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Effects of e-Cigarette Advertisements on Adolescents' Perceptions of Cigarettes

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ABSTRACT

This study examined the effect of exposure to “cigalike” (products resembling cigarettes) e-cigarette advertisements on adolescents' perceptions of cigarettes. A nationally representative sample of 802 adolescents (13–17 years old) was randomly assigned to watch three e-cigarette or three control advertisements. Never-smokers who saw the e-cigarette advertisements ($n = 352$) reported significantly lower perceived risks of smoking than those in the control condition ($n = 320$). Ever-smokers ($n = 130$) did not show significant differences across the conditions. In subgroup analyses, current smokers (reported smoking in the past 30 days, $n = 31$) in the e-cigarette condition reported significantly lower perceived benefits of smoking than those in the control condition. E-cigarette advertisements can affect adolescents' perceptions of cigarettes. Many advertisements, especially the ones promoting “cigalikes,” depict e-cigarettes as being similar to cigarettes (e.g., look, flavor) but also as a solution for cigarettes' shortcomings (e.g., bad smell). While the advertisements include messages about problems posed by cigarettes, proposing e-cigarettes as a solution may decrease the perceived risks of smoking among never-smokers. It may also not be clear to adolescents whether advertisements are for cigarettes or e-cigarettes. Regulating e-cigarette advertisements to minimize adolescents' exposure may prevent potential harmful effects on never-smokers' perception of smoking.

Adolescents' electronic cigarette (e-cigarette) usage has substantially increased, becoming the most popular tobacco product in the US for both high school (16.0%) and middle school (5.3%) students, with use rates higher than cigarettes (high school students: 9.3%; middle school students: 2.3%) (Singh et al., 2016). Coinciding with the increase in e-cigarette use has been the rapid increase in e-cigarette marketing. E-cigarette advertising expenditures have grown more than five times between 2012 and 2014, from \$22.1 million to \$125 million (U.S. Department of Health and Human Services, 2016). Many e-cigarette advertisements include content that is particularly appealing to youth, such as animation, or emotional and sexual appeals (Padon, Maloney, & Cappella, 2017). In 2014, more than 18 million, or 68.9% of middle and high school students in the US, reported being exposed to e-cigarette advertisements through a variety of channels such as retail stores, the internet, TV/movies, and newspapers/magazines (Singh et al., 2016).

There is a significant association between exposure to e-cigarette marketing and adolescents' attitudes and behaviors regarding e-cigarettes. Self-reported exposure to e-cigarette marketing (e.g., Mantey, Cooper, Clendennen, Pasch, & Perry, 2016) as well as exposure in experimental studies (e.g., Farrelly et al., 2015) were found to be significantly associated with greater susceptibility to using e-cigarettes among adolescents. However, little is known about the

effects of e-cigarette advertisements on the perceptions of cigarettes among adolescents. E-cigarettes are frequently advertised as an alternative to cigarettes and/or as a cigarette smoking cessation aid, but observational studies have demonstrated e-cigarette use predicts increase in subsequent cigarette smoking among youth (Leventhal et al., 2015; Miech, Patrick, O'Malley, & Johnston, 2017; Wills et al., 2016). E-cigarette advertisements might promote more negative views of cigarettes, or they might encourage smoking. For example, advertisements that mention the “thousands of chemicals” in cigarettes might increase perceived risk of smoking. On the other hand, by portraying a behavior that looks like smoking, e-cigarette advertisements might normalize cigarette smoking or increase the urge to smoke. Exposure to e-cigarette advertisements has been found to increase adult smokers' urge to smoke cigarettes among both current (Kim, Lee, Shafer, Nonnemaker, & Makarenko, 2015; King et al., 2016) and former smokers (Durkin, Bayly, & Wakefield, 2016). Another experiment found that visual depictions of e-cigarette use and the appearance of “cigalike” devices increased current daily smokers' urge to smoke cigarettes and decreased former smokers' intention to abstain from smoking (Maloney & Cappella, 2016).

A recent study found a worrisome effect of e-cigarette advertisements on children. In the UK, children (11–

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16 years old) who reported never having smoked cigarettes or e-cigarettes reported significantly lower perceived risk of smoking one or two cigarettes occasionally when they saw e-cigarette advertisements, compared to those who did not watch any messages (Petrescu, Vasiljevic, Pepper, Ribisl, & Marteau, 2016). However, this study did not include adolescents with smoking experience.

The current study examines the effects of e-cigarette advertisements on adolescents' perceptions of cigarettes, and how their responses differ depending on their previous experience with smoking cigarettes. This study focuses especially on "cigalike" advertisements, many of which compare e-cigarettes to cigarettes in terms of their health, financial or social consequences (Zhu et al., 2014). Also, the visual stimuli in these e-cigarette advertisements can be considered smoking cues because the "cigalike" products' appearance and use behavior emulates combustible cigarettes (Maloney & Cappella, 2016).

Methods

Participants and procedures

Adolescents between 13 and 17 years old were recruited from a nationally representative online panel (*GfK's Knowledge Panel*). This was part of a larger between-subject experiment ($N = 1,336$) where there were three conditions showing different sets of three advertisements (e-cigarette, cigarillo, and a bottled water control condition). Only those in the e-cigarette and the control conditions were included in the current analyses. About 10% of participants had technical difficulties in displaying the video advertisements and were shown print advertisements of the same product category. These were excluded from the analyses, leaving 802 adolescents: 413 in the e-cigarette and 389 in the control condition.

The participants' parents or guardians were Knowledge Panel members who reported that they had eligible children in their household and consented to their participation in the experiment. The participants were randomly assigned to see either e-cigarette or control advertisements. They watched three video advertisements that corresponded to their assigned condition. After viewing each video, participants answered several questions evaluating the advertisement (not included in the current study). After watching all three advertisements, participants were asked to report their perceptions of different tobacco products including cigarettes, e-cigarettes, and cigarillos. The current study focuses on responses about cigarettes; responses regarding other tobacco products are reported elsewhere (Popova, Halpern-Felsher, Walsh, & Ling, 2015a, 2015b). At the end of the experiment, all the participants were debriefed about tobacco industry marketing tactics, and the harmful effects of cigarettes and alternative tobacco products, including the potential addictiveness of e-cigarettes.

Stimuli

Participants saw three videos that were randomly selected from a larger message pool (14 e-cigarette advertisements and seven control (bottled water) advertisements). All

advertisements were found on YouTube. They were all professionally produced in English, promoting products for the US market. No user-generated videos (e.g., reviews, amateur videos) were included in the study. Both treatment (e-cigarette) and control videos ranged between 30 seconds and 2 minutes in length. All e-cigarette advertisements featured "cigalikes" (e-cigarettes that resemble combustible cigarettes in appearance) produced by both tobacco-company owned brands (six advertisements from Blu, one from Green Smoke, one from Vuse) and independent brands (one from Blaze, one from Fin, two from NJOY, one from Volcano, one from Smokeless Image). The claims featured in the advertisements included: e-cigarettes look, taste and satisfy like real cigarettes; e-cigarettes do not generate ash, tobacco smoke or odor; e-cigarettes can be used in places where smoking is not allowed; e-cigarettes don't include tobacco and tar; romantic partners will not reject e-cigarette users as they reject cigarette smokers; e-cigarettes cost less than cigarettes; e-cigarettes come in different flavors; e-cigarettes involve high-level technology; and e-cigarettes are enjoyed by cool young people. The control condition advertisements for bottled water were comparable to the e-cigarette ones on quality, length and other format features that adolescents might find appealing, such as the use of young models, upbeat music, and fast-paced edits. See online supplement for further details about the stimuli.

Measurements

Smoking status

Participants were asked whether they have ever smoked cigarettes, even one puff. Participants who responded "yes" were categorized as "ever-smoker" and those responding "no" were categorized as "never-smokers." Since the level of smoking experiences varies among ever-smokers, ranging from experimenting with one or two cigarettes in their lifetime to regular smoking, a subgroup of "current smokers" was created for additional analyses. The ever-smokers were further asked how many times they have smoked a cigarette during their entire life (response options were: one time, 2–5 times, 6–10 times, more than ten times). Those who responded "6–10 times" or "more than 10 times" ($n = 65$) were then asked whether they have smoked cigarettes during the past 30 days. Those who said "yes" were categorized as "current smokers" ($n = 31$).

Perceived risks and benefits

Participants were presented with a short scenario: "Imagine that you just began smoking. You smoke about two or three cigarettes each day. Sometimes you smoke alone, and sometimes you smoke with friends." (Halpern-Felsher, Biehl, Kropp, & Rubinstein, 2004; Song et al., 2009) Then participants estimated their chance of personally experiencing physical risks (e.g., gum disease, lung cancer, mouth cancer, trouble catching breath) and addiction risks (become addicted to cigarettes) given the scenario. For perceived benefits of smoking, similar questions were used for two positive consequences (look more grown up, feel relaxed). The participants used a 0–100% scale to indicate how likely they thought

they would experience each specific consequence as a result of smoking (perceived risks: $M = 60.34\%$, $SD = 30.75$, Cronbach's $\alpha = .93$; perceived benefits: $M = 16.11\%$, $SD = 23.96$, $r = .51$).

Both perceived risks and benefits of smoking were adopted from a longer measure, which has been shown to be associated with smoking status (Halpern-Felsher et al., 2004; Roditis, Delucchi, Cash, & Halpern-Felsher, 2016) as well as to be predictive of future smoking initiation (Song et al., 2009). The shorter scale included items on different types of perceived risks (short-term health risks, long-term health risks and addiction risks) and benefits in the original measure.

Smoking susceptibility

Participants responded to three different questions: "What is the chance that you will try a cigarette (that is, taking even just one puff) sometime over the next 6 months?," "What is the chance that you will smoke a whole cigarette sometime over the next 6 months?" (1 = definitely will not, 2 = maybe not, 3 = maybe, 4 = definitely will), and "If someone handed you a cigarette at a party, how likely would you be to try it?" (1 = very unlikely, 5 = very likely). Those who answered "definitely will not" for the first two questions and "very unlikely" for the third question were classified as not susceptible to smoking cigarettes. Everyone else was classified as susceptible (16.3%, Cronbach's $\alpha = .95$; Pierce, Choi, Gilpin, Farkas, & Merritt, 1996).

Social norms

Two items were used: "It's okay for teens my age to smoke cigarettes once in a while/everyday" on a 5-point Likert-type scale (1 = strongly disagree, 5 = strongly agree). The responses were dichotomized so that those with any response other than "strongly disagree" to both questions were categorized as having positive teen smoking norms (21.5%, $r = .78$).

Anti-tobacco industry sentiment

Participants were asked how much they agreed with three statements on support for action against the tobacco industry on a 5-point Likert-type scale (1 = strongly disagree, 5 = strongly agree): "I want to be involved with efforts to get rid of cigarette smoking," "I would like to see the cigarette companies go out of business," and "Taking a stand against smoking is important to me" ($M = 3.65$, $SD = .95$, Cronbach's $\alpha = .86$). This measure has been shown to be negatively associated with current smoking and positively associated with intention to quit smoking (Ling, Neilands, & Glantz, 2009).

Intention to quit smoking

Participants who reported smoking more than 6 times ($n = 65$), which included current smokers, were asked about their intention to quit smoking cigarettes. Intention to quit was measured using three different questions: whether they would like to quit smoking (general intention to quit; 64.6% responded "yes"), and more specific questions regarding when they expected to quit (never expect to quit, 8.8%; may quit in the future but not in the next 6 months, 26.3%; will quit in the next 6 months, 5.3%; will quit in the next month, 59.7%). A majority of participants responded that they expected to quit

in the next month, and the responses were dichotomized into those who intended to quit in the next month or not. Participants also estimated the chance they thought that they would still be smoking in 5 years (0–100%; $M = 27.08$, $SD = 31.29$).

Product confusion

Product confusion was defined as the audience being incorrect in recognizing the product promoted in the advertisements. After watching all three advertisements, participants were asked which product was advertised in the messages they just saw and selected the answer from a list of tobacco products (cigarettes, e-cigarettes, cigarillos, cigars, smokeless tobacco and other). Since this study focused on product confusion with e-cigarette advertisements, only those who were in the e-cigarette condition ($n = 413$) were examined. Participants who incorrectly reported the advertisements promoted cigarettes (8.2%) or who reported the advertisements did not promote e-cigarettes (4.4%) were considered to be "confused". If a participant incorrectly reported that the e-cigarette advertisement promoted cigarettes, and also incorrectly reported that the advertisement did *not* promote e-cigarettes, they were considered to show "complete confusion".

Demographics

The participants' parents reported the adolescents' age and gender. GfK provided the parents' education level (Less than high school, High school, Some college, Bachelor's degree or higher) based on the panel information. Participants self-reported their race and ethnicity.

Previous experiences with cigarettes

Those who reported ever smoking a cigarette were asked whether they had certain experiences after smoking a cigarette in their life (1 = never, 5 = always). An index measuring positive experiences was created by averaging responses for two items ("felt relaxed", "looked more grown up"; $M = 2.12$, $SD = 1.05$). Negative experiences were measured using three items ("got a bad cough", "got gum disease", "became addicted to cigarettes"; $M = 1.60$, $SD = .71$). As experiencing positive or negative outcomes during the past encounters with risky behaviors can influence expectancies or perceptions of outcomes for future behavior (Gerrard, Gibbons, Benthin, & Hessling, 1996), these variables were used as additional control variables for ever-smokers.

Analyses

The data were weighted to the national population to adjust for any study nonresponse, non-coverage, under- or over-sampling. Continuous outcome variables (e.g., perceived risks/benefits) were analyzed using multivariate OLS regression analyses, and dichotomous outcome variables (e.g., smoking susceptibility, social norms) were analyzed using logistic regression.

Known demographic cigarette smoking risk factors such as participants' age, gender, race/ethnicity, and parents' education level (Johnston, O'Malley, Miech, Bachman, &

Schulenberg, 2016) were included as control variables. These demographic variables were included in the models for all participants; for those who reporting ever smoking a cigarette, previous positive and negative experiences with cigarettes were also included as control variables. Because of the different sets of control variables, ever- and never-smokers were analyzed separately. For analyses comparing current and non-current smokers, a single model for each dependent variable including an interaction term between the experimental condition and smoking status as well as the control variables was fitted. All analyses were conducted using STATA 14.

Results

Participants

Out of the 802 participants, 403 (50.3%) were female and mean age was 15.18 years old ($SD = 1.41$). The majority was non-Hispanic White ($n = 552$, 68.8%), followed by Hispanic ($n = 110$, 13.7%) and non-Hispanic Black ($n = 64$, 8.0%). Parents of 351 (43.8%) participants had a BA or higher level of education, 268 (33.4%) had some college, 183 (22.8%) had high school or less. Slightly over 16% ($n = 130$) of participants reported smoking at least one puff of a cigarette in their entire life ("ever-smokers") and 3.9% ($n = 31$) of participants reported smoking cigarettes in the past 30 days ("current smokers").

Effect of e-cigarette advertisement exposure

When the analyses included all participants, only anti-industry sentiment showed a significant difference between the e-cigarette and the control condition controlling for ever-smoker status ($b = .16$, $SE = .08$, $p = .04$), suggesting that those who saw e-cigarette advertisements reported greater anti-industry sentiment. However, when examined separately, never- and ever-smokers reported different effects of e-cigarette advertisement exposure (see Table 1). Since the control variables were different for never- and ever-smokers, interaction effects were not examined; only the main effects within each subgroup are reported.¹

Among never-smokers, exposure to the e-cigarette advertisements resulted in significantly lower perceived risks of cigarette

smoking ($M = 58.81$, $SD = 30.97$) compared to the control condition ($M = 64.41$, $SD = 31.08$), $b = -5.88$, $SE = 2.86$, $p = .04$. For ever-smokers, there was no significant difference between e-cigarette and control conditions in perceived risks of cigarette smoking ($p = .26$). For all other variables (perceived benefits of cigarette smoking, social norms, susceptibility, and anti-industry sentiment) there were no significant differences between the conditions between never- or ever-smokers (all $ps > .05$).

Table 2 presents further results focusing on ever-smokers. Ever-smokers were divided into current smokers (reported smoking in the past 30 days) and non-current smokers. For these analyses, models including interaction terms between the current smoker status and the experimental condition were fitted, where the significance of the interaction terms and the simple main effect for each subgroup was examined. A significant interaction effect between smoking status and condition emerged on perceived benefits of smoking ($b = -37.27$, $SE = 14.28$, $p = .01$). The observed interaction effect implied that the effects of e-cigarette advertisement exposure were different depending on the ever-smokers' current smoking status. Current smokers in the e-cigarette condition reported significantly lower perceived benefits of cigarettes than the control condition ($b = -37.59$, $SE = 12.91$, $p = .004$), while non-current smokers did not show a significant difference.

No other outcome variables yielded significant interaction effects (all $ps > .20$) or simple main effects for either subgroup (current smokers: all $ps > .08$; non-current smokers: all $ps > .40$). Current smokers in the e-cigarette condition showed lower susceptibility to smoking, greater anti-tobacco industry sentiment and greater intention to quit smoking than those in the control condition, but none of the effects reached statistical significance.

Product confusion

To further examine why the never-smokers who saw e-cigarette advertisements reported significantly lower perceived risks of smoking, an additional analysis was conducted addressing product confusion. Table 3 shows the numbers and proportions (unweighted) of never- and ever-smokers who were shown e-cigarette advertisements reporting whether they thought the products promoted in the advertisements were cigarettes or

Table 1. Effect of e-cigarette ad exposure on never- ($n = 672$) and ever-smokers' ($n = 130$) perceptions of and susceptibility to smoking cigarettes.

	Never-smokers				Ever-smokers			
	E-cig condition ($n = 352$)	Control condition ($n = 320$)	Coeff.	SE	E-cig condition ($n = 61$)	Control condition ($n = 69$)	Coeff.	SE
Perceived risk (b)	58.81 (30.97)	64.41 (31.08)	-5.88*	2.86	54.53 (32.09)	46.16 (32.56)	7.41	6.57
Perceived benefit (b)	16.35 (25.46)	15.33 (24.69)	0.81	2.43	22.29 (25.83)	31.87 (31.10)	-8.61	5.30
Susceptibility (OR)	10.5%	10.6%	1.01	0.29	42.6%	52.7%	0.60	0.24
Norm, dichotomous (OR)	14.9%	16.8%	0.82	0.21	48.1%	57.8%	0.57	0.26
Anti-tobacco industry (b)	3.74 (0.96)	3.62 (0.90)	0.14+	0.08	3.43 (0.98)	3.19 (0.86)	0.20	0.15

Note. ** $p < .01$, * $p < .05$, + $p < .10$. All analyses were weighted. Coeff. = Coefficient; SE = Standard Error. For continuous variables, mean and standard deviations (in parentheses) are displayed for each condition.

Ever-smokers are those who have reported smoking a cigarette (even one puff) in their entire lifetime.

Control variables include race, age, gender and parents' education for all participants; previous experiences with positive or negative effects of cigarette smoking among ever-smokers.

¹When models with an interaction term and common control variables were fitted, the interaction effect between smoking status and condition emerged as significant on perceived risks ($b = 15.13$, $SE = 7.70$, $p = .05$) and marginally significant on perceived benefits ($b = -10.99$, $SE = 6.55$, $p = .09$) of smoking. Other outcome variables did not yield significant interaction effects (all $ps > .20$).

Table 2. Effect of e-cigarette ad exposure on non-current ($n = 99$) and current smokers' ($n = 31$) perceptions of and susceptibility to smoking cigarettes.

	Interaction effects (Smoking status x Condition)		Non-current smokers				Current smokers			
	Coeff.	SE	E-cig condition ($n = 50$)		Control condition ($n = 49$)		E-cig condition ($n = 11$)		Control condition ($n = 20$)	
									Coeff.	SE
Perceived risk (b)	-8.89	14.90	59.33 (31.81)		53.15 (34.67)		31.02 (27.70)		32.72 (26.62)	-4.03 13.03
Perceived benefit (b)	-37.27*	14.28	22.93 (25.70)		26.41 (31.38)		19.15 (30.53)		42.35 (29.98)	-37.59** 12.91
Susceptibility (OR)	0.56	0.75	34.8%		38.8%		80.8%		79.8%	0.50 0.60
Norm, dichotomous (OR)	1.11	1.38	40.4%		44.4%		85.7%		82.6%	0.91 1.00
Anti-tobacco industry (b)	0.39	0.33	3.45 (1.08)		3.32 (0.82)		3.34 (0.62)		2.95 (0.95)	0.43+ 0.26
Intention to quit smoking ^a										
General intention to quit (OR)	5.32	9.32	78.7%		72.8%		69.7%		38.5%	2.05+ 1.18
Intention to quit next month (OR)	1.56	2.48	84.5%		87.2%		46.7%		30.3%	1.49 1.13
Smoking in 5 years (b)	0.83	14.80	10.16 (20.69)		2.19 (4.41)		38.89 (36.09)		36.37 (29.73)	0.01 12.29

Note. ** $p < .01$, * $p < .05$, + $p < .10$. All analyses were weighted. Coeff. = Coefficient; SE = Standard Error.

For continuous variables, mean and standard deviations (in parentheses) are displayed for each condition. Control variables include race, age, gender and parents' education, previous experiences with positive or negative effects of cigarette smoking.

^aIntention to quit (general and next month) and chance of smoking in 5 years were measured only among those who reported that they have smoked 6 or more cigarettes in lifetime ($n = 65$).

Table 3. Product confusion among never- and ever-smokers in the e-cigarette condition.

		Never-smokers			Ever-smokers			
		(n = 352)			(n = 61)			
Which of the following products were advertised in the ads?		Cigarette	No	Yes	Total	No	Yes	Total
E-cig	No		6	10	16	2	0	2
			1.7%	2.8%	4.6%	3.3%	0.0%	3.3%
	Yes		316	20	336	55	4	59
			89.8%	5.7%	95.5%	90.2%	6.6%	96.7%
	Total		322	30	352	57	4	61
			91.5%	8.5%	100.0%	93.4%	6.6%	100.0%

Note. Unweighted ns and proportions displayed. Cells in bold typeface indicate product confusion (i.e. thinking cigarettes were promoted and/or e-cigarettes were NOT promoted in the advertisements they watched).

e-cigarettes. The overall proportion of product confusion was not significantly different between never- and ever-smokers. Among never-smokers, 8.5% thought that e-cigarette advertisements promoted cigarettes, and 4.6% failed to notice that these advertisements were for e-cigarettes. This proportion was slightly higher than confusion among ever-smokers (6.6% and 3.3%), although the differences were not statistically significant ($\chi^2s = .27$ and $.20$, all $ps > .60$). However, a few respondents ($n = 10$), who were all never-smokers, reported "complete confusion"—that the advertisements were promoting cigarettes and not promoting e-cigarettes.

Discussion

Exposure to e-cigarette advertisements can affect adolescents' perceptions of cigarettes, and the effects differ by smoking status. After seeing e-cigarette advertisements, never-smokers reported significantly lower perceived risks of smoking cigarettes than those who saw the control advertisements.

One possible explanation for the finding that never-smoker adolescents reported lower risks of smoking after seeing "ciga-like" advertisements could be that in many advertisements, e-cigarettes were depicted as a solution to problems

encountered when smoking cigarettes. Many advertisements, especially the ones promoting "cigalikes," depict e-cigarettes as being similar to cigarettes (e.g., look, flavor) but also as a solution for cigarettes' shortcomings. Many e-cigarette advertisements used in the current study argued that the cigarette-related problems, such as bad odors, less attractiveness, and needing to step outside to smoke a cigarette, could be solved by e-cigarettes. This is consistent with other e-cigarette advertisement content analyses (Padon et al., 2017; Richardson, Ganz, & Vallone, 2014), which found that many "cigalikes" advertisements used competitive or comparative appeals. While the advertisements included messages about cigarettes' problems, proposing e-cigarettes as a solution may have decreased perceived risks of smoking. It is possible that adolescents, especially those who have never smoked cigarettes and thus have no direct experience with the addictiveness of cigarettes, interpreted e-cigarette advertisements as portraying an easy solution to cigarette-related problems and thus believed it was less risky to smoke cigarettes (Bolton, Cohen, & Bloom, 2006).

When asked what product they thought was promoted in the advertisements they saw, never- and ever-smokers did not show a significant difference in their overall perception of

whether advertisements were for cigarettes or e-cigarettes. However, only never-smokers showed complete confusion about the promoted products, reporting that the advertisements promoted cigarettes and not e-cigarettes, albeit in a small number ($n = 10$). This suggests that one possible reason why never-smokers might have had more favorable beliefs of cigarettes after viewing e-cigarette advertisements could be if they erroneously attributed the positive arguments presented in the advertisements to cigarettes rather than e-cigarettes. However, since the number of respondents who reported product confusion was quite low and not significantly different between ever- and never-smokers, more research is required to further explore this idea.

Unlike never-smokers, ever-smokers did not show significant differences across the two conditions. However, among ever-smokers, differentiating between current and non-current smokers showed diverging patterns. For non-current smokers, none of the dependent variables yielded significant differences between the conditions. On the other hand, current smokers showed significantly lower perceived benefits of smoking when exposed to the e-cigarette advertisements compared to those who saw the control advertisements. Current smokers are more likely to have experienced the shortcomings of smoking that are mentioned in the e-cigarette advertisements, such as bad odors. It is possible that the personal experience contributed to the observed results that current smokers more frequently agreed with the advertisements' arguments against cigarette smoking.

Perceived norms about smoking or anti-tobacco industry sentiment did not yield significant effects of exposure to e-cigarette advertisements regardless of smoking status. Since the models portrayed in the advertisements were all adults, and the current study specifically measured smoking norms among "teens of my age", this might explain why the advertisements did not result in significant differences in adolescents' perceived peer group norms. Also, while many advertisements discussed the negative consequences of cigarettes, they did not necessarily address the tobacco industry's marketing tactics. Unlike the "cigalike" products, which include several brands owned by tobacco companies (e.g. Blu), second-generation e-cigarette advertisements or promotions in vape shops tend to focus more on their independence from "big tobacco" (Allem, Unger, Garcia, Baezconde-Garbanati, & Sussman, 2015). Future studies may examine whether exposure to advertisements containing anti-industry themes affects the audience's anti-industry sentiment.

These results suggest that among more experienced cigarette smokers (e.g., current smokers), viewing e-cigarette advertisements might decrease propensity to smoke cigarettes via reduction in perceived benefits of smoking. However, it should be noted that the vast majority of adolescents are never-smokers (~80%), who are subject to potential detrimental effects of e-cigarette advertising exposure (i.e. reduced perceived risks of smoking cigarettes). Only a small fraction of adolescents are current smokers (~4% in the current dataset) who might report lower perceived benefits of smoking after viewing e-cigarette advertisements. It should also be noted that the number of current smokers in this study is too small to reach a conclusive interpretation.

Implications for regulation of e-cigarette advertisements

The current study showed that seeing e-cigarette advertisements can affect adolescents' perceptions of smoking cigarettes, and the effects differ according to smoking experience. The results suggest that never-smokers, who make up the majority of the adolescent population, may be subject to some deleterious effects from e-cigarette advertising, as those who saw the "cigalike" advertisements perceived smoking cigarettes as less risky than those who saw control messages. While viewing e-cigarette advertisements did not directly affect adolescent never-smokers' smoking susceptibility (also see Petrescu et al., 2016), the significant decrease in their perceived risks of smoking raises concern. Perceived risks of smoking is a predictor of future smoking initiation both in empiric studies (Song et al., 2009), and proposed by behavioral theories, such as the Theory of Planned Behavior (Fishbein & Ajzen, 2010) and the Health Belief Model (Strecher & Rosenstock, 1997).

Cigarette marketing is regulated, including restrictions on TV, outdoor advertising, and brand-sponsored events. However, current federal legislation lacks provisions regarding the marketing of e-cigarettes. The FDA's deeming regulation (Food and Drug Administration, 2016) categorized e-cigarette containing nicotine as a tobacco product, but its ability to regulate e-cigarette advertising is quite limited (Tobacco Control Legal Consortium, 2016). This study suggests advertisements promoting "cigalike" products that resemble cigarettes might result in most adolescents having more favorable perceptions of cigarettes. Regulating e-cigarette advertisements to minimize non-smoking adolescents' exposure might be able to prevent this deleterious effect on adolescent never-smokers. About 70% of middle and high school students in the US reported some exposure to e-cigarette advertisements over a variety of channels in 2014, including exposure through multiple sources (Singh et al., 2016). While many existing studies on e-cigarette advertisement exposure emphasize its association with adolescents' e-cigarette usage (e.g., Farrelly et al., 2015), the current study adds an additional concern that e-cigarette advertising may also reduce adolescents' perceived risk of smoking cigarettes, undermining tobacco control efforts. Regulation of e-cigarette marketing similar to the restrictions on cigarettes, such as banning advertising on TV or restricting advertising in magazines and other channels with large youth exposure should be considered.

Limitations and future studies

While the current analyses found differential effects of seeing e-cigarette advertisements depending on previous smoking experience, the number of ever-smokers ($n = 130$) and current smokers (smoking within the past 30 days; $n = 31$) is quite small, and significantly different in sample size per condition than the never-smokers. With sample size of 130, the minimum detectable effect size is Cohen's $d = .50$ (i.e., a medium effect; Cohen, 1988); with 31 current smokers, only large effects ($d > 1.00$) are detectable with .80 power.

Therefore, it should be noted that many of the tests for ever-smokers, and especially for current smokers, were underpowered. Another minor limitation was the definition of current smokers was atypical, as past 30-day smoking was asked only of those reporting having smoked six or more cigarettes, and may have resulted in a slight underestimate of current smoking. The differences in sample size in the current dataset is due to the nationally representative nature of the sample. It reflects the current smoking rates among the US 8-12th graders in 2015–21.1% reported lifetime ever use of cigarette, and 7.0% reported smoking cigarettes in the past 30 days (Johnston et al., 2016). To better understand the exact nature of differences between never- and ever-smokers, blocking or over-sampling of ever-smokers will be necessary to allow a more equivalent comparison between the two groups.

Although a significant effect was found on adolescent never-smokers' perceived risks of smoking cigarettes after seeing e-cigarette advertisements (vs. control advertisements), the current study did not measure longer-term cognitive effects or behavioral changes. While the risk perception measure has been validated to be predictive of smoking behavior (Song et al., 2009) and is therefore a good proxy variable, future studies utilizing a longitudinal design would better address links between exposure to e-cigarette advertisements and adolescents' smoking behavior.

Another limitation of the current study design is that it cannot address why e-cigarette advertisement exposure affects never-smokers' perceived risks of smoking, and what elements of the marketing messages might be responsible. To better inform advertising regulations, it would be important to determine which message features are driving this effect. Previous research has suggested certain message features, such as smoking/vaping cues, can be responsible for e-cigarette advertisements evoking smoking urges among current smokers (King et al., 2016; Maloney & Cappella, 2016). Future studies could evaluate whether advertising featuring comparisons between e-cigarettes and cigarettes might make non-smoking adolescents perceive cigarettes as less risky because they present e-cigarettes as an effective and easy solution to the problems caused by cigarettes.

The current study only used e-cigarette advertisements for “cigalikes,” which resemble cigarettes. It is possible that showing dissimilar e-cigarette products such as the larger “mods” and “tanks”, which are gaining more popularity among young adults, may yield different results. Whether it is showing the vaping behavior (e.g. bringing the device toward one's mouth, exhaling smoke-like vapors) or the “cigalike” appearance of the product that drives the observed effects is an empirical question. It is possible that either showing a behavior that resembles smoking or showing a product that resembles a cigarette is responsible for the observed effect, or that there may be additive effects of both of these features.

Conclusion

Many adolescents in the US report that they have been exposed to e-cigarette marketing messages through a variety of channels. E-cigarette advertisements may influence

adolescents' initiation of e-cigarette use. This study adds that exposure to e-cigarette advertisements can also affect adolescents' risk perception of smoking cigarettes, which is a significant predictor of smoking initiation (Roditis et al., 2016; Song et al., 2009). In this study, adolescent never-smokers who were exposed to e-cigarette advertisements reported significantly lower perceived risks of smoking cigarettes when compared to those exposed to control advertisements. Regulating the channels and content of e-cigarette advertisements should be considered to minimize adolescents' exposure and their potential harmful effects on never-smokers.

Disclosure of potential conflicts of interest

The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Cancer Institute and the Food and Drug Administration.

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