07, 0.81], p < 0.02), and had higher incomes (b = 0.12, 95% CI: [0.09, 0.15], p < 0.001) rated the e-cigarette advertising source as more credible on average.

#### 3.2. Associations of perceived source credibility with ad responses

Participants with greater perceived source credibility reported greater perceived relevance (b = 0.22, 95% CI: [0.16, 0.28], p < 0.001), effectiveness (b = 0.33, 95% CI: [0.26, 0.41], p < 0.001), and liking of

**Table 1**

Characteristics of participants enrolled in an online experiment, 2021 (N = 497).<sup>a</sup>

	N = 497
Age; mean (sd)	31.9 (10.6)
Gender; n (%)	
Female	224 (45.1)
Male	238 (47.9)
Non-binary	35 (7.0)
Sexual Orientation; n (%)	
Straight or heterosexual	270 (54.3)
Lesbian or gay	57 (11.5)
Bisexual	142 (28.6)
Other non-heterosexual	28 (5.6)
Race/ethnicity <sup>b</sup> ; n (%)	
Non-Hispanic White	353 (71.2)
Non-Hispanic Black	56 (11.3)
Hispanic	54 (10.9)
Other/multiple	33 (6.6)
Income; n (%)	
\$0–9,999	88 (17.7)
\$10,000–19,999	51 (10.3)
\$20,000–29,999	45 (9.1)
\$30,000–39,999	41 (8.2)
\$40,000–49,999	45 (9.1)
\$50,000–59,999	27 (5.4)
\$60,000–69,999	17 (3.4)
\$70,000–79,999	25 (5.0)
\$80,000–89,999	19 (3.8)
\$90,000–99,999	22 (4.4)
> \$100,000	117 (23.5)

<sup>a</sup> Participants were recruited from the online survey platform, Prolific.

<sup>b</sup> One participant did not provide their race/ethnicity.

the ad (b = 0.41, 95% CI: [0.34, 0.49], p < 0.001; Table 3).

E-cigarette use moderated the effect of perceived source credibility on perceived ad relevance (p < 0.001; Table 3). A one-unit increase in perceived source credibility was associated with increased perceived ad relevance among participants who had never used an e-cigarette (b = 0.22, 95% CI: [0.16, 0.28], p < 0.001), but perceived source credibility was not associated with perceived ad relevance among current and ever e-cigarette users. Cigarette smoking status also moderated the effect of perceived source credibility on perceived ad relevance (p < 0.001; Table 4). A one-unit increase in perceived source credibility was associated with increased perceived ad relevance among participants who had never smoked a cigarette (b = 0.22, 95% CI: [0.17, 0.27], p < 0.001), but perceived source credibility was not associated with perceived ad relevance among current cigarette smokers.

E-cigarette use moderated the effect of perceived source credibility on perceived ad effectiveness (p < 0.001; Table 3). Among participants who had never used an e-cigarette, a one-unit increase in perceived source credibility was associated with increased perceived ad effectiveness (b = 0.33, 95% CI: [0.27, 0.40], p < 0.001). Among current e-cigarette users, a one-unit increase in perceived source credibility was associated with decreased perceived ad effectiveness (b = -0.34, 95% CI: [-0.66, -0.02], p = 0.038). Perceived source credibility was not associated with perceived ad effectiveness among ever e-cigarette users. Cigarette smoking status did not moderate the association between perceived source credibility and perceived ad effectiveness (Table 4).

Neither e-cigarette use nor cigarette smoking status moderated the effect of perceived source credibility on ad liking (Tables 3 and 4, respectively).

#### 3.3. Associations of perceived source credibility with e-cigarette product responses

Participants with greater perceived source credibility had greater interest in using the advertised products (b = 0.16, 95% CI: [0.08, 0.23], p < 0.001; Table 3). Perceived source credibility was not associated with

**Table 2**  
Unadjusted associations between perceived source credibility and covariates (N = 497).

Variable	b	95% CI	P-value
Age	<b>0.02</b>	<b>0.01, 0.03</b>	<b>&lt;0.001</b>
Gender			
Female (ref)			
Male	<b>0.91</b>	<b>0.68, 1.13</b>	<b>&lt;0.001</b>
Other	-0.25	-0.69, 0.20	0.276
E-cigarette use <sup>a</sup>			
Never (ref)			
Ever	-0.16	-0.46, 0.14	0.294
Current	<b>0.70</b>	<b>0.44, 0.96</b>	<b>&lt;0.001</b>
Cigarette smoking <sup>b</sup>			
Non-smoking (ref)			
Currently smoking	<b>0.89</b>	<b>0.66, 1.12</b>	<b>&lt;0.001</b>
Sexual orientation			
Straight (ref)			
Gay/lesbian	<b>-0.98</b>	<b>-1.33, -0.62</b>	<b>&lt;0.001</b>
Bisexual	<b>-0.82</b>	<b>-1.07, -0.56</b>	<b>&lt;0.001</b>
Other	<b>-1.07</b>	<b>-1.55, -0.58</b>	<b>&lt;0.001</b>
Race/ethnicity			
Non-Hispanic White (ref)			
Non-Hispanic Black	<b>0.44</b>	<b>0.07, 0.81</b>	<b>0.02</b>
Other/multiple	-0.29	-0.75, 0.18	0.228
Hispanic	<b>-0.46</b>	<b>-0.84, -0.09</b>	<b>0.016</b>
Income <sup>c</sup>	<b>0.12</b>	<b>0.09, 0.15</b>	<b>&lt;0.001</b>

<sup>a</sup> Participants were “never” users of e-cigarettes if they reported never using the product, even once; “former” users of e-cigarettes or other tobacco if they reported using the product at least once, but not in the past 30 days; and “current” users of e-cigarettes or other tobacco if they reported using the product at least once in the past 30 days.

<sup>b</sup> Participants were non-smokers if they reported not smoking in the past 30 days and current smokers if they smoked in the past 30 days.

<sup>c</sup> Income was treated as a continuous variable consisting of 11 levels (\$0–9,999 to >\$100,000 in increments of \$10,000).

**e-cigarette harm perceptions.**

E-cigarette use status moderated the effect of perceived source credibility on interest in using the advertised products ( $p < 0.001$ , [Table 3](#)). A one-unit increase in perceived source credibility was associated with increased interest in using e-cigarettes among participants who had never used e-cigarettes ( $b = 0.16$ , 95% CI: [0.08, 0.23],  $p < 0.001$ ), but perceived source credibility was not associated with use interest among current and ever e-cigarette users. Cigarette smoking status also moderated the effect of perceived source credibility and interest in using the advertised product ( $p < 0.001$ ; [Table 4](#)). Among nonsmokers, a one-unit increase in perceived source credibility was associated with increased interest in using e-cigarettes ( $b = 0.17$ , 95% CI: [0.12, 0.23],  $p < 0.001$ ), but the association was nonsignificant among current smokers.

Neither e-cigarette use nor cigarette smoking status moderated the association between source credibility and e-cigarette harm perceptions ([Tables 3 and 4](#), respectively).

**4. Discussion**

Using real-world ads by popular e-cigarette companies ([Liu et al., 2018](#)), our study found that perceived source credibility of e-cigarette ads was associated with increased perceived ad relevance, effectiveness, liking, and interest in using the advertised e-cigarette products. Furthermore, these associations were strongest for never e-cigarette users. In other words, we identified that perceiving e-cigarette

**Table 3**  
Adjusted models estimating main effect of source credibility and interaction effects of source credibility and e-cigarette use on ad and e-cigarette perceptions (N = 497).<sup>a</sup>

Variable	b	95% CI	P-value
<b>Perceived ad relevance</b>			
Source credibility (stratified by e-cigarette use)			
Never	<b>0.22</b>	<b>0.16, 0.28</b>	<b>&lt;0.001</b>
Ever	-0.02 <sup>a</sup>	-0.31, 0.27	0.91
Current	<b>0.11<sup>b</sup></b>	<b>-0.20, 0.42</b>	<b>0.491</b>
<b>Perceived ad effectiveness</b>			
Source credibility (stratified by e-cigarette use)			
Never	<b>0.33</b>	<b>0.27, 0.40</b>	<b>&lt;0.001</b>
Ever	-0.03 <sup>a</sup>	-0.33, 0.28	0.868
Current	<b>-0.34<sup>a</sup></b>	<b>-0.66, -0.02</b>	<b>0.038</b>
<b>Ad liking</b>			
Source credibility	<b>0.41</b>	<b>0.36, 0.46</b>	<b>&lt;0.001</b>
<b>Use interest</b>			
Source credibility (stratified by e-cigarette use)			
Never	<b>0.16</b>	<b>0.08, 0.23</b>	<b>&lt;0.001</b>
Ever	0.17 <sup>a</sup>	-0.18, 0.52	0.335
Current	0.18 <sup>b</sup>	-0.18, 0.55	0.329
<b>Harm perceptions</b>			
Source credibility	-0.04	-0.10, 0.03	0.278

<sup>a</sup> Linear mixed effects models with random intercepts were used to estimate associations. We report significant main effects and interaction effects for perceived source credibility and e-cigarette use status on outcome variables. Covariates included age, gender, sexual orientation, race, ethnicity, and cigarette use. P-values were calculated using partial F-tests. Tukey’s tests were used to assess statistical significance of pairwise comparisons. P-values that meet the criteria for statistical significance are bolded. Means without a common superscript letter differ ( $p < 0.001$ ). Models analyzed the interaction between e-cigarette use status and age group, but results are only stratified by age group status when the interaction was statistically significant. Stratified results are presented from models with statistically significant ( $p < 0.05$ ) interactions between age group and e-cigarette use status.

**Table 4**  
Adjusted models estimating main effect of source credibility and interaction effects of source credibility and cigarette use on ad and e-cigarette perceptions (N = 497).<sup>a</sup>

Variable	b	95% CI	P-value
<b>Perceived ad relevance</b>			
Source credibility (stratified by cigarette smoking)			
Non-smokers	<b>0.22</b>	<b>0.17, 0.27</b>	<b>&lt;0.001</b>
Current smokers	0.04	-0.26, 0.34	0.781
<b>Perceived ad effectiveness</b>			
Source credibility (main effect)	<b>0.39</b>	<b>0.34, 0.43</b>	<b>&lt;0.001</b>
<b>Ad liking</b>			
Source credibility (main effect)	<b>0.41</b>	<b>0.36, 0.46</b>	<b>&lt;0.001</b>
<b>Use interest</b>			
Source credibility (stratified by cigarette smoking)			
Non-smokers	<b>0.17</b>	<b>0.12, 0.23</b>	<b>&lt;0.001</b>
Current smokers	0.08	-0.27, 0.43	0.656
<b>Harm perceptions</b>			
Source credibility (main effect)	-0.04	-0.10, 0.03	0.278

<sup>a</sup> Linear mixed effects models with random intercepts were used to estimate associations. We report significant main effects and interaction effects for perceived source credibility and cigarette smoking status on outcome variables. Covariates included age, gender, sexual orientation, race, ethnicity, and e-cigarette use.

companies as credible when viewing real-world ads increases favorable perceptions toward the ads and interest in using the advertised e-cigarette products—particularly among adults who have never used an e-cigarette. Results suggest that public health messaging that challenges the credibility of e-cigarette companies may be an effective method to

reduce the influence of e-cigarette ads on e-cigarette related attitudes among adults who have never used e-cigarettes.

Our findings that positive associations between perceived source credibility and e-cigarette ad and product perceptions were generally strongest among adults who had never used e-cigarettes and were nonsmokers suggests that perceived source credibility is one mechanism by which e-cigarette advertisements might persuade nonusers to use e-cigarettes (Pokhrel et al., 2019; Lienemann et al., 2018; Pierce et al., 2017). We also identified that perceived source credibility was *negatively* associated with perceived ad effectiveness among current e-cigarette users. These findings align with existing research that demonstrates differences in the trusted sources of tobacco-related health information between tobacco users and non-users (Guttman and Peleg, 2003; Rutten et al., 2009). It is also possible that the current e-cigarette users in our study held pre-existing positive attitudes toward their preferred e-cigarette brand, and that they were shown a randomly-selected ad from an e-cigarette brand that they did not prefer and thus found less credible (Falomir and Invernizzi, 1999). Altogether, results suggest that e-cigarette public health education campaign messages targeting people who have never used e-cigarettes could capitalize on counter-industry strategies (i.e., e-cigarette denormalization messages). Such counter-industry messaging might be less effective among current e-cigarette users, thus requiring additional strategies that restrict appealing ad features (e.g., social benefits and flavor (Villanti et al., 2021)).

Perceived source credibility was not associated with perceptions of e-cigarette harm in our sample, which contrasts prior research (Vogel et al., 2020). Furthermore, neither e-cigarette use status nor cigarette smoking status moderated these associations. Because increased harm perceptions are associated with reduced e-cigarette use among adults (Wang et al., 2021; Zhu et al., 2017; Levy et al., 2018; Biener and Hargraves, 2015), more research is needed to understand factors that influence harm perceptions of e-cigarettes to effectively communicate about the health harms of e-cigarettes to tobacco non-users. Future research into e-cigarette harm perceptions might also consider how to communicate harms of e-cigarettes to nonusers while still positioning e-cigarettes as a potential harm reduction tool for smokers (Wackowski et al., 2020).

Finally, we found several sociodemographic correlates of perceived source credibility. Individuals who self-identified as Non-Hispanic Black perceived e-cigarette ad companies as more credible than those who self-identified as Non-Hispanic White. These racial differences may reflect historical and targeted marketing by the tobacco industry toward marginalized social groups (Primack et al., 2007). This finding suggest that specific social groups might benefit from targeted interventions that aim to reduce the credibility of e-cigarette companies.

## 5. Limitations and future directions

Our study has limitations related to sampling and data collection methods. Because we used convenience sampling, our findings are not generalizable to the US population. However, tobacco research studies using online convenience sampling have found comparable results to studies using probability sampling (Jeong et al., 2018). Additionally, we used self-reported measures to collect data, which raises the potential for social desirability bias in reporting tobacco-related behaviors (Rozin and Singh, 1999). Despite these limitations, the results from our study present opportunities for future research to examine the effects of counter-industry marketing on e-cigarette ad perceptions, product perceptions, and use behaviors. From a harm reduction perspective, public health messaging may also capitalize on perceived source credibility to convey the potential health benefits of using e-cigarettes for adults who smoke.

## 6. Conclusions

This study provides some of the first evidence that source credibility

influences consumer perceptions of e-cigarette advertising and the advertised e-cigarette products. Our findings showed that perceived source credibility of real-world advertisements was associated with positive consumer perceptions of ad relevance, effectiveness, liking, and increased interest in using the advertised e-cigarette products. Additionally, we found that e-cigarette use and cigarette smoking moderated these associations, with effects of perceived source credibility on e-cigarette ad and product perceptions generally being the strongest among adults who had never used e-cigarettes and nonsmokers. These findings indicate a need for targeted health messaging based on e-cigarette use and cigarette smoking status. Findings from our study underscore that counter-industry tactics that reduce the credibility of e-cigarette companies might be particularly effective among people who do not use e-cigarettes and nonsmokers.

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## CRedit authorship contribution statement

**Donghee N. Lee:** Conceptualization, Methodology, Investigation, Writing – original draft. **Jessica Liu:** Formal analysis, Methodology, Data curation, Writing – review & editing. **Brittney Keller-Hamilton:** Data curation, Investigation, Writing – review & editing. **Joanne G. Patterson:** Data curation, Writing – review & editing. **Amelia V. Wedel:** Writing – review & editing. **Coralia Vázquez-Otero:** Writing – review & editing, Data curation. **Elise M. Stevens:** Funding acquisition, Data curation, Investigation, Methodology, Writing – review & editing, Supervision.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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