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Evaluating the Actual and Perceived Effectiveness of E-Cigarette Prevention Advertisements among Adolescents

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Abstract

Background.—The efficacy of e-cigarette prevention ads among adolescents has seldom been studied. We sought to examine the impact of ads from the Food and Drug Administration (FDA) *The Real Cost* prevention media campaign on what adolescents think and believe about vaping. We also sought to test whether perceived message effectiveness (PME) served as a proxy for ad impact.

Methods.—Participants were 543 U.S. adolescents ages 13-17. In an online experiment, we randomized adolescents to either: 1) persuasive e-cigarette prevention ads that were targeted to adolescents from the FDA *The Real Cost* campaign (FDA condition) or 2) information-only e-cigarette harms control videos (control condition). Participants in each condition viewed 2 videos in a random order. After ad exposure, the survey assessed PME (*message* and *effects* perceptions), risk beliefs about vaping, attitudes toward vaping, and intentions to vape.

Results.—The FDA's *The Real Cost* ads led to higher beliefs about the harms of vaping ($p<.001$), more negative attitudes toward vaping ($p<.001$), and lower intentions to vape ($p<.05$) compared to the control videos. *The Real Cost* ads also scored higher on both *message* perceptions

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(p<.001) and *effects* perceptions (p<.001) compared to control. *Effects* perceptions were associated with all three outcomes (all ps<.001, adjusting for both types of PME and covariates), but *message* perceptions did not offer additional predictive value.

Conclusions.—Exposure to *The Real Cost* vaping prevention ads gave adolescents a more negative view of vaping and lowered their intentions to vape compared to control videos. *Effects* perceptions may be superior to *message* perceptions as a proxy for e-cigarette prevention ad impact.

Keywords

message effects; campaign; perceived message effectiveness; e-cigarette; vaping; The Real Cost

1. Introduction

E-cigarette use among adolescents is an urgent public health problem according to the U.S. Surgeon General (U.S. Department of Health and Human Services, 2016), and the U.S. Food and Drug Administration (FDA) characterizes it as an “epidemic” (Food and Drug Administration, 2018). By 2014, e-cigarettes had become the most commonly used tobacco product among high school-aged adolescents (Jamal et al., 2017), and e-cigarettes continue to dwarf the use of other tobacco products among this population (Cullen et al., 2019). The 2019 National Youth Tobacco Survey shows that e-cigarette use has continued to skyrocket, with more than 1 in 4 high school students reporting past 30-day use (Cullen et al., 2019) and an additional 40% identified as non-users who are susceptible to future use (Wang et al., 2019).

Although likely less harmful than combustible tobacco products (Bhatnagar et al., 2014; Chen, Bullen, & Dirks, 2017), e-cigarettes still pose harms, especially for youth. E-cigarettes expose users to chemicals and metals that may cause health problems (National Academies of Sciences Engineering and Medicine, 2018). E-cigarette use may elevate blood pressure, cause respiratory damage, and harm adolescent brain development (National Academies of Sciences Engineering and Medicine, 2018; U.S. Department of Health and Human Services, 2016). Moreover, e-cigarette use can lead to nicotine addiction and may also facilitate the uptake of combustible cigarette smoking among youth (Leventhal et al., 2015; Office of the Surgeon General, 2018). A recent meta-analysis synthesized studies that included more than 17,000 adolescents and young adults, and found that e-cigarette users were at least three times more likely than non-users to subsequently initiate combustible cigarette smoking (Soneji et al., 2017).

Youth tobacco prevention media campaigns are an efficacious tool to reduce the initiation, prevalence and progression of tobacco use (Farrelly, Nonnemaker, Davis, & Hussin, 2009; Niederdeppe, Avery, Byrne, & Siam, 2014; White et al., 2011; Wilson et al., 2012). Most campaigns to date, however, have aimed to prevent *cigarette smoking*, with a dearth of studies examining effects of campaigns on *e-cigarette prevention*. Launched in 2014, The Food and Drug Administration’s *The Real Cost* youth tobacco prevention campaign (Crosby, Santiago, Talbert, Roditis, & Resch, 2019; Duke et al., 2015) initially focused on cigarette smoking, but recently expanded to include smokeless tobacco (Walker, Evans,

Wimpy, Berger, & Smith, 2018) and e-cigarettes (U.S. Food and Drug Administration, 2019). Evaluations of *The Real Cost* smoking prevention campaign suggest it has influenced adolescent risk beliefs about combustible tobacco (Duke et al., 2018) and smoking initiation (Duke et al., 2019; Farrelly, 2017); however, we know little about the potential impact of the campaign's *e-cigarette* prevention ads on adolescents' risk beliefs, attitudes, and intentions.

While the findings above speak to the *actual* effectiveness of *The Real Cost* campaign, perceived message effectiveness (PME) ratings are commonly employed when developing ads for use in *The Real Cost* (Zhao et al., 2016) and other tobacco education campaigns (Noar, Bell, Kelley, Barker, & Yzer, 2018). PME measures consist of target audience ratings of the likely impact of persuasive messages (Dillard, Weber, & Vail, 2007) and tend to be one of two types – *message* or *effects* perceptions (Baig et al., 2019). *Message* perceptions are judgments about whether a message promotes further processing that leads to persuasion. Examples include the extent to which recipients perceive a message as attention-grabbing, meaningful, or informative (e.g., "This ad is informative"). *Effects* perceptions, by contrast, are judgments about a message's potential to change antecedents of behavior or behavior itself. Examples include the extent to which a message would make one believe that e-cigarettes are harmful, or the extent to which a message would motivate one to not vape (e.g., "This ad would motivate me to not vape"). To date, studies of FDA's *The Real Cost* campaign have mostly applied *message* perceptions measures (Duke et al., 2015; Zhao et al., 2016; Zhao, Roditis, & Alexander, 2019), while a growing literature suggests *effects* perceptions may better predict ad impact (Baig et al., 2020; Brennan, Durkin, Wakefield, & Kashima, 2014; Rohde, Noar, Prentice-Dunn, Kresovich, & Hall, 2020). More research is needed to understand which types of PME measures best predict *actual* message effectiveness in the context of e-cigarette prevention messages and campaigns.

To advance the literature on e-cigarette prevention campaigns, we conducted an experimental evaluation of *The Real Cost* e-cigarette prevention ads among adolescents. We sought to 1) examine the impact of the e-cigarette prevention ads on risk beliefs, attitudes toward vaping, and intentions to vape (i.e., *actual* effectiveness); and 2) compare both *message* and *effects* perceptions (i.e., *perceived* effectiveness) of e-cigarette prevention ads and their associations with actual effectiveness outcomes.

2. Methods

2.1 Participants

Participants were a national convenience sample of U.S. adolescents (aged 13-17) recruited in Summer 2019. Participants were recruited via Qualtrics, a survey technology firm with access to a panel of 95 million diverse participants. Qualtrics distributed the online survey to parents, inviting them to consider the survey opportunity for their adolescent children. Interested parents provided informed consent online, after which they were instructed to give the computer or tablet to their child to provide assent online. Our recruitment efforts yielded 543 participants.

2.2 Procedures

This study used a between-subjects experimental design. Participants were randomized to one of two video message blocks: 1) two persuasive e-cigarette prevention ads targeted to adolescents from the FDA *The Real Cost* campaign (FDA condition), or 2) two information-only e-cigarette prevention videos *not* targeted to adolescents from the Mayo Clinic (control condition). Participants viewed the two ads per their assigned condition (FDA's *The Real Cost* ads or control videos), one at a time, in a random order. Participants could not advance to the next screen until the ~30 second ad concluded. Upon study completion, a standardized incentive was delivered to each participant. The University of North Carolina Institutional Review Board approved all study procedures.

The FDA condition used 30-second *The Real Cost* campaign ads that were systematically designed and tested through a process of extensive formative development by the agency (Roditis, Dineva, et al., 2019). The two ads were similar in theme (addiction and other health effects of vaping), style (scripted scenes featuring adolescents), and brand (*The Real Cost*). The FDA's stated purpose of these ads is to dissuade adolescents from using e-cigarettes.

The control condition used videos from the Mayo Clinic that were also approximately 30-second informational "news style" clips featuring researchers discussing the harms of e-cigarette use. To our knowledge, formative research was not used in the development of these ads. The two control videos were also similar in theme (addiction and other health effects of vaping), style (news style clips for a general audience), and brand (*Mayo Clinic*). We chose these ads as a control because they covered similar content as the ads from *The Real Cost*, but were *not* expected to perform as well given that they were informational in nature and *not* targeted to youth. See Supplementary Table 1 for a detailed description of all ads used in this study.

2.3 Measures

Before viewing the ads, the survey assessed participant demographics and tobacco product use. After viewing the ads, the survey assessed *message* perceptions and *effects* perceptions. Finally, the survey assessed risk beliefs about vaping, attitudes toward vaping, and intentions to vape (i.e. *actual* effectiveness).

Current tobacco product use.—E-cigarette use was assessed by asking adolescents if they had used e-cigarettes or other vaping devices in their lifetime (ever use) and in the past 30 days (current use) (Population Assessment of Tobacco and Health Study, 2018). Prior to presenting these items, we provided a brief description of e-cigarette and vaping devices accompanied by example images of vaping devices, including JUUL. Participants were instructed to only report on e-cigarette use or vaping that did not involve marijuana. Current cigarette smoking was assessed by asking adolescents if they had ever tried smoking cigarettes and if they currently smoked some days or every day (S. Davis et al., 2009). Current use of other tobacco products (OTP) was assessed by having adolescents select other tobacco products (traditional cigars, hookah, and little cigars and cigarillos) that they had used in the past 30 days.

Demographics and other control variables.—The survey assessed age, gender, race, ethnicity, parents' education, and sexual orientation. Immediately after each ad was shown, the survey assessed how many times *prior* to taking the survey adolescents had seen each ad in their respective condition (FDA or control). The item read, "Before today, how many times have you seen this advertisement;" and the response scale was "never", "1-2 times", "3-5 times", "6-10 times", and "11 or more times". We dichotomized ad exposure for analyses (0=had never seen either ad before; 1=had seen one or both of the ads before).

Message perceptions.—Message perceptions were assessed using a validated scale that is commonly used in pre-testing of FDA campaigns (K. C. Davis, Nonnemaker, Duke, & Farrelly, 2013; Duke et al., 2015). The measure began with the stem, "The ads…" and contained the following six items: 1) grab my attention, 2) are informative, 3) are meaningful, 4) are worth remembering, 5) are convincing, and 6) are powerful. The 5-point response scale ranged from "strongly disagree" (1) to "strongly agree" (5). Reliability of the scale was α=.93.

Effects perceptions.—We developed 13 items about perceptions of the vaping prevention ads based on a prior tobacco-related effects perception scale (Baig et al., 2019). Item content was informed by the *message impact framework* categories of message reactions, attitudes/beliefs, social interactions, and intentions (Noar et al., 2016). Example items were, "The ads make vaping seem like a bad idea to me" and "The ads keep me from wanting to vape." The 5-point response scale ranged from "strongly disagree" (1) to "strongly agree" (5). We assessed scale structure using a maximum likelihood exploratory factor analysis with oblique rotation (promax). Results indicated a unidimensional factor, and each of the 13 scale items had acceptable factor loadings (range = .63 - .88; model eigenvalue = 8.61). Reliability of the scale was α=.96. See Supplementary Table 2 for all scale items and factor loadings.

Risk beliefs about vaping.—Risk beliefs were assessed using a 9-item scale adapted from prior work (Brennan, Gibson, Kybert-Momjian, Liu, & Hornik, 2017; Sangalang et al., 2019). Example items were, "If I vape, I will become addicted to vaping" and "If I vape, I will breathe in dangerous chemicals." The 5-point response scale ranged from "very unlikely" (1) to "very likely" (5). Reliability of the scale was α=.93.

Attitudes toward vaping.—Attitudes toward vaping were assessed using a 3-item scale adapted from prior work (Zhao et al., 2019). The survey presented the stem "Vaping is…" and 5-point response scales with these anchors: bad-good, unenjoyable-enjoyable, and negative-positive. Reliability of the scale was α=.89.

Intentions to vape.—Intentions to vape were assessed using a 3-item scale adapted from past studies (Coleman et al., 2014; Wakefield et al., 2004). The items assessed how likely it is that the respondent will: 1) vape soon, 2) vape in the next year, and 3) be vaping 5 years from now. The 5-point response scale ranged from "not at all likely" (1) to "extremely likely" (5). Reliability of the scale was α=.95.

2.4 Data analysis

We conducted Independent samples *t*-tests and chi-square tests to compare experimental conditions on demographic and tobacco use variables, which revealed no differences. We then used independent samples *t*-tests and Cohen's *d* effect sizes to compare experimental and control conditions. We also used zero-order correlations and difference of correlation tests (Lee & Preacher, 2013) to compare correlations of *message* and *effects* perceptions and other variables. Finally, we computed multivariable regression models to further examine the association between *message/effects* perceptions (PME) and *actual* ad effectiveness outcomes, using separate models to predict risk beliefs about vaping, attitudes toward vaping, and intentions to vape. The main predictor in the models was either *message* perceptions, *effects* perceptions, or both measures. All models adjusted for experimental condition, prior exposure to the ads, age, gender, race (White versus other), Hispanic ethnicity, mother's education (no bachelor's degree versus bachelor's degree or higher), and current OTP and e-cigarette use. All analyses were conducted using R (Version 3.6.2) (R Foundation for Statistical Computing, 2019).

3. Results

3.1 Participant characteristics

The average age of participants was 15 years (Table 1). Most participants identified as White (80%), and 15% were Hispanic. A minority of participants (8%) were either gay, lesbian, or bisexual. Almost half had parents with at least a bachelor's degree (>40% for both parents). Ever use of e-cigarettes was common (38%; n=204), with nearly all being current users (32%; n=174). Other current tobacco product use included combustible cigarettes (7%), little cigars and cigarillos (10%), hookah (7%), and traditional cigars (10%). Finally, 34% of participants in the FDA condition and 24% in the control condition reported having seen at least one of the two ads prior to taking the survey (p=.012).

3.2 Effects of experimental condition

The Real Cost e-cigarette prevention ads led to higher risk beliefs about the harms of vaping compared to control (p<.001). In addition, *The Real Cost* ads led to more negative attitudes toward vaping and lower intentions to vape compared to the control videos (p<.001 and p=.024, respectively; see Table 2 and Figure 1). PME mirrored these findings of greater effectiveness of *The Real Cost* ads compared to the control videos. Both *message* perceptions and *effects* perceptions were higher among *The Real Cost* ads compared to control (both p<.001).

3.3 Associations between PME and Actual Effectiveness Outcomes

Higher *message* and *effects* perceptions were associated with higher risk beliefs about vaping, more negative attitudes toward vaping and lower intentions to vape (all p<.001). Compared to *message* perceptions, however, *effects* perceptions were more strongly associated with risk beliefs about vaping (p<.001), attitudes toward vaping (p<.001), and intentions to vape (p<.001; Table 3). The correlation between *message* perceptions and *effects* perceptions was .69 (p<.001).

In adjusted analyses, *message* perceptions about the ads had a positive association with risk beliefs about vaping (b=.43, p<.001) and a negative association with both attitudes toward vaping (b=−.18, p<.001) and intentions to vape (b=−.19, p<.001; Table 4). Similarly, *effects* perceptions about the ads had a positive association with risk beliefs about vaping (b=.66, p<.001) and a negative association with both attitudes toward vaping (b=−.43, p<.001) and intentions to vape (b=−.42, p<.001; Table 4). When comparing these models, the *effects* perceptions models explained more total adjusted variance than the *message* perceptions models for risk beliefs (R^2=.57 vs. R^2=.33), attitudes toward vaping (R^2=.45 vs. R^2=.35), and intentions to vape (R^2=.46 vs. R^2=.37).

Finally, in a model with both *message* and *effects* perceptions, only *effects* perceptions were associated with risk beliefs about vaping (b=.66, p<.001; Table 5), attitudes toward vaping (b=−.56, p<.001) and intentions to vape (b=−.54, p<.001), as expected. *Message* perceptions were *not* associated with risk beliefs about vaping (b=.00, p=.92), and in contrast with expectations, were *positively* associated with attitudes toward vaping (b=.19, p<.001) and intentions to vape (b=.17, p=.001). Given the counter-intuitive results with respect to *message* perceptions, we ran the same models with both *message* and *effects* perceptions together, but without adjusting for any covariates. These models revealed the same pattern of results for both *message* and *effects* perceptions (data not shown), indicating that the findings were *not* a methodological artifact related to adjustment of those covariates.

4. Discussion and Conclusion

The Real Cost e-cigarette prevention ads were effective in generating higher risk beliefs about the harms of vaping, lowering attitudes toward vaping, and reducing intentions to vape in a national U.S. sample of adolescents, relative to the control videos. Extensive theoretical and empirical findings suggests that changes in these constructs are associated with subsequent behavior change (Fishbein & Ajzen, 2010; Sheeran et al., 2016; Webb & Sheeran, 2006). The FDA's *The Real Cost* e-cigarette prevention ads evaluated in this experiment were developed with substantial formative research with the target audience (Roditis, Dineva, et al., 2019; Roditis, Jones, Dineva, & Alexander, 2019), and the final ads reflected this target audience input. That is, these ads 1) featured youth in "acted out" situations that mirror their real lives, such as school and social settings with peers; 2) emphasized consequences of e-cigarette use that may be important to adolescents, such as loss of freedom due to addiction and brain or lung damage that may limit academic and athletic performance; and 3) had high production values that can compete with programming in which these ads are embedded. Our data suggest that this is a recipe for effective e-cigarette prevention ads for adolescents, although FDA's formative work with youth revealed several nuances that need to be considered when crafting such messages (e.g., realistic scenarios and vaping consequences that are believable to youth) (Roditis, Dineva, et al., 2019; Roditis, Jones, et al., 2019).

Both forms of PME that we examined – *message* and *effects* perceptions – mirrored the *actual* impact of the ads on effectiveness outcomes. Thus, if one were choosing ads based upon these ratings, both types of ratings would have led campaign designers to choose the more effective ads (*The Real Cost* ads instead of the control videos). However, *effects*

perceptions were more strongly associated with all three *actual* ad effectiveness outcomes than *message* perceptions. Further, when controlling for *message* perceptions, *effects* perceptions remained associated with all three actual effectiveness outcomes in the expected direction; this result was not true for *message* perceptions. After controlling for *effects* perceptions in the combined model, *message* perceptions demonstrated *no* association with risk beliefs about vaping, a *positive* association with more positive attitudes toward vaping, and *stronger* intentions to vape. While these counterintuitive findings are not due to other covariate adjustment as we demonstrated with additional analyses, it remains possible that they could be a statistical artifact due to the inclusion of highly correlated constructs (*message* and *effect* perceptions) in the same model.

A more plausible explanation, however, seems to be that once the *effects* perceptions variance is parceled out of *message* perceptions, the remaining variance is not meaningful to persuasive messaging – and may even be counterproductive. Why might that be the case? First, unlike *effects* perceptions measures, which have participants rate messages on items that include both personal and behavioral referents (e.g., the ads keep me from wanting to vape), *message* perceptions measures typically contain neither (e.g., the ads were compelling). Evidence suggests that this lack of specifying referents increases "noise" when participants make message ratings, as different participants think about different personal referents (e.g., me, close friends, people in general), when rating the same messages (Dillard & Ye, 2008). Perhaps because of this, message perceptions scales have been found to have greater measurement error than effects perceptions scales (Baig et al., 2019). Second, we know that some anti-tobacco ads can, for some viewers, result in boomerang effects such as cueing cravings for the tobacco product (Kang, Cappella, Strasser, & Lerman, 2009). Thus, it may be that *message* perceptions measures are picking up on some aspects of this iatrogenic effect for those youth. Indeed, it is worth noting that all of the ads used in the current study (both FDA and control) featured visual depictions of youth using e-cigarettes.

In addition, it is important to note that other studies have shown similar findings. For instance, in a recent study of adult smokers examining messages about chemicals in cigarette smoke (Baig et al., 2020), *effects* perceptions predicted key behavioral antecedents and cessation behavior after controlling for *message* perceptions, while *message* perceptions exhibited counterintuitive results after adjusting for *effects* perceptions. In a vaping prevention advertising study with young adults (Rohde et al., 2020), only *effects* perceptions predicted actual effectiveness outcomes after adjusting for *message* perceptions, while *message* perceptions exhibited no association with those same outcomes after adjusting for *effects* perceptions. This suggests that *effects* perceptions may be the superior measure, and in cases where message designers need to select a single PME measure, that *effects* perceptions is likely the better choice between the two types of PME.

Strengths of our experiment include balanced experimental conditions, a national sample of adolescents with substantial numbers of current tobacco users, use of high-quality ad stimuli developed by the FDA, and use of measures (e.g., *effects* perceptions, risk beliefs) that were designed for use with *The Real Cost* ads. Limitations include the use of a convenience sample, a single exposure of participants to a small set of e-cigarette prevention ads, and a one-time experiment that precluded measurement of future behavior. We also did not include

a no-treatment control condition in our experimental design, and thus we do not know what effects *The Real Cost* ads would have compared to no ads. Confirming our findings in a national probability sample of adolescents would provide additional empirical evidence of the impact of *The Real Cost* e-cigarette prevention ads on youth, although similar experiments have typically shown consistent findings in convenience and representative samples (Jeong et al., 2019).

Future research should consider additional messaging approaches that may be impactful for e-cigarette prevention beyond the approach employed by *The Real Cost* campaign. For instance, the *Truth* anti-smoking campaign was successful in using industry manipulation as a messaging tactic to reduce youth cigarette smoking (Sly, Hopkins, Trapido, & Ray, 2001), and studies should evaluate a similar approach in the e-cigarette prevention context. Another approach is a campaign focused on social norms, mirroring successful binge drinking reduction campaigns that have used a "corrections of norms" approach (DeJong & Smith, 2013). Indeed, while e-cigarette use has grown substantially among youth, studies show that youth dramatically overestimate how much their peers vape (Noland et al., 2016; Pepper et al., 2017), suggesting a norms corrective approach could be a fruitful one to explore. Finally, future studies should also examine the longitudinal impact of vaping prevention messages on vaping initiation and use.

In conclusion, our experiment examined the efficacy of *The Real Cost* e-cigarette prevention ads (versus control videos) on actual ad effectiveness outcomes and compared that to adolescents' PME ratings of expected impact. The FDA ads increased risk beliefs about vaping and lowered both attitudes toward vaping and intentions to vape compared to the control videos. Both types of PME measures – *message* perceptions and *effects* perceptions – mirrored the effectiveness findings. We also found that *effects* perceptions were more strongly associated with actual effectiveness outcomes than *message* perceptions. Future work should expand our findings by examining the impact of *The Real Cost* ads with a nationally representative sample of adolescents and conduct further work to explore the efficacy of additional messaging approaches for e-cigarette prevention.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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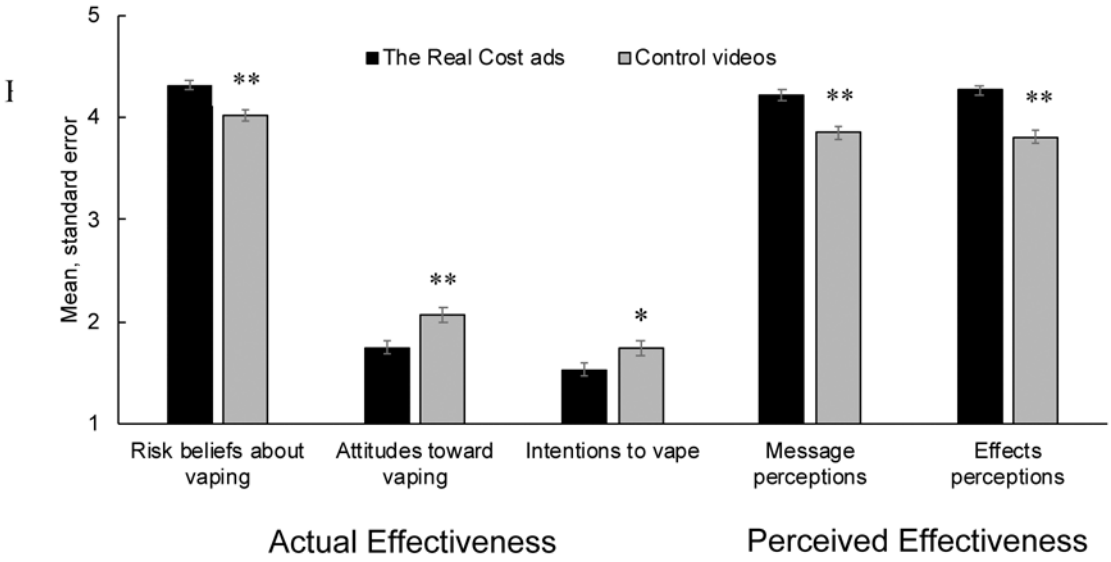

Figure 1.

Actual and perceived effectiveness of *The Real Cost* and control videos. Scores ranged from 1-5; higher scores indicate greater perceived effectiveness, greater risk beliefs, more positive attitudes towards vaping and higher intentions to vape. *p<.05, **p<.001

Table 1.

Participant characteristics by e-cigarette prevention experimental condition

	FDA ads *n*=274 *n* (%)	Control videos *n*=269 *n* (%)	Total *n*=543 *n* (%)
Age, M years (SD) [age range]	14.99 (1.41) [13-17]	15.07 (1.40) [13-17]	15.03 (1.40) [13-17]
Race			
White	210 (77%)	225 (84%)	435 (80%)
Black or African American	32 (12%)	23 (9%)	55 (10%)
Asian	8 (3%)	4 (1%)	12 (2%)
American Indian or Alaskan native	3 (1%)	0 (0%)	3 (1%)
Native Hawaiian or Other Pacific	0 (0%)	1 (<1%)	1 (<1%)
Islander	14 (5%)	11 (4%)	25 (5%)
More than one race	7 (3%)	5 (2%)	12 (2%)
Other/did not answer			
Hispanic	46 (17%)	36 (13%)	82 (15%)
Gender			
Female	140 (51%)	135 (50%)	275 (51%)
Male	134 (49%)	133 (50%)	267 (49%)
Transgender	0 (0%)	1 (<1%)	1 (<1%)
Gay, lesbian or bisexual	25 (9%)	19 (7%)	44 (8%)
Mother's education			
High school or less	64 (23%)	59 (22%)	123 (23%)
Some college or associate's	74 (27%)	83 (31%)	157 (29%)
Bachelor's degree	79 (29%)	66 (25%)	145 (27%)
Graduate degree	52 (19%)	58 (21%)	110 (20%)
Did not answer	5 (2%)	3 (1%)	8 (1%)
Father's education			
High school or less	102 (37%)	85 (32%)	187 (34%)
Some college or associate's degree	52 (19%)	56 (21%)	108 (20%)
Bachelor's degree	51 (19%)	47 (17%)	98 (18%)
Graduate degree	65 (24%)	76 (28%)	141 (26%)
Did not answer	4 (1%)	5 (2%)	9 (2%)
Current tobacco product use			
E-cigarettes	79 (29%)	95 (35%)	174 (32%)
Combustible cigarettes	22 (8%)	15 (6%)	37 (7%)
Little cigars and cigarillos	23 (8%)	29 (11%)	52 (10%)
Hookah	21 (8%)	16 (6%)	37 (7%)
Traditional cigars	31 (11%)	25 (9%)	56 (10%)

Note. *M*=Mean; *SD*=standard deviation

Table 2.

Impact of e-cigarette prevention ads on actual and perceived effectiveness (n=543)

Variable	FDA ads *M* (*SD*)	Control videos *M* (*SD*)	*p*	Cohen's *d*
Actual effectiveness				
Risk beliefs about vaping	4.32 (.79)	4.02 (.92)	<.001	.35
Attitudes toward vaping	1.75 (1.07)	2.07 (1.13)	<.001	.30
Intentions to vape	1.53 (1.04)	1.74 (1.18)	.024	.19
Perceived effectiveness				
Message perceptions	4.22 (.87)	3.85 (1.00)	<.001	.40
Effects perceptions	4.27 (.80)	3.81 (1.03)	<.001	.50

Note. *M*=Mean; *SD*=standard deviation. Scores ranged from 1-5; higher scores indicate greater perceived effectiveness, greater risk beliefs, more positive attitudes towards vaping and higher intentions to vape.

Table 3.

Correlation of perceived and actual effectiveness of e-cigarette prevention ads

	Actual effectiveness		
Perceived effectiveness	**Risk beliefs about vaping**	**Attitudes toward vaping**	**Intentions to vape**
Message perceptions	.48*	−.14*	−.14*
Effects perceptions	.74*	−.46*	−.45*
Difference in correlations	$p<.001$	$p<.001$	$p<.001$

*$p<001$.

Table 4.

Association of perceived and actual effectiveness, adjusted analyses

	Message Perceptions Models						Effects Perceptions Models					
	Risk beliefs about vaping		Attitudes toward vaping		Intentions to vape		Risk beliefs about vaping		Attitudes toward vaping		Intentions to vape	
	b	*p*	*b*	*p*	*b*	*p*	*b*	*p*	*b*	*p*	*b*	*p*
Perceived message effectiveness												
Message perceptions	.43	<.001	−.18	<.001	−.19	<.001	-	-	-	-	-	-
Effects perceptions	-	-	-	-	-	-	.66	<.001	−.43	<.001	−.42	<.001
Control												
Experimental condition (FDA ads)	.11	.083	−.23	.005	−.10	.202	−.02	.756	−.13	.086	.00	.950
Participant saw ad before	−.02	.789	.29	.002	.34	<.001	.03	.582	.22	.011	.32	<.001
Age	.04	.094	−.05	.087	−.02	.441	.03	.094	−.05	.063	−.01	.574
Female	.08	.230	−.08	.301	−.07	.365	.05	.300	−.04	.580	−.05	.467
White	.05	.547	−.03	.732	−.04	.726	.09	.181	−.05	.606	−.09	.355
Hispanic	−.20	.022	.18	.108	.15	.164	−.16	.022	.16	.108	.13	.202
Mother's bachelor's degree	.03	.649	.02	.844	−.10	.199	.01	.902	.06	.431	−.07	.331
Any OTP current use	−.02	.797	.24	.037	.33	.004	.02	.817	.30	.005	.33	.002
Current e-cigarette user	−.56	<.001	1.10	<.001	1.10	<.001	−.30	<.001	.89	<.001	.93	<.001

Note. n=542; Results are from linear regressions that controlled for all variables in the column; *b*=unstandardized regression coefficient. coefficient. Message perceptions models: Risk beliefs adjusted R^2=.33, Attitudes toward vaping adjusted R^2=.35, and Intentions to vape adjusted R^2=.37. Effects perceptions models: Risk beliefs adjusted R^2=.57, Attitudes toward vaping adjusted R^2=.45, and Intentions to vape adjusted R^2=.46

Table 5.

Association of perceived and actual effectiveness, adjusted analyses including both types of perceived effectiveness

	Risk beliefs about vaping		Attitudes toward vaping		Intentions to vape	
	b	***p***	***b***	***p***	***b***	***p***
Perceived message effectiveness						
Message perceptions	.00	.916	.19	<.001	.17	.001
Effects perceptions	.66	<.001	−.56	<.001	−.54	<.001
Control						
Experimental condition (FDA ads)	−.02	.753	−.14	.063	.00	.996
Participant has seen ad before	.03	.579	.20	.019	.30	<.001
Age	.03	.093	−.05	.063	−.01	.562
Female	.05	.304	−.04	.599	−.05	.496
White	.09	.182	−.02	.819	−.07	.454
Hispanic	−.16	.023	.15	.135	.11	.264
Mother’s bachelor’s	.01	.890	.04	.608	−.09	.207
Any OTP current use	.02	.801	.28	.009	.30	.006
Current e-cigarette user	−.30	<.001	.85	<.001	.90	<.001

Note. n=542. Results are from linear regressions that controlled for all variables in the column; b=unstandardized regression coefficient. Risk beliefs adjusted R^2=.57, Attitudes toward vaping adjusted R^2=.46, and Intentions to vape adjusted R^2=.47.