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Unintended Consequences? Testing the Effects of Adolescent-Targeted Anti-Vaping Media upon Adult Smokers

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by

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ABSTRACT

A great deal of controversy surrounds e-cigarettes, with some arguing that protection of youth and non-users is paramount and others maintaining that these products are beneficial from a harm reduction perspective for use by adult smokers for switching from combustible cigarettes and for smoking cessation. Opponents of e-cigarettes have allocated tremendous funds toward advertising campaigns aimed at youth deterrence; however, to date, the effects of these ads upon adult smokers have yet to be examined. The current study used a between-subjects experimental design to investigate the effects of an FDA-distributed youth-targeted anti-vaping PSA, "Vaping is an Epidemic," upon adult smokers who view it. The PSA shows teens vaping and, upon inhalation, parasite-like organisms invading their organs and skin. We hypothesized that the FDA PSA – compared to a matched control video that was similar in parasitic activity but absent of e-cigarette content – would increase negative health-related expectancies, and because the PSA conveys that e-cigarettes are very powerful, it would also increase expectancies concerning potency. We also hypothesized that the anti-vaping PSA would impact other general expectancies of e-cigarettes and additional variables reflecting motivation to quit smoking (i.e., switch to vaping). We found that viewing the PSA produced increases in both health harm and potency expectancies ($ps < .01$), which were correlated ($p < .001$). We also found significant group differences ($ps < .05$) such that viewing the PSA resulted in overall more negative expectancies about e-cigarettes and all other variables related to harm reduction usage. Those who viewed the PSA rated e-cigarettes as more harmful and less effective compared to those who saw the control video. Viewing the PSA also resulted in lower switching motivation

(i.e., switching from combustible to e-cigarettes). Overall, our findings indicated that adult smokers who viewed the PSA were less likely to consider e-cigarettes for smoking cessation, thus reducing access to a cessation aid with growing empirical support. Findings suggest that youth-oriented anti-vaping messages may have unintended public health consequences upon adult audiences.

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INTRODUCTION

Combustible cigarette smoking is the leading cause of preventable death worldwide (USDHHS, 2014). In the United States, approximately 14% of adults (age 18 or older) are smokers; however, 68% of these smokers report wanting to quit (Wang et al., 2018). Nonetheless, annual cessation success rates for adult smokers remain low — at approximately 7% (CDC, 2017). Results from the National Health Interview Survey, an annual, nationally representative, in-person survey of the noninstitutionalized U.S. civilian population, showed that among smokers who were trying to quit, the use of cessation counseling and/or pharmacotherapy (both nicotine replacement therapy and medications for cessation) increased during 2000–2005 from 21.9% to 29.1%. Findings from the most recent analyses showed that this rate of use of counseling and/or pharmacotherapy remained generally unchanged from 2005, and has plateaued entirely from 2010-2015 (CDC, 2017). Overlapping with this plateau, rates of current electronic cigarette (e-cigarette) use among all adults rose over six-fold from 2010 (0.3-1%) to 2013 (2.6-6.8%) (King, Patel, Nguyen, & Dube, 2014; McMillen, Gottlieb, Shaefer, Winickoff, & Klein, 2014). Furthermore, the prevalence of current e-cigarette use among adult former smokers rose significantly from 2014-2016 (3.8-4.8%), whereas there was a significant reduction in e-cigarette use among adult current smokers during this time frame (15.9-10.8%) (Bao et al., 2018). This pattern may suggest that e-cigarette use is the means by which a proportion of adults' transition from current to former smokers. Furthermore, population-based data showed that the dramatic increase in e-cigarette use among adult smokers was associated with a statistically significant increase in the national smoking cessation rate (Zhu et al., 2017).

Since the introduction of e-cigarettes and their increasing prevalence, there have been conflicting viewpoints concerning the impact of these products on both smokers and nonsmokers, with a strong emphasis on adolescents' risk. Potential benefits and harms of e-cigarettes have been suggested, such as the likely harm-reduction benefits for those who are unable or unwilling to quit smoking using existing U.S. Food and Drug Administration (FDA)-approved cessation methods and/or counseling, along with concerns, such that these products may pose a threat of nicotine dependence among those who are not otherwise susceptible (e.g., Fagerström, Etter, & Unger, 2015). These views have become increasingly polarized as e-cigarettes have become both more widespread and substantially more effective at nicotine delivery and consequent higher dosing (Balfour et al., 2021).

E-Cigarettes

E-cigarettes, which are portable devices that use a battery-powered heating element to aerosolize liquid for inhalation, come in a variety of types (Brown & Cheng, 2014; Ebbert, Agunwamba, & Rutten, 2015). Earlier first-generation e-cigarettes are disposable or re-chargeable and tend to resemble cigarettes in size and shape. Later second- and third-generation models vary in appearance due to customizable features; many have no resemblance to cigarettes whatsoever. These later versions are both rechargeable and refillable, such that they can be filled with the user's preferred solution per nicotine content (or lack thereof) and flavor type. Despite the ability to customize some models, in general, first- through third-generation e-cigarettes have been shown to be less effective than combustible cigarettes at nicotine delivery, particularly among novice users (Norton, June, & O'Connor, 2014; Trtchounian, Williams, & Talbot, 2010). However, in a review, Evans and Hoffman (2014) found that e-cigarette use was generally

associated with decreased cravings for cigarettes, despite reported deficiencies in nicotine delivery.

Juul. In 2015, the e-cigarette landscape drastically changed with the launch of Juul (Huang et al., 2019; Willett et al., 2019), and similar vaping devices. Juul is a closed system "pod mod" device charged via USB. Juul is marketed as an alternative to combustible cigarettes and existing e-cigarette devices. Juul works similarly to other e-cigarette devices but has several features that make it distinctive and more effective at nicotine delivery. First, the Juul device resembles a USB drive, making it both sleek and easily concealable (Allem, Dharmapuri, Unger, & Cruz, 2018). Second, in terms of nicotine delivery, the liquid in a Juul "pod" (disposable pre-filled cartridge that contains 0.7 ml solution with 5% nicotine by weight) contains protonated nicotine ("nicotine salt" vs. freebase nicotine typically used in e-cigarettes) that is absorbed at almost the same rate as nicotine from a combustible cigarette (O'Connell et al., 2019). Moreover, the aerosol from nicotine salt is reported to produce less subjective irritation in the chest and lungs, compared to combustible cigarettes (Krishnan-Sarin et al., 2019). Lastly, Juul has more than twice the nicotine concentration as the majority of e-cigarettes. One Juul pod has approximately the same amount of nicotine as one pack of cigarettes (from http://www.Juulvapor. com).

Reasons for e-cigarette use. Juul has transformed into the largest retail e-cigarette brand in the U.S., thereby elevating sales of the entire e-cigarette category (Huang et al., 2019). Though studies and surveys have not yet elucidated the likely multifactorial reasons for this fast growth specific to Juul, past research has shown many reasons for the initiation and maintenance of e-cigarette use that likely generalize to Juul. Reported reasons for e-cigarette use include: that they are an alternative to combustible cigarettes (Dawkins, Turner, Roberts, & Soar, 2013); e-

cigarettes pose reduced health risks compared to cigarettes (Majeed et al., 2017); e-cigarettes cost less than cigarettes (Patel et al., 2016); and e-cigarettes are more convenient because they can be used in non-smoking areas (Sears et al., 2017). Furthermore, in a recent study conducted with adult smokers, among those who had used Juul, the most frequently endorsed reason for use was, "I was trying to quit smoking cigarettes" (Patel et al., 2019), Notably, independent of the reported reason for the initiation of use, many e-cigarette users report quitting smoking or substantially reducing tobacco use after e-cigarette initiation (Caponnetto et al., 2014; Dawkins et al., 2013; Siegel, Tanwar, & Wood, 2011).

E-cigarettes for Smoking Cessation

In 2019, Juul launched the "Make the Switch" advertising campaign, which features adults sharing reasons why they made the switch from cigarettes (or other tobacco products) to Juul. The majority of the advertising budget was allocated to television commercials. Although the FDA bans e-cigarette companies from purporting that the product is less harmful than cigarettes or that they are smoking cessation products, Juul conveys an implicit message of cessation by stating that it is "designed with smokers in mind" and is "for adult smokers seeking a satisfying alternative to cigarettes" (from http://www.Juulvapor. com).

Although media campaigns implicitly suggest that e-cigarettes are aimed at smoking cessation, studies directly investigating e-cigarettes for this purpose are limited due to regulatory issues and limited long-term safety data. Almost all published studies utilized first- or second-generation devices. Randomized controlled trials conducted with e-cigarettes have shown that e-cigarettes were as effective as nicotine patches (Bullen et al., 2013); that the 1-year abstinence rate was nearly double with e-cigarettes compared to NRT (Hajek et al., 2019); that e-cigarettes plus NRT were more effective than NRT alone (Walker et al., 2020); that participants with no

intention of quitting smoking showed significant smoking reductions following provision of an e-cigarette (Caponnetto et al., 2014; Polosa et al., 2014); and that smokers who were instructed and incentivized for complete substitution of cigarettes with e-cigarettes showed significant reductions in smoking and a nearly double 8-week abstinence rate compared to NRT (Hatsukami et al., 2019). Additionally, a cohort study found that former smokers who were current vapers had over three times the smoking abstinence rate at one year follow-up compared to smokers and dual users who comprised the remainder of the sample (Manzoli et al., 2015). These findings suggest that e-cigarettes likely are effective for maintaining smoking abstinence and for smoking reduction and/or cessation. (Hartmann-Boyce et al., 2016; McRobbie, Bullen, Hartmann-Boyce, & Hajek, 2014).

Notably, almost no studies have been conducted with devices that utilize protonated nicotine, "nicotine salt." One small randomized cross-over study (O'Connell et al., 2019) found that the highest level of salt tested (40 mg) in a closed-system pod device showed a pharmacokinetic profile most similar to a combustible cigarette. Reported subjective effects were most favorable following smoking a combustible cigarette followed by vaping the 40 mg salt solution. The authors conclude that the rapid absorption with a higher plasma concentration achieved with nicotine salt likely produces greater reductions in desire to smoke; this is thought to be important for facilitation of both smokers' switching to e-cigarettes and for relapse prevention.

Reduced harmfulness of e-cigarettes. In addition to a growing literature suggesting that e-cigarettes may be effective for smoking cessation (Hajek et al., 2015, 2019; Hartmann-Boyce et al., 2016; McNeill et al., 2018; McRobbie et al., 2014), there is also considerable evidence suggesting that e-cigarettes are far less harmful than combustible cigarettes (e.g., Abrams et al,

2018; Brandon et al., 2015). According to Public Health England and the Royal College of physicians, e-cigarettes are at least 95% less harmful than traditional cigarettes (McNeill et al., 2015; Royal College of Physicians, 2016). In 2018, Public Health England reaffirmed their position that e-cigarettes pose only a fraction of harms compared to smoking; thus, smokers should be encouraged to switch to e-cigarettes (McNeill et al., 2018). Additionally, an expert committee of the National Academies of Sciences, Engineering, and Medicine (2018) found conclusive evidence that completely switching to e-cigarettes reduces users' exposure to numerous toxicants and carcinogens found in combustible cigarettes. Furthermore, they found substantial evidence that completely switching to e-cigarettes results in reduced adverse health consequences in several organ systems. However, opponents to the proposed helpfulness and harm-reduction potential of e-cigarettes argue, among other topics, that these devices pose a risk to youth and never-smokers' susceptibility to smoking (Berry et al., 2019; Soneji et al., 2018; Warner & Mendez, 2019). Additionally, Eissenberg et al. (2020) argued against the claim that e-cigarettes are 95% safer than cigarettes by suggesting that current devices and liquids have changed in ways that could induce more harm than previously reported.

Effects of E-cigarette Advertising on Smoking Cessation

A central question of the harm reduction versus adolescent/never-smokers risk debate concerns whether e-cigarette advertising impacts smoking cessation (Dave et al., 2019). Recent trends in U.S. smoking rates suggest that increased use of e-cigarettes may be contributing to reductions in adult smoking; the rate dropped from 20.9% in 2005 to 15.1% in 2015. Furthermore, during the 2011-2015 period during which data on e-cigarette use are available, adult smoking reduced by 4.23 percentage points (Dave et al., 2019). Simultaneous with the surge in e-cigarette use from 2010 (0.3-1%) to 2013 (2.6-6.8%) (King, Patel, Nguyen, & Dube,

2014; McMillen, Gottlieb, Shaefer, Winickoff, & Klein, 2014), there was a substantial increase in e-cigarette advertising expenditures from $3.6M in 2010 to $112M in 2014, with the majority of spending allocated to magazine and television ads with national reach (Kim, Arnold, & Makarenko, 2014; Kornfield et al., 2015). As evidence of the effectiveness of e-cigarette advertising having national reach, in a 2013 sample of Florida residents, approximately 48% of adults had been exposed to e-cigarette marketing (Kim et al., 2014).

Dave et al. (2019) assert that e-cigarette television advertising plays a causal role in adult smoking cessation. They conducted a series of mutinominal logit models utilizing data from the Simmons National Consumer Survey matched to e-cigarette advertising aired on national and local broadcast and cable stations. The models, which controlled for targeted ads, examined the probabilities of quitting, failing to quit, and attempting to quit. Their sample (N=8291) mean quit rate was 9%, which is above the national average of 7%. Their most comprehensive model showed that exposure to one additional television advertisement (above the mean of three advertisements) raised the quit probability by 1%, relative to the sample mean quit rate. Due to the linearity of the models, exposure to five additional ads, for example, would increase the number of quitters by 5%. Those who quit smoking were exposed to more e-cigarette television advertisements (on average, 4.5) than those who failed a quit attempt (3.7 advertisements) or those who did not attempt to quit (2.9 advertisements). Furthermore, television advertising for e-cigarettes was associated with increases in cessation attempts using each of four methods investigated: e-cigarettes only, NRT only, cold turkey, and other (a mixed methods quit attempt). Those who attempted to quit with the use of e-cigarettes only accounted for the second highest percentage (24.1%), outnumbered only by “other” (i.e., mixed methods approach, which was 40%). Furthermore, television advertising had no statistically significant impact on the failure

rate; however, exposure to an additional television advertisement raised the quit attempt probability by 0.07 marginal percentage points. Dave et al. conclude that a policy banning television advertising of e-cigarettes (to take effect in August, 2022) would reduce the number of smokers who quit by 3% (105,000 individuals); whereas, if the FDA were not to enforce a forthcoming ban on e-cigarette advertising, the number of smokers who quit could increase by 10% (350,000 individuals). These percentages were calculated based on data from 2015; hence, the percentages could be higher at present.

E-cigarette advertising content. The content of e-cigarette advertisements tends to include comparative claims regarding combustible cigarettes, such as themes that implicitly convey that e-cigarettes are a healthier or "smarter" alternative to cigarettes or could be used as a cessation aide (Haardörfer et al., 2017; Payne et al., 2016; Banerjee et al., 2015). Current FDA regulations do not permit ads to explicitly state that the products can be used for smoking cessation or are less harmful than traditional cigarettes; however, Kim et al. (2015) found that 75% of a sample of adult smokers reported that viewing a television ad for e-cigarettes "made me think about quitting smoking." Similar to the majority of advertisements for e-cigarettes, the ad viewed by their sample (http://www.youtube.com/watch?v=tHPU2gR_RiI) for blu e-cigarettes conveyed several messages about the superiority of e-cigarettes to traditional cigarettes, such as e-cigarettes are more convenient/can be used anywhere (and thus avoid smoking restrictions), come in a variety of flavors, are available in different nicotine strengths, have no odor or ash, produce vapor (not smoke), cost less, and are a "smarter alternative to cigarettes."

Expectancies

Although Kim et al. (2015) did not propose reasons why the advertisement caused such a high proportion of viewers to report that it made them think about quitting smoking, the effect could be mediated by cognitive expectancies. Drug-related expectancies are often considered within the framework of social learning theories (Bandura, 1977) that suggest individuals hold both "self-efficacy expectancies" and "outcome expectancies" about their behavior and its consequences (Brandon, Herzog, Irvin, & Gwaltney, 2004; Brandon, Juliano, & Copeland, 1999). Self-efficacy expectancies incorporate thoughts regarding the ability to accomplish a behavior, such as quitting smoking.

Outcome expectancies refer to the approximated consequences occasioned by a behavior; in this case, e-cigarette use. Drug outcome expectancies refer to beliefs about the results of substance use, and they have been shown to reliably predict behavior (e.g., Brandon, Juliano, & Copeland, 1999). Outcome expectancies have received more attention in substance use research, particularly concerning alcohol use, regarding the role of expectancies in the initiation, maintenance, and cessation of substance use (Goldman, 1999; Goldman, Brown, & Christiansen, 1987; Goldman, Del Boca, & Darkes, 1999). Outcome expectancies are essential to cognitive models explaining motivational antecedents of substance use behavior (Abrams & Niaura, 1987; Pokhrel et al., 2014; Brandon, Juliano & Copeland, 1999). Prior to the initiation of substance use, outcome expectances are thought to develop via observation, including through media (Leventhal & Schmitz, 2006).

Within the alcohol use literature, outcome expectancies have been studied since the 1970s via balanced-placebo experiments that have shown that many behavioral effects of alcohol – generally attributed to pharmacological effects – are actually due to outcome expectancies

(Hull & Bond, 1986; Marlatt, Demming, & Reid, 1973). Within a broader research context of the "placebo effect," reviews have concluded that the concepts of expectancy and placebo could be considered to be interchangeable (Benedetti, Carlino, & Pollo, 2011). Additionally, expectancies, as measured by psychometric scales, have been shown to predict subsequent drinking behavior, even in children and adolescents who had never directly experienced alcohol (Christiansen, Goldman, & Inn, 1982; Christiansen et al., 1989; Colder et al., 2014; Jester et al., 2014). Furthermore, experiments utilizing random assignment showed that expectancies can be malleable, with resultant effects on drinking quantities; thus, outcome expectancies also represent behavioral-control processes (Darkes & Goldman, 1993, 1998; Scott-Sheldon et al., 2012). In sum, within a larger explanatory framework, outcome expectancies can be viewed as a future-oriented aspect of substance use motivation (e.g., Benitez & Goldman, 2019; Goldman, 2002).

Smoking expectancies. Outcome expectancies pertaining to combustible cigarette smoking have been extensively studied. Four types of smoking expectancy constructs have been previously validated in a college student sample: negative consequences (e.g., health risks), positive reinforcement/sensory satisfaction (e.g., smoking helps me relax), negative reinforcement/negative affect reduction (e.g., cigarettes help me deal with depression), and appetite/weight control (e.g., smoking helps to control my appetite) (Smoking Consequences Questionnaire [SCQ]; Brandon & Baker, 1991). A follow-up study conducted with nicotine-dependent adult smokers revealed a greater number of factors (10) than those four factors found with college students; this finding suggests that expectancies become more specific with smoking experience (SCQ-A; Copeland, Quinn, & Brandon, 1995). Similar patterns of

expectancy differentiation based on age and experience have been found with respect to alcohol (Brown, Christiansen, & Goldman 1987; Rohsenow, 1983).

E-cigarette expectancies. Pokrel et al. (2014) assessed whether these types of smoking outcome expectancies generalize to e-cigarettes in a college student sample. They found that being a current smoker was positively associated with positive e-cigarette expectancies, such that current smokers were more likely to endorse the following positive e-cigarette expectancies: social enhancement, affect regulation, and positive sensory expectancies. Additionally, being a current smoker was negatively associated with the following negative e-cigarette expectancies: negative health consequences, negative appearance, negative sensory experience, and addiction concern. Additionally, higher positive expectancies were associated with greater likelihood of past 30-day use of e-cigarettes. Higher negative expectancies, with the exception of addiction concern, were associated with lower likelihood of past 30-day e-cigarette use. Among those who had never used e-cigarettes, positive expectancies were significantly associated with higher intentions to use e-cigarettes in the future. To date, e-cigarette expectancy studies generally have been limited to college-aged samples (e.g., Harrell et al., 2019; Pokhrel et al, 2015; Pokhrel et al., 2018) and studies of adults based on survey findings (Harrell et al., 2015a, 2015b; Piñeiro et al., 2016).

To investigate e-cigarette expectancies on smoking and vaping urge reduction in adults, Palmer and Brandon (2018) conducted a balanced-placebo study. They crossed instructional set (told nicotine/told non-nicotine) with drug dose (nicotine/non-nicotine) to test e-cigarette expectancies via the placebo effect (i.e., told nicotine/given non-nicotine). They found that, among dual users of combustible and e-cigarettes, there was a main effect of instructional set on reductions in craving to smoke cigarettes, with participants who were told that their e-cigarette

contained nicotine reporting greater craving reduction, independent of whether they received a nicotine or non-nicotine solution. With respect to reduced cravings for e-cigarettes, they found an interaction between drug dose and instructional set; as such, nicotine e-cigarettes reduced cravings more than non-nicotine e-cigarettes only among participants told to expect nicotine. This study lends support that cognitive expectancies contribute to the acute effects of e-cigarettes on craving in adults and that e-cigarettes likely have utility for smoking cessation.

Anti-Vaping Media

Although substantial support for the harm reduction potential of e-cigarettes and their use for effective smoking cessation have been discussed thus far, there are concerns about youth non-smokers' susceptibility to e-cigarette use (USDHHS, 2016; Gentzke et al., 2019), along with some data showing e-cigarette use among youth is associated with initiation and maintenance of cigarette smoking (Berry et al., 2019; Hartman-Boyce et al., 2016; National Academies of Science, Engineering, and Math, 2018). Given these concerns and the rapid rise of e-cigarette use, the FDA responded in 2018 with a $60M anti-vaping media campaign, "The Real Cost Youth E-Cigarette Prevention Campaign," geared toward combating what the FDA calls an "epidemic of youth vaping" (https://www.fda.gov/tobacco-products/public-health-education/real-cost-campaign). This ongoing campaign has launched a series of sensationalized advertisements (and other materials) using scare tactics in an attempt to dissuade youth from using e-cigarettes. This strategy is based on prior anti-smoking campaigns, such as "Tips from Former Smokers," that featured graphic imagery intended to scare teens into quitting smoking.

Potential unintended consequences of anti-vaping campaigns. Public health campaigns designed to scare youth away from vaping may have unintended consequences for adults who are exposed to these ads and other materials. Consequently, anti-vaping youth

campaigns could produce the opposite effects that Dave et al. (2019) and Kim et al. (2015) found with e-cigarette advertisements, previously shown to increase smoking cessation rates, attempts, and induce contemplation regarding cessation. These unintended consequences may occur via modification of adults' expectancies about e-cigarettes, and the generalization of those expectancies to other aspects of e-cigarettes, such as their potential for smoking cessation. On one hand, the negative information about e-cigarettes may lead to generalized negative expectancies about them, encompassing their efficacy for smoking cessation. It is also possible that the health warnings about e-cigarettes increase negative expectancies about the harms of e-cigarettes, which directly discourages their use for smoking cessation. (i.e., why switch if they are just as harmful as smoking?). These expectancies may suppress the desire to use e-cigarettes – and even the efficacy of them – as a smoking cessation aide; including use to cope with urges to smoke. On the other hand, the information about the dangers of e-cigarettes as conveyed in the PSA may lead to generalized expectancies about e-cigarette potency, including their potential efficacy for coping with urges and smoking cessation. As such, these expectancies may increase the desire to use, and the efficacy of, e-cigarettes. These two possibilities are not necessarily mutually exclusive. Both types of expectancies could occur, and possibly even cancel each other out at the end. Alternatively, one type of expectancy may be prepotent with respect to its effect upon smoking cessation.

The Present Study

To date, there have been no investigations to assess whether anti-vaping campaigns are even effective at deterring youth from using e-cigarettes. Critically, there also has been no research investigating unintended consequences of these advertisements upon adult smokers. The goal of the proposed study was to investigate the effects of an FDA-distributed anti-vaping PSA

aimed at youth upon adult smokers who view it. In particular, it examined if the PSA — compared to a neutral control video—produced changes in specific expectancies regarding (1) negative health harms of vaping and (2) potency of e-cigarettes. Additionally, it examined if the PSA altered general expectancies about (3) the efficacy of vaping for smoking cessation. We also assessed downstream dependent variables, including interest in using e-cigarettes to quit smoking (i.e., switching motivation).

Specific Aims and Hypotheses

Specific Aim 1. Evaluate the effects of an anti-vaping PSA on acute e-cigarette expectancies, as compared to a neutral, control video

Hypothesis 1.1 Negative media about e-cigarettes will increase negative health-related expectancies, compared to the control video.

Hypothesis 1.2. Because the advertisement conveys that e-cigarettes are very powerful, positive expectancies concerning the potency of e-cigarettes will increase, compared to the control video.

Specific Aim 2 . Evaluate whether the anti-vaping PSA produces changes in other expectancies relevant to harm reduction, compared to the control video.

Hypothesis 2.1. The anti-vaping PSA will impact other general expectancies of e-cigarettes. However, we are agnostic on whether the FDA PSA will produce generally more negative expectancies (i.e., generalizing from the predicted negative health expectancy change) or generally more positive expectancies (i.e., generalizing from the predicted potency expectancy change). Measured expectancies include affect regulation, physical sensations, weight control, taste, stimulation, and social impression.

Hypothesis 2.2. It is hypothesized that main effects of media type will impact other variables reflecting motivation to quit smoking (i.e., switch to vaping). These variables include harmfulness/safety and efficacy of e-cigarettes for cessation relative to other nicotine-containing products, satisfaction, craving reduction, and motivation to switch. We are once again agnostic upon the direction of the impact.

Secondary Aims

Secondary Aim 1 Exploration of participant characteristics as moderators

Participant characteristics, baseline expectancies about e-cigarettes, and smoking dependence will be further explored as moderator variables, as previous research and theory indicate that these factors may influence response to e-cigarette use. In particular, age will be tested as a moderator, given that younger participants have been shown in previous research to have higher positive e-cigarette expectancies than older participants (Dave et al., 2019); thus, age may moderate the effects of media type on specific and general expectancies, in addition to switching motivation. Furthermore, given that the FDA has targeted younger viewers with their advertisement campaign, younger participants may have been previously exposed to the PSA used in this study. As such, prior exposure, independent of age, will also be considered as a moderator variable. Lastly, participants' trait impulsivity, as assessed by measures of lack of premeditation and sensation seeking, previously shown to be significantly associated with risky behavior, such as substance use (Cyders et al., 2014), will also be tested as a moderator.

Secondary Aim 2. Expectancies as mediators of Specific Aim 2

Outcome expectancies relevant to negative health consequences and potency will be explored as mediators of the relation between media type and the dependent measure of

switching motivation. Outcome expectancies relevant to negative health consequences and potency will also be explored as mediators of the relation between media type and general expectancies such as affect regulation and weight control, as previous research and theory have found that smoking behavior is often maintained by these variables.

METHOD

Using a between-subjects design with adult smokers who had limited experience with e-cigarette use, all participants first watched a baseline neutral video. Participants were then randomized such that approximately one half of the sample viewed an FDA anti-vaping youth campaign PSA and the other half viewed a control video that was generally matched for duration, arousal, and health harm, but absent of e-cigarette content. Dependent measures of expectancies about e-cigarettes, harmfulness of e-cigarettes, effectiveness of e-cigarettes for smoking cessation, and likelihood of switching from combustible to e-cigarettes were obtained prior to and following the videos. The entire session was preprogrammed through Qualtrics and presented remotely via Amazon's MTurk platform. Analyses were then conducted to assess whether the FDA PSA modified specific and general expectancies about e-cigarettes.

Sample Size

Sample size analyses were conducted using G-power (Faul, Erdfelder, Lang, & Buchner, 2007). It was determined that a sample size of 128 (64 per group) would be required for the analysis to achieve power of .80 for detecting main effects among the 2 groups, with a medium sized effect (f = .25) and a two-tailed alpha level of .05. Due to concerns about participants' pass rate of programmed attention checks used to promote data quality (see below), it was determined that the sample size should be increased to 160 to account for any potential data quality issues.

Participants

Participant recruitment occurred via Amazon's Mechanical Turk (MTurk) platform such that individuals who likely met eligibility requirements were assessed by a preliminary screening survey presented on MTurk. Eligible participants were then contacted with an option to participate (as an MTurk paid "worker" for $7.50) in an online survey about Media and Smoking that would take approximately 30 min to complete. Interested participants (MTurk Workers) completed the remote session after meeting eligibility criteria: 1) At least 24 years old; 2) Current daily smoker (smoke at least 5 cigarettes per day); 3) Smoking history of at least 100 lifetime cigarettes; 4) Must have limited lifetime use of e-cigarettes (fewer than 30 occasions); 5) No past 30-day use of e-cigarettes; and 6) Not currently using a nicotine replacement product or other cessation product, such as a nicotine patch, nicotine gum, or pharmacotherapy. The lower age limit of the sample for the present study was set to ensure participants would be well above the age group targeted by the FDA for the campaign PSA. A study flow diagram detailing participant recruitment and randomization can be seen in Figure 1.

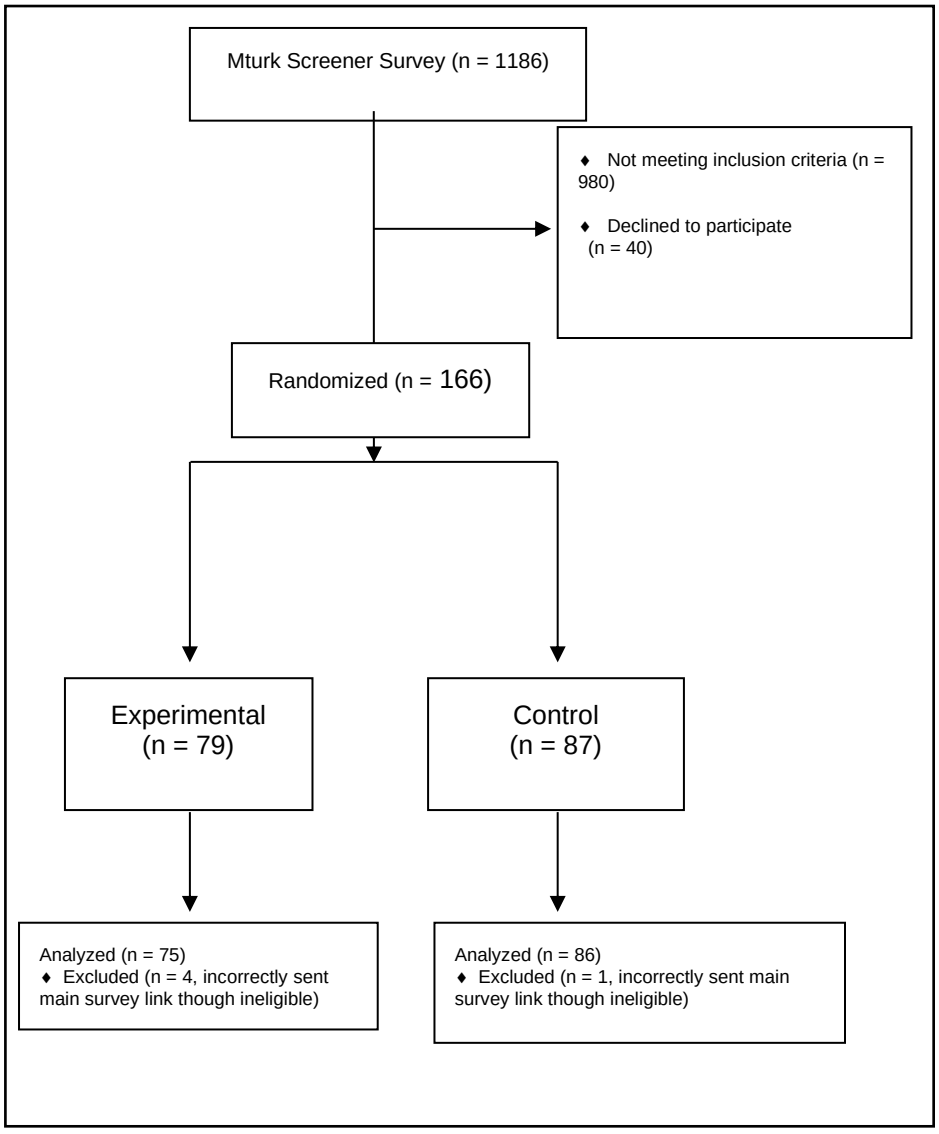

Figure 1. Study flow

Baseline Measures

Baseline and Demographic Questionnaire. Participants completed questionnaires capturing basic demographic information, smoking history, and vaping history. Questionnaires pertaining to the individual's expectancies about e-cigarettes and trait impulsivity were also administered.

Expectancies about E-cigarettes . Participants' expectancies about the effects of e-cigarette use were measured with a modified version of the Smoking Consequences Questionnaire-Adult (SCQ-A; Copeland, Brandon, & Quinn, 1995). On this scale, participants were asked to consider the likelihood of a particular consequence on a scale of "0– completely unlikely" to "9– completely likely." The original questionnaire was developed to assess expectancies about the reinforcing effects of cigarettes in adults, and the items load onto ten factors: Negative Affect Reduction, Stimulation/State Enhancement, Health Risk, Taste/Sensorimotor Manipulation, Social Facilitation, Weight Control, Craving/Addiction, Negative Physical Feelings, Boredom Reduction, and Negative Social Impression. In the present study, the highest loading item from each factor was included. All items were modified to ask about vaping e-cigarettes instead of smoking combustible cigarettes. Additionally, questions about satisfaction, stress reduction, and negative health consequences were added. Similar modified versions have been effectively utilized in previous research to assess expectancies of e-cigarette use in comparison to expectancies about cigarette smoking and NRT (Harrell et al., 2015a) and showed good internal consistency in the current study (coefficient $\alpha = 0.87$). Three newly developed items to assess potency were also added: E-cigarettes produce powerful effects; E-cigarettes can provide a strong dose of nicotine; Vaping produces powerful physical

sensations. The three potency items showed acceptable internal consistency (coefficient α = 0.66) and the three negative health harm items showed good internal consistency (coefficient α = 0.78) in the current study.

Smoking Dependence. Cigarette dependence was measured with the Fagerström Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991), which was included in the smoking history form. Scores on this measure range from 1-10, with higher scores indicating greater dependence (α = 0.66).

Motivation to Quit Smoking. Motivation to quit was measured with the Contemplation Ladder (Biener & Abrams, 1991), which was included in the smoking history form. The contemplation ladder is a single-choice, visual analogue scales that depicts a ladder, such that higher rungs represent greater levels of readiness to change.

Desire to Smoke. The desire to smoke was measured using a 3-item adaptation of the Questionnaire of Smoking Urges-Brief (QSU). The QSU is a 10-item questionnaire that measures desire and intentions to smoke based on relief of negative symptoms and anticipation of positive effects (Cox, Tiffany, & Christen, 2001; Tiffany & Drobes, 1991). However, there is evidence that an adaptation of this measure, which utilizes 3 items assessing urge to smoke, is equally valid in measuring desire to smoke (Kozlowski, Pillitteri, Sweeney, Whitfield, & Graham, 1996). In the present study, this shorter version was administered. For each item, participants were asked to report the degree to which they agree with a particular statement from "0 – strongly disagree" to "6 – strongly agree," for a score range of 0-18. The modified version in the present study showed excellent reliability (α = 0.91), as did the original version (α = 0.92).

Affect. The maintenance of cigarette smoking can be partially attributed to affect regulation (Brandon, 1994). Changes in affect in response to film clips as assessed by a single-item measure of pleasant versus unpleasant on a 9-point Likert scale was previously shown to be a valid and reliable measure of momentary state change (Gross & Levenson, 1995; Rottenberg, Ray, & Gross, 2007). Participants were asked to report, in the present moment, the degree to which they feel pleasant to unpleasant on nine-point Likert scale (0– "not at all" to 8– "extremely").

Trait Impulsivity/Proneness for Risky Behavior. Previous research has shown that trait impulsivity is significantly associated with the initiation and maintenance of risky behaviors, such as substance use (e.g., Cyders et al., 2014). Additionally, specifically concerning e-cigarettes, increased impulsivity has been shown to be significantly associated with initiation and use (e.g., Chivers et al., 2016; Grant et al., 2019). The UPPS-P Impulsive Behavior Scale, which utilized the Five Factor Model of personality to elucidate the multi-faceted nature of impulsivity, is comprised of 59 items that represent five factors (Lynam et al., 2006). Development and validation of a shorter 20-item form, the SUPPS-P, was shown to retain the original factor structure (Cyders et al., 2014). For the present study, eight items from the SUPPS-P that represent two of the factors: (1) premeditation ($\alpha = 0.81$) and (2) sensation seeking ($\alpha = 0.75$) were administered. These two scales were previously shown to have the strongest significant association with risky behavior (Cyders et al., 2014). Participants were asked to report the degree to which they agree with each item on a four-point Likert scale (1– "agree strongly" to 4– "disagree strongly").

Harmfulness of E-cigarettes. Participants were asked to rate the harmfulness of e-cigarettes relative to combustible cigarettes and NRT on a harm continuum represented as

pictures with corresponding identification labels that included: combustible cigarette, e-cigarette (First-, Second-generation products, and mod-pod device, such as Juul), pharmacotherapy (e.g., Chantix/varenicline), nicotine gum, and nicotine patch. Scores for each item ranged from "0 – not at all harmful" to "100 – extremely harmful."

Effectiveness of E-Cigarettes for Smoking Cessation. Participants were asked to rate how strongly they believe each of four products (e-cigarette [e.g., First-, Second-generation products, and mod-pod device, such as Juul), pharmacotherapy [e.g., Chantix/varenicline], nicotine gum, and nicotine patch is effective for smoking cessation. Scores for each item ranged from "0 – not at all effective" to "100 – extremely effective."

Likelihood of Switching from Cigarettes to E-cigarettes. After viewing the video to which they were assigned, participants were asked to estimate their likelihood to switch from cigarettes to e-cigarettes by rating this possibility from "0 – not at all likely" to "10 – extremely likely."

Aversiveness of Video. If a participant had previously seen the video, there could have been an effect of past exposure on affect elicitation, among other dependent variables. Additionally, in an attempt to assess whether the videos elicited approximately equal disgust between groups, a question was asked to rate the level. A questionnaire was administered to ask: 1) If the participant had ever seen the video previously; 2) If yes, approximately how many times; 3) Rate the level of disgust from "0–not at all disgusting" to "10–extremely disgusting."

APPARATUS

Videos

First, all participants viewed a 30-s baseline video both to orient the participant to the forthcoming task and to disguise the purpose of the experiment. The video was a general paper towel commercial that is neutral to pleasant in tone. The video depicts parents chatting in a kitchen, with the mother working on a computer. Next, a child dressed as a pirate enters and lightheartedly scares the father by sneaking up with a pirate's sword. Afterward, the father spills his drink, and it approaches the mother's computer. The paper towel is used to clean up the mess, and the commercial closes with the father playfully chasing his pirate-dressed daughter.

Participants were then randomly assigned to view one of two 30-s videos, either the FDA's Real Cost of Vaping Campaign video, "Vaping is an Epidemic" PSA (https://www.youtube.com/watch?v=zYuyS1Oq8gY), or a control non-e-cigarette video (an abridged portion of Animal Planet's Monsters Inside Me, Season 8, Episode 11, "My Lungs are Rotting;" https://www.youtube.com/watch?v=7quwKQD_exM) that was generally matched for duration, health harm, and disgust arousal.

Experimental video. The FDA PSA begins with the narrator stating that "an epidemic is spreading" while showing teenaged girls with skin lesions that look like raised parasites. This is followed by what is presumably the inside of the body with numerous parasites traveling throughout. The PSA then alternates between showing internal parasites and external bodily

lesions in the shape of these parasites on teenaged males' bodies. The narrator then explains that the epidemic releases chemicals throughout the bloodstream. Finally, the narrator explains that it is not a parasite causing these harmful health issues, but rather, they are due to vaping. The PSA closes with images of teenaged females and males using an e-cigarette that is similar to Juul. Thus, attributing the parasite-like damage to the e-cigarette.

Control video. The control video shows a woman in a hospital gown who has numerous skin lesions (similar in appearance to those in the FDA PSA), which the narrator states are due to an infestation of parasites. The video then shows images of the roundworm, toxocara, including showing the parasites within the human body as they move through the bloodstream. The parasites are abundant within the body. The narrator explains that the parasites are attacking the woman's organs, and the body responds by forming patches of the rash over her body. The video closes by stating that the woman likely contracted the parasite by eating tainted food.

PROCEDURE

The order of the procedure and measures administered at each timepoint is summarized in in the next page in Table 1.

MTurk Screening

Individuals, MTurk "workers," were screened for eligibility via Amazon's MTurk platform via completion of a 10-question survey, for which the worker was paid $0.15, independent of eligibility status. To combat the potential problem of individuals completing the eligibility survey multiple times, IP addresses were screened, such that only the first submission from an IP address was considered for eligibility and only unique Mturk worker IDs were eligible for payment. There were no duplicate IP address occurrences and all submissions were from unique worker IDs in the present study.

Qualified participants were then offered the opportunity to complete an approximately 30-min survey. Interested participants were then remotely directed via hyperlink to the Qualtrics session. TurkGate, which is a web service that provides some useful functionality for running MTurk experiments, was utilized to restrict the survey preview option, given that exposing workers to parts of the survey prematurely (e.g., previews) may have invalidated results. TurkGate also prevents workers from returning to a survey (even if they closed it accidentally). Participants were then notified of compensation for completion of the survey ($7.50). As with the eligibility survey, both IP addresses and Worker IDs were screened for duplicate submissions; there were not duplicate occurrences of either in the present study.

Table 1

Procedure order and measures administered

Procedure Order	Measures Administered
Mturk Screening Survey	Mturk Screening Questionnaire
Beginning of Session (Main Survey)	Informed Consent
	Demographic and Smoking/vaping History
	FTND
	Contemplation Ladder
	Modified SCQ-A
	Harmfulness of E-cigarettes Questionnaire
	Effectiveness of E-cigarettes for Smoking Cessation Questionnaire
	Affect Measure
	SUPPS-P ([lack of] premeditation and sensation seeking subscales)
	QSU
Baseline Video	
Post Baseline Video	Affect Measure
	Baseline Video Questionnaire
Experimental/Control Video	
Post Video	Modified SCQ-A
	Harmfulness of E-cigarettes Questionnaire
	Effectiveness of E-cigarettes for Smoking Cessation Questionnaire
	Affect Measure
	Likelihood of Switching and Video Questionnaire
	Contemplation Ladder
	QSU
	Final Smoking Questionnaire
Compensation	Compensation Form

Consent. A consent form, which included a brief description of the study and explained the purpose, risks, benefits, rights, and confidentiality of the study was first presented on a screen. Participants were informed that this was a study of Media and Smoking to assess smokers' reactions to brief videos. By clicking a box labeled "I agree," the main survey was then initiated. If a participant clicked "I do not agree," then the survey was terminated.

Randomization. After electronically consenting to participate, participants then viewed the baseline video. Afterward, a randomizer element within the Qualtics survey created a branch such that participants were randomly assigned either to the FDA PSA or the control video; hereafter, these conditions are referred to as experimental and control, respectively.

Administration of Baseline Questionnaires. Participants completed demographic and baseline measures as follows: Demographic and Smoking/Vaping History Questionnaire, which also included the FTND and Contemplation, Modified version of the SCQ-A, Harmfulness of E-cigarettes Questionnaire, Effectiveness of E-cigarettes for Smoking Cessation Questionnaire, Affect Measure, SUPPS-P Impulsivity Behavior Scale (only two scales: [lack of] premeditation and sensation seeking), and QSU.

Videos. First, participants were told that this was a study to assess smokers' responses to two brief (30 s) videos. Then, participants were shown the baseline video. Following the baseline video, participants completed the following measures: Affect Measure and Video Questionnaire.

Participants then viewed the video to which they were randomized. Then the following dependent measures were administered: Modified version of the SCQ-A, Harmfulness of E-cigarettes Questionnaire, Effectiveness of E-cigarettes for Smoking Cessation Questionnaire. Additionally, the Likelihood of Switching to E-cigarettes Questionnaire was administered.

Inattention checks. To attenuate effects of nonadherence to instructions on data quality, there were four inattention checks programmed within the session. The first inattention check occurred at the end of the Smoking History Questionnaire, and it asked participants to select which of the following specialty cigarette brands have they tried or none of the above. The five

listed brands were devised for this study (Midnight Cowboy, Wild Llama, Fortunate Spare, Wiltshire Lights, and Jamestown Menthol). To pass this inattention check, participants needed to select "none of the above." The second inattention check, which was an infrequency item from the Attentive Responding Scale (ARS-18; Maniaci & Rogge, 2014) was embedded (item 5) within the SUPPS-P, and it stated, "I'd rather be hated than loved." Scores on this item of 3–"disagree some" or 4–"disagree strongly" were considered as passing; whereas scores of 1–"agree strongly" and 2–"agree some" were considered as failing the inattention check. The third and fourth inattention checks occurred during the Baseline Video Questionnaire and Post-Video Questionnaire, respectively. The item was the same for each, and it stated, "In 5 words or less, what was this video about?" To pass the first of these checks, participants needed to mention at least one of the following: paper towels, pirates, family, or spill. To pass the second, those who viewed the FDA PSA needed to mention at least one of the following: e-cigarettes, epidemic, vaping, parasite, or health harms/dangers of e-cigarettes. For participants who watched the control video, they must have mentioned at least one of the following: rash, roundworm, parasite, and/or toxocara. For both of the video inattention checks, any synonyms for the previously stated words were also accepted as passing. Participants needed to pass 3 of the 4 inattention checks for data to be included in analyses.

Compensation. On the last screen of the survey, participants were presented a compensation form requesting their Worker ID. Upon verification of the participant's satisfactory pass rate of the inattention checks (see above), compensation of $7.50 was deposited into the worker's MTurk account within seven business days. All participants in the present study met the attention check criterion for payment, and there were no occurrences of either duplicate IP address or Worker ID.

DATA ANALYSIS

To test group equivalence on demographics, nicotine dependence, and other baseline variables, a series of chi-squares or analyses of variance (ANOVAs) were conducted, comparing the two condition groups. Next, to test the hypotheses in Aims 1 and 2, condition groups were compared using one-way ANOVA or analysis of covariance (ANCOVA; if a pre-test score was used as a covariate).

Several expectancy and baseline characteristics were explored as moderators to evaluate if participant characteristics affected the main effect of the video manipulation. Hierarchical liner regression was used, entering the pre-test score (if applicable) as the first step, the manipulation variable as the second step (video type), the moderator variable (expectancy variable, dependence, motivation to quit, age, or gender) as the third step, and lastly, the moderator X manipulation interaction. Post-hoc simple effects analyses were used to assess trends between moderator variable groups. Finally, any significant differences in moderator groups were followed up by exploratory comparisons of expectancies using independent samples t-tests.

Analysis of mediation was conducted using the PROCESS macro developed by Hayes (2017). In these analyses, video type served as the independent variable, e-cigarette expectancy ratings from either the three negative health harm or three potency items served as the mediator, and effectiveness of e-cigarettes for smoking cessation or switching motivation was the outcome. Additional mediation analyses were conducted on specific expectancies relevant to the outcome variables. Statistical significance of the indirect (mediated) effect was estimated using 10,000

bootstrapped samples and the 95% CI. Separate mediation analyses were conducted based either on negative health harm or potency expectancies, as well as the specific expectancies tested.

RESULTS

Participant Characteristics

Five participants were removed from final analyses (because they were inadvertently sent a survey link despite not meeting eligibility criteria from the initial screening survey) for a final sample size of 161. Two participants reported smoking during the study session. Removing their data did not appreciably alter the results, so they were retained. Participant demographic and smoking/vaping characteristics can be seen in Tables 2 and 3, respectively. Overall, the sample was diverse and representative of the geographic area of recruitment. Participants' trait impulsivity, previously found to be significantly associated with substance use (e.g., Cyders et al., 2014), including the initiation and maintenance of e-cigarette use (e.g., Chivers et al., 2016; Grant et al., 2019) was measured, given that differences on this variable could have produced confounds and/or moderation of subsequent comparisons between conditions. Measured by the SUPPS-P, in which the minimum subscale score is 4 and the maximum is 16, the sample was low on (lack of) premeditation (M: 6.60; SD: 2.14) and sensation seeking (M: 8.13, SD: 2.95). Results from chi-squared tests and ANOVAs did not show any significant differences between conditions on any demographic, smoking/vaping characteristic, or impulsivity variable.

Table 2

Participant demographics (N=161)

Variable	Description	Mean or N	% or SD
Age	(range 25-75)	49.3	11.86
Gender	Male	56	35%
	Female	104	65%
	Transgender	1	<1%
Race	American Indian / Alaska Native	2	1%
	Asian	5	3%
	Native Hawaiian / Pacific Islander	0	0%
	Black / African American	14	9%
	White / European Origin	136	85%
	Multiracial	4	2%
Ethnicity	Hispanic / Latino	7	4%
	Non-Hispanic	154	96%
Marital Status	Single	32	20%
	Married/Domestic Partnership	88	55%
	Separated	2	1%
	Divorced	31	19%
	Widowed	8	5%
Sexual Orientation	Lesbian	0	0%
	Gay	3	2%
	Bisexual	8	5%
	Straight	149	93%
	Prefer not to answer	0	0%
	Other (pansexual)	1	1%
Education	Less than high school	2	1%
	High School	42	26%
	Some College	51	32%
	Tech School / Associate's	32	20%
	4-year College Degree	25	16%
	Some school beyond 4-year degree	4	3%
	Beyond 4-year Degree / Professional Degree	5	3%
Income	Under $10,000	9	6%
	$10,000 - $29,999	37	23%
	$30,000 - $49,999	46	29%
	$50,000 - $69,999	27	17%
	$70,000 - $89,999	12	8%
	Over $90,000	30	19%

Note: No significant differences between conditions were found for any of the variables.

Table 3

Participant smoking and vaping characteristics

Variable	Mean or N	% or SD
Cigarettes per day (Range 5-40)	14.9	6.60
Reported years smoking	29.8	12.07
Reported past cigarette cessation attempt	130	81%
Reported past e-cigarette use	78	49%
FTND	4.7	2.16

Note: No significant differences were found between conditions on these variables.

Significant differences between conditions were found on one baseline variable (affect) and two pre-test variables (e-cigarette expectancy for appetite control [measured by the modified SCQ] and effectiveness of e-cigarettes for smoking cessation); these are shown in the leftmost columns of Table 3. Concerning affect, those in the experimental group reported higher scores at baseline, compared to the control group, F (1, 159) = 8.18, $p < .01$. Regarding the two significant pre-test variables, compared to the control group, those in the experimental group reported lower scores on both the e-cigarette expectancy item for appetite control, F (1, 159) = 6.48, $p < .01$, and on the rating of effectiveness of e-cigarettes for smoking cessation, F (1, 159) = 6.94, $p < .01$.

Furthermore, initial analyses revealed a floor effect, such that participants who rated the effectiveness of e-cigarettes for smoking cessation as zero or one at baseline, rated all related subsequent dependent variables as zero or one, respectively (e.g., likelihood of switching from cigarettes to e-cigarettes). The slider scale on the survey defaulted to the value of one if a participant clicked on the lowest end and did not manually move it leftward (to zero) from this initial position, such that a score of one potentially could be functionally equivalent to zero. In sum, there were 21 participants (14 in the experimental group and 7 in the control group) who

showed this floor effect. Data from these participants contributed to heteroscedasticity and nonnormality. Consequently, all data were analyzed for the full sample and for the subsample of participants (n = 140) who did not show this floor effect (i.e., the effectiveness of e-cigarettes for smoking cessation rating was greater than one at baseline). Data met assumptions of normality and homogeneity of variance following removal of these participants from analyses.

The subsample, relative to the full sample, showed a smaller baseline difference in affect, but the difference remained significant, F (1, 138) = 4.61, $p < .05$; however, there were no other significant differences on baseline or pre-test variables, which are shown in the rightmost columns of Table 4. Notably, the significant difference in affect was no longer present in the full sample or subsample after participants viewed the baseline video, either when testing with ANCOVA (to control for pre-test levels) or by ANOVA (Full Sample: F [1, 159] = 4.47, p = .50; Experimental M = 5.37, SD = 1.85; Control M = 5.17, SD = 1.84; Subsample: F [1, 138] = .98, p = .33; Experimental M = 5.36, SD = 1.7; Control M = 5.06, SD = 1.81). Accordingly, the subsample groups viewed the video to which they had been assigned with no remaining significant differences on key variables.

Table 4

Significant baseline and pre-test variables between conditions

	Full Sample			Subsample		
	Means			Means		
Variable	Experimental	Control	F	Experimental	Control	F
Appetite Control (Modified SCQ expectancy item)	2.72	3.65	6.48*	3.02	3.75	3.65
Effectiveness of E-Cigarettes for Smoking Cessation	28.79	40.02	6.94**	35.28	43.56	3.62
Affect	6.09	5.35	8.18**	5.93	5.33	4.61*

*Note: * p* < .05, ** *p* <.01. SCQ = Smoking Consequences Questionnaire (modified for e-cigarettes).

Affect and disgust elicitation. Between condition differences on the affect and disgust measures were tested to assess whether the FDA and control videos elicited equivalent levels of each. As seen in Table 5, there were no between condition differences on affect (controlling for pre-test levels) or disgust. Had these affective experiences differed in response to the videos, it could have produced confounds for subsequent comparisons between conditions.

Table 5

Manipulation effects on posttest affect and disgust elicitation, with and without adjusting for pre-manipulation values.

	Full Sample						Subsample					
	Means			Adjusted Means			Means			Adjusted Means		
Variable	Exp.	Control	F	Exp.	Control	F	Exp.	Control	F	Exp.	Control	F
Affect	2.23	1.49	5.04*	2.11	1.61	2.32	2.31	1.53	4.79*	2.17	1.63	2.51
Disgust	5.75	6.23	1.66	--	--	--	5.72	6.29	2.23	--	--	--

Note: * *p* < .05. -- = no pre-test covariate adjustment. Exp. = Experimental.

Aim 1

We first tested specific health harm and potency expectancies hypothesized to be affected by the video manipulation. As seen in Table 6, participants who viewed the FDA PSA reported greater e-cigarette health harm expectancies (controlling for pre-test levels) compared to those who viewed the control video, F (1, 158) = 10.04, $p < .01$ (full sample), F (1, 137) = 11.60 $p < .001$ (subsample). A similar effect was found for potency expectancies, F (1, 158) = 17.28, $p < .001$ (full sample), F (1, 137) = 10.80 $p < .01$ (subsample). Additionally, we found that the health harm and potency scales were positively correlated in both the full sample at pre-test, $r(159) = .38$, $p < .001$, and post-test, $r(159) = .48$, $p < .001$, and in the subsample at pre-test, $r(138) = .40$, $p < .001$, and post-test $r(138) = .51$, $p < .001$.

For both the full sample and subsample, age, gender, nicotine dependence (measured by the FTND), impulsivity (measured by the SUPPS-P [lack of] premeditation and sensation seeking subscales), and prior exposure to the video were tested as moderators of these expectancy effects. No moderation was found.

Table 6

Manipulation effects on posttest modified SCQ – E-cigarette expectancies, with and without adjusting for pre-manipulation values

	Full Sample						Subsample					
	Means			Adjusted Means			Means			Adjusted Means		
Variable	Exp.	Control	F	Exp.	Control	F	Exp.	Control	F	Exp.	Control	F
Health	21.87	20.47	2.52	22.10	20.42	10.04**	21.39	20.11	1.75	21.71	19.90	11.63**
Harms	16.71	14.58	5.35*	16.91	14.41	17.28**	16.62	14.75	3.99*	16.74	14.66	10.81**
Potency	2.2	3.37	9.47**	2.92	3.57	7.58**	2.41	3.52	7.39**	2.49	3.46	15.8***
Affect Regulation	1.59	2.57	8.66**	1.75	2.43	17.84***	1.75	2.67	6.25*	1.85	2.59	17.39***
Stimulation	1.8	2.65	6.09*	1.99	2.49	6.41*	2.05	2.78	3.85	2	2.71	4.25*
Concentration	3.01	3.94	4.08*	3.31	3.68	1.83	3.25	4.15	3.4	3.38	4.04	5.38*
Boredom Reduction	2.73	3.81	7.62**	3.17	3.43	1.55	3.05	3.97	5.06*	3.41	3.70	1.59
Taste	2.25	3.31	9.13**	2.62	3.00	2.66	2.54	3.42	5.45*	2.84	3.18	1.81
Weight Control	1.24	1.76	2.37	1.50	1.52	.02	1.30	1.87	2.59	1.55	1.68	.65
Sociability	6.17	5.56	2.61	6.26	5.48	12.14***	5.90	5.42	1.42	6.06	5.31	9.23**
Negative Physical Sensations	3.52	4.00	1.16	3.85	3.71	.27	3.75	4.03	.36	3.96	3.87	.36
Negative Social Impression	2.25	3.26	6.61*	2.45	3.08	7.91**	2.57	3.44	4.33*	2.69	3.36	6.97**
Vaping would be Satisfying	3.32	4.44	7.28**	3.65	4.16	7.28**	3.64	4.62	5.27*	3.9	4.42	4.12*
Satisfy Nicotine Craving												

Note: * $p < .05$, ** $p < .01$, *** $p < .001$. Exp. = Experimental. Modified SCQ = Smoking Consequences Questionnaire (modified for e-cigarettes).

Aim 2

Positive Expectancies. We next tested if the positive expectancy variables presented in Hypothesis 2A were affected by the video manipulation. As seen in Table 6, participants who viewed the FDA PSA reported lower e-cigarette positive expectancies (controlling for pre-test levels) compared to those who viewed the control video for affect regulation (F [1, 158] = 7.58, $p < .01$ [full sample], F [1, 137] = 15.80 $p < .001$ [subsample]), stimulation (F [1, 158]= 17.84, $p < .001$ [full sample], F [1, 137] = 17.39, $p < .001$ [subsample]), and concentration (F [1, 158)]=

6.41 $p < .05$ [full sample], F [1, 137] = 4.25 $p < .05$ [subsample]). Additionally, participants in the subsample who viewed the FDA PSA reported lower boredom reduction expectancies than those who viewed the control video, F (1, 137) = 5.38 $p < .05$. Results revealed no group effects on taste, weight control, or sociability.

Negative Expectancies. Shown in Table 6, participants who viewed the FDA PSA reported higher e-cigarette negative physical sensation expectancies than did those who viewed the control video, F (1, 158) = 12.14, $p < .001$ (full sample), F (1, 137) = 9.23, $p < .01$ (subsample). No significant differences were found on negative social impression.

Expectancies Related to Switching to E-Cigarettes. We tested group differences in expectancies reflecting motivation to switch from combustible to e-cigarettes. As seen in Table 6, participants who viewed the FDA PSA reported lower e-cigarette satisfaction expectancies ("E-cigarettes would be satisfying") compared to those who viewed the control video, F (1, 158) = 7.91, $p < .01$ (full sample), F (1, 137) = 11.33 $p < .001$ (subsample). A similar effect was found for nicotine craving expectancies ("Vaping would satisfy my nicotine cravings"), F (1, 158) = 17.28, $p < .001$ (full sample), F (1, 137) = 10.80 $p < .01$ (subsample).

Harmfulness of E-cigarettes. Subsequently, harmfulness ratings of e-cigarettes relative to cigarettes and smoking cessation aids, including nicotine patches, nicotine gum, and smoking cessation medications were tested. As seen in Table 7, participants who viewed the FDA PSA reported greater harmfulness ratings of e-cigarettes compared to those who viewed the control video, F (1, 158) = 12.45, $p < .001$ (full sample), F (1, 137) = 14.5, $p < .001$ (subsample). Notably, we did not find group differences on harmfulness ratings of any of the other products.

When comparing harmfulness ratings of products individually, Welch two-sample t-tests revealed that e-cigarettes were rated at baseline (full sample M: 77.99; subsample M: 75.69) by

both condition groups as significantly more harmful than all tested cessation aids (nicotine gum: full sample M: 26.50, t[317.78] = 20.88, $p < .001$; subsample M: 25.70, t[271.83] = 19.02, $p < .001$; nicotine patches: full sample M: 27.89, t[319.95] = 19.39, $p < .001$; subsample M: 27.73, t[276.64] = 17.78, $p < .001$; smoking cessation medications: full sample M: 33.91, t[312.92] = 15.58, $p < .001$; subsample M: 32.84, t[276.55] = 14.64, $p < .001$). However, e-cigarettes were rated at baseline by both groups as significantly less harmful than combustible cigarettes (full sample M: 87.59, t[257.77] = -14.43, $p < .001$; subsample M: 86.92, t[240.34] = -15.93, $p < .001$). Following the video manipulation, those who viewed the FDA PSA no longer rated e-cigarettes (full sample M: 87.07; subsample M: 85.41) as significantly different in harmfulness from combustible cigarettes (full sample M: 89.95, t[130.97] = -1.12, $p = .26$; subsample M: 82.23, t[103.99] = -1.33, $p = .19$), whereas those who watched the control video continued to rate e-cigarettes (full sample M: 77.97; subsample M: 76.27) as significantly less harmful than combustible cigarettes (full sample M: 88.52, t[127.81] = -3.98, $p < .001$; subsample M: 87.94, t[137.72] = -3.87, $p < .001$). As occurred at baseline, following the video manipulation, both groups continued to rate e-cigarettes as significantly more harmful than the tested smoking cessation aids.

Table 7

Manipulation effects on posttest harmfulness ratings, with and without adjusting for pre-manipulation values

	Full Sample						Subsample					
	Means			Adjusted Means			Means			Adjusted Means		
Variable	Exp.	Control	F	Exp.	Control	F	Exp.	Control	F	Exp.	Control	F
E-cigarette	87.07	77.97	8.00**	86.23	78.69	14.50***	85.41	76.27	6.63*	84.97	76.61	14.20***
Nicotine Gum	26.95	25.05	0.29	26.68	25.28	0.67	25.54	24.57	0.08	25.41	24.67	0.18
Cigarette	89.95	87.91	0.88	88.91	88.81	0.92	89.28	87.94	0.31	88.68	88.39	0.06
Nicotine Patch	31.51	29.53	0.26	30.57	30.35	0.01	30.43	29.51	0.05	29.78	30.01	0.011
Cessation Medications	37.61	30.22	3.43	34.45	32.96	0.61	37.11	29.44	0.06	33.84	31.97	0.78

Note: * $p < .05$, ** $p < .01$, *** $p < .001$. Exp. = Experimental

` **Effectiveness of E-cigarettes for Smoking Cessation.** We next compared groups on their ratings of effectiveness of e-cigarettes for smoking cessation relative to the same alternative smoking cessation aids. As seen in Table 8, participants who viewed the FDA PSA reported lower effectiveness ratings of e-cigarettes for smoking cessation compared to those who viewed the control video, F (1, 158) = 8.65, $p < .01$ (full sample), F (1, 137) = 7.78, $p < .01$ (subsample). There were no significant ratings differences between condition groups for the other cessation products. Results are plotted for the full sample and the subsample in Figure 2a and 2b, respectively. Subsequently, a factorial ANOVA was conducted to examine the effect of condition group (experimental and control) and smoking cessation product (nicotine gum, e-cigarette, nicotine patch, and cessation medications) on ratings of effectiveness for smoking cessation. The group X product interaction did not reach statistical significance in either the full sample, F (3, 636) = 2.14, $p = .09$ or the subsample, F (3, 552) = 2.11, $p = .10$.

Table 8

Manipulation effects on posttest effectiveness for smoking cessation ratings, with and without adjusting for pre-manipulation values.

	Full Sample						Subsample					
	Means			Adjusted Means			Means			Adjusted Means		
Variable	Exp.	Control	F	Exp.	Control	F	Exp.	Control	F	Exp.	Control	F
E-Cigarettes	22.53	39.33	15.45***	22.53	39.33	8.65**	27.54	42.56	10.96**	31.17	39.76	7.78**
Nicotine Gum	39.81	43.02	0.7	42.48	40.7	0.58	40.75	41.66	0.049	42.72	40.14	1.11
Nicotine Patch	45.8	52.02	2.57	48.7	49.5	0.17	47.34	50.71	0.68	48.67	49.69	0.22
Smoking Cessation Medications	50.33	60.44	6.35**	53.66	57.54	2.55	52.34	59.95	3.18	54.27	58.46	2.52

Note: * $p < .05$, ** $p < .01$, *** $p < .001$. Exp. = Experimental.

Switching Motivation from Combustible to E-cigarettes. Participants randomized to the FDA PSA reported lower likelihood of switching (i.e., switching motivation) from combustible to e-cigarettes (full sample M = 3.65; subsample M = 4.48) than those who viewed the control video (full sample M = 14.35; subsample M = 15.62), F (1, 159) = 18.37, $p < .001$ (full sample), F (1, 138) = 15.58, $p < .001$ (subsample). Results for the full sample and subsample are plotted in Figure 3a and 3b, respectively.

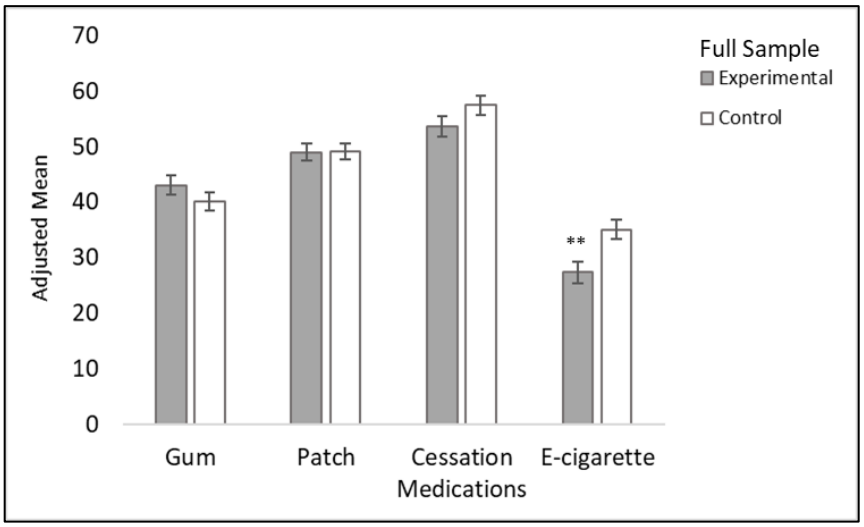

Figure 2a. Manipulation effects on posttest effectiveness for smoking cessation ratings upon the full sample, with adjusting for pre-manipulation values

Note. ** $p < .01$. Scores presented are adjusted by respective pre-test scores. Error bars are standard error of the mean.

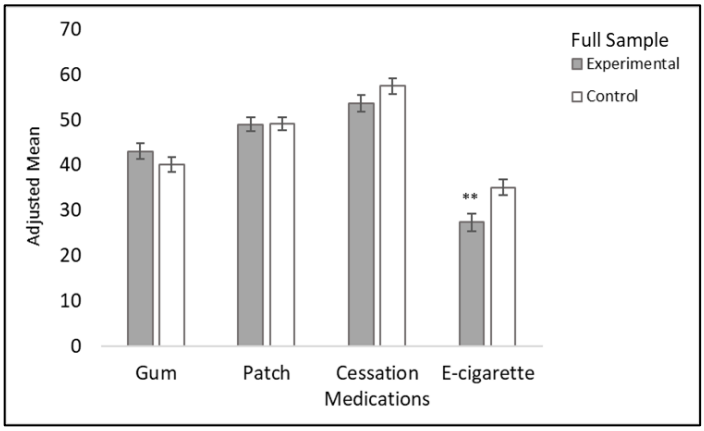

Figure 2b. Manipulation effects on posttest effectiveness for smoking cessation ratings upon the subsample, with adjusting for pre-manipulation values.

Note. ** $p < .01$. Scores presented are adjusted by respective pre-test scores. Error bars are standard error of the mean.

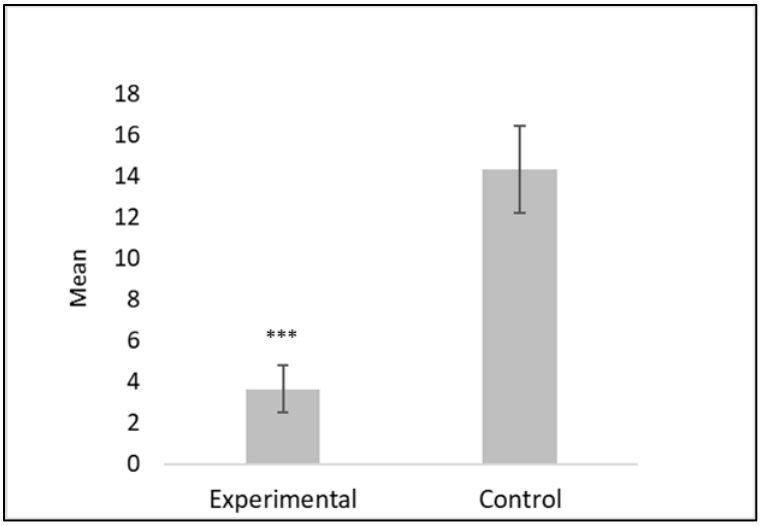

Figure 3a. Manipulation effects on switching motivation from combustible to e-cigarettes upon the full sample.

Note. *** $p < .001$. Error bars are standard error of the mean.

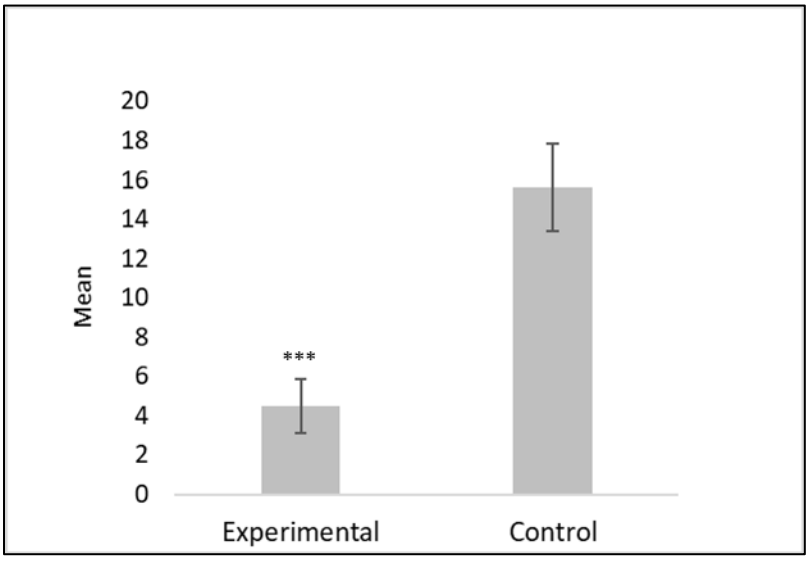

Figure 3b. Manipulation effects on switching motivation from combustible to e-cigarettes upon the subsample.

*Note. *** $p < .001$. Error bars are standard error of the mean.*

Motivation to Quit Smoking. With respect to overall motivation to quit smoking as measured by the Contemplation Ladder, we found no differences between experimental conditions for either the full sample or subsample (see Table 9). Notably, this variable was the only one for which we had missing data; 23 participants did not complete this measure. Thus, analyses were conducted with 138 participants' data in the full sample (63 in the Experimental condition and 75 in the Control) and 136 in the subsample (62 in the Experimental condition and 74 in the control). This missingness was likely due this particular measure differing from the others in response instructions.

Table 9

Manipulation effects on posttest Contemplation Ladder – motivation to quit smoking, with and without adjusting for pre-manipulation values

	Full Sample (*n* = 138)						Subsample (*n* = 136)					
	Means			Adjusted Means			Means			Adjusted Means		
Variable	Exp.	Control	F	Exp.	Control	F	Exp.	Control	F	Exp.	Control	F
Contemplation Ladder	5.41	5.05	0.74	5.33	5.12	2.64	5.35	5.03	0.53	5.17	5.15	0.04

Note: Exp. = Experimental.

Urge to Smoke. On urge to smoke, measured by the QSU, those in the full sample who watched the FDA PSA reported lower urges (controlling for pre-test levels) than those who viewed the control video, F (1, 158) = 7.12, $p < .01$, but the difference did not appear in the subsample (see Table 10).

Table 10

Manipulation effects on posttest QSU – Urge to smoke, with and without adjusting for pre-manipulation values

	Full Sample						Subsample					
	Means			Adjusted Means			Means			Adjusted Means		
Variable	Exp.	Control	F	Exp.	Control	F	Exp.	Control	F	Exp.	Control	F
QSU	7.58	10.09	7.74**	8.21	9.54	7.12**	7.66	10.04	6.34*	8.45	9.43	3.56

Note: ** p < .01. Exp. = Experimental. QSU – Questionnaire of Smoking Urges – Brief urge factor.

Mediation Analyses

First-order correlations were calculated using post-manipulation scores of potential mediators and key dependent variables (effectiveness of e-cigarettes for smoking cessation and switching motivation). As shown in Table 11, effectiveness of e-cigarettes for smoking cessation was most strongly positively correlated with positive expectancies (affect regulation, satisfaction, craving reduction, and stimulation) and most negatively correlated with harmfulness of e-cigarettes. A similar pattern was seen for the dependent variable of switching motivation. The same pattern of results was found for the subsample.

Table 11

First-order correlations of key dependent variables among the full sample.

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Health Harms (SCQ)	1									
2. Potency (SCQ)	.44***	1								
3. Affect Regulation (SCQ)	-.05	.28***	1							
4. Satisfying (SCQ)	-.05	.20*	.82***	1						
5. Nicotine Craving Reduction (SCQ)	.02	.34***	.75***	.74***	1					
6. Stimulation (SCQ)	-.06	.35***	.78***	.72***	.7***	1				
7. Negative Physical Sensations (SCQ)	.52***	.31***	-.19*	-.29***	-.12	-.14	1			
8. Harmfulness	.71***	.25**	-.24**	-.23**	-.23**	-.20*	.52***	1		
9. Effectiveness for Smoking Cessation	-.30***	.01	.49***	.46***	.43***	.43***	-.24**	-.36***	1	
10. Switching Motivation	-.22**	.04	.47***	.50***	.38***	.41***	-.20*	-.39***	.46***	1

Note: *** $p < .001$ ** $p < .01$. * $p < .05$. Exp. = Experimental. SCQ = Smoking Consequences Questionnaire (modified for e-cigarettes).

A series of mediation analyses was then conducted; video type served as the independent variable and effectiveness of e-cigarettes for smoking cessation and switching motivation served as the outcomes. The mediation models shown in Figure 4 were tested in the full sample and in the subsample using post-manipulation scores of each potential mediator. For the outcome variable of effectiveness of e-cigarettes for smoking cessation, shown in Table 12, the bootstrapped analyses revealed a statistically significant indirect (mediated) effect in the full sample and subsample of affect regulation (full sample: β = 6.55; 95% CI = 2.01-10.43; subsample: β = 5.92; 95% CI = 1.41-10.10), satisfaction (full sample: β = 5.69; 95% CI = 1.16-8.74; subsample: β = 3.95; 95% CI = .22-7.76), nicotine craving reduction (full sample: β = 5.05; 95% CI = 1.05-8.63; subsample: β = 4.17; 95% CI = .56-7.91), stimulation (full sample: β = 5.50; 95% CI = 1.45-8.82; subsample: β = 4.68; 95% CI = .86-8.28), and harmfulness of e-

cigarettes (full sample: β = 4.37; 95% CI = 1.01-7.37; subsample: β = 3.47; 95% CI = .43-6.24). However, the direct effect of video on effectiveness remained statistically significant when each mediator was considered. These findings indicate that each of the aforementioned variables mediated a portion of the relationship between video and effectiveness of e-cigarettes for smoking cessation. The nature of the partially mediated relationships was that lower scores on affect regulation (full sample: β = 5.60, $p < .001$; subsample: β = 5.33, $p < .001$), satisfaction (full sample: β = 5.17, $p < .001$; subsample: β = 4.54, $p < .001$), nicotine craving reduction (full sample: β = 4.51, $p < .001$; subsample: β = 4.25, $p < .001$), and stimulation (full sample: β = 5.61, $p < .01$; subsample: β = 5.09, $p < .01$) were associated with lower scores on effectiveness of e-cigarettes. Alternatively, higher scores on harmfulness (full sample: β = -.88, $p < .001$; subsample: β = -.38, $p < .001$) were associated with lower scores on effectiveness. The same pattern of results was found for the outcome variable of switching motivation, shown in Table 13.

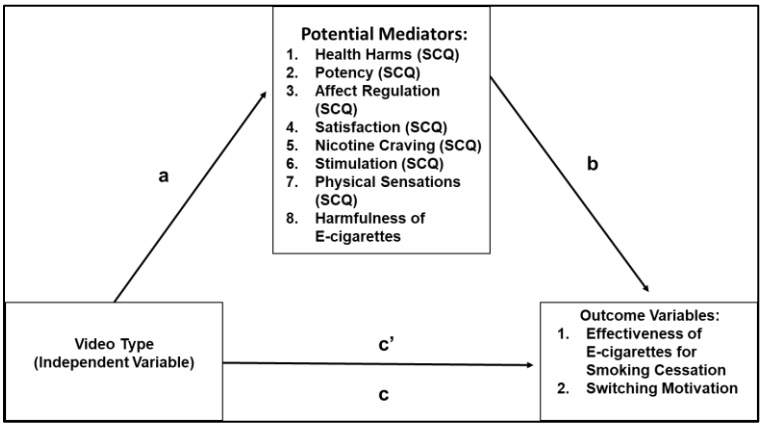

Figure 4. Mediation models tested.

Note: a = path from video (IV) to mediator. b = path from mediator to outcome variable. c = total effect of IV on outcome variable. c' = direct effect of IV on outcome variable. SCQ = Smoking Consequences Questionnaire (modified for e-cigarettes).

Table 12

Mediation analyses on the dependent variable of effectiveness of e-cigarettes for smoking cessation

	Full Sample						Subsample					
	Unstandardized Coefficients				95% CI		Unstandardized Coefficients				95% CI	
Mediator	***a***	***b***	***c'***	***ab***	**Lower**	**Upper**	***a***	***b***	***c'***	***ab***	**Lower**	**Upper**
Health Harms (SCQ)	-1.4	-1.53***	14.88**	2.14	-0.63	4.82	-1.23*	-1.24	13.61**	1.53	-0.83	4.29
Potency (SCQ)	-2.13*	0.07	17.51***	-0.15	-2.57	1.03	-1.88*	0.1	15.64**	-0.19	-2.49	1.25
Affect Regulation (SCQ)	1.17**	5.60***	10.84*	6.55	2.01	10.43	1.11**	5.33***	9.60*	5.92	1.41	10.1
Satisfaction (SCQ)	1.10*	5.17***	12.09**	5.69	1.16	8.74	.87*	4.54***	11.41*	3.95	0.22	7.76
Nicotine Craving (SCQ)	1.12**	4.51***	12.26**	5.05	1.05	8.63	.98*	4.25***	11.26*	4.17	0.56	7.91
Stimulation (SCQ)	.98**	5.61**	11.89**	5.5	1.45	8.82	.92*	5.09**	10.82*	4.68	0.86	8.28
Physical Sensations (SCQ)	-0.62	-2.75**	15.35***	1.71	-0.34	4.01	-0.5	-1.93*	14.23**	0.97	-0.64	3.08
Harmfulness of E-Cigarettes	-9.10**	-.48***	13.01**	4.37	1.01	7.37	-9.14*	-.38***	12.09**	3.47	0.43	6.24

Note: *** $p < .001$ ** $p < .01$. * $p < .05$. a = path from video (IV) to mediator. b = path from mediator to effectiveness of e-cigarettes for smoking cessation (DV). c' = direct effects. ab = indirect (mediated) effects. SCQ = Smoking Consequences Questionnaire (modified for e-cigarettes). Total effects (c path) for the full sample: β = 16.80*** and the subsample: β = 15.02**.

Table 13

Mediation analyses on the dependent variable of switching motivation

	Full Sample						Subsample					
	Unstandardized Coefficients				95% CI		Unstandardized Coefficients				95% CI	
Mediator	***a***	***b***	***c'***	***ab***	**Lower**	**Upper**	***a***	***b***	***c'***	***ab***	**Lower**	**Upper**
Health Harms (SCQ)	-1.4	-.66**	9.92***	0.92	-0.3	2.1	-1.23*	-.60*	10.51**	0.74	-0.5	1.97
Potency (SCQ)	-2.13*	0.11	11.30***	-0.21	-1.98	0.2	-1.88*	0.44	11.74***	-0.83	-2.19	0.34
Affect Regulation (SCQ)	1.17**	3.16***	7.41**	3.7	1.2	5.93	1.11**	3.34***	7.84**	3.71	0.93	6.23
Satisfaction (SCQ)	1.10*	3.32***	7.67**	3.62	0.67	5.87	.87*	3.44***	8.41**	3.01	0.19	5.81
Nicotine Craving (SCQ)	1.12**	2.34***	8.44**	2.62	0.51	4.57	.98*	2.54***	9.00**	2.49	0.36	4.68
Stimulation (SCQ)	.98**	3.16***	8.00**	3.1	0.78	5.22	.92*	3.19***	8.59**	2.94	0.55	5.21
Physical Sensations (SCQ)	-0.62	-1.41**	10.00***	0.87	-0.16	2.02	-0.5	-1.26*	10,65***	0.63	-0.44	1.78
Harmfulness of E-Cigarettes	-9.10**	-.31***	8.29**	2.81	0.67	4.58	-9.14*	-.29***	8.87**	2.65	1.05	4.58

Note: *** $p < .001$ ** $p < .01$. * $p < .05$. a = path from video (IV) to mediator. b = path from mediator to effectiveness of e-cigarettes for smoking cessation (DV). c' = direct effects. ab = indirect (mediated) effects. SCQ = Smoking Consequences Questionnaire (modified for e-cigarettes). Total effects (c path) for the full sample: β = 10.70*** and the subsample: β = 11.14***.

DISCUSSION

A great deal of controversy surrounds e-cigarettes, with some arguing that protection of youth and non-users is paramount and others maintaining that these products are beneficial from a harm reduction perspective for use by adult smokers for switching from combustible cigarettes and for smoking cessation (Balfour et al., 2021). To advance the agenda of the former, opponents of e-cigarettes have allocated tremendous expenditures toward the production of advertising campaigns aimed at youth deterrence; however, to date, the effects of these ads upon adult smokers has yet to be examined. In the present study, a between-subjects experimental design was utilized to investigate the effects of an FDA-distributed youth-targeted anti-vaping PSA upon adult smokers who view it. In an attempt to elucidate whether viewing this PSA would impact adult smokers' interest in using e-cigarettes for smoking cessation (i.e., switching motivation), a number of outcome variables were tested.

It was hypothesized that the FDA PSA—compared to a matched control video absent of e-cigarette content—would increase negative health-related expectancies, and, because the PSA conveys that e-cigarettes are very powerful, it would also increase positive expectancies concerning the potency of e-cigarettes. We observed that viewing the FDA PSA, relative to the control video, produced increases in both health harm and potency expectancies.

Additionally, we hypothesized that the anti-vaping PSA would impact other general expectancies of e-cigarettes and additional variables reflecting motivation to quit smoking (i.e., switch to vaping); however, we were agnostic concerning the direction of the impact. We found that viewing the FDA PSA produced lower positive expectancies related to affect regulation,

stimulation, concentration, and, within the subsample, boredom reduction. Also, we found that participants who viewed the FDA PSA reported higher e-cigarette negative physical sensation expectancies. Concerning expectancies relevant to motivation to quit smoking, we found that those who viewed the FDA PSA rated expectancies for e-cigarette satisfaction and nicotine craving reduction lower compared to those who viewed the control video. Contrary to our hypotheses, the observed increased potency expectancies did not generalize to more positive expectancies. Rather, viewing the FDA PSA resulted in overall more negative expectancies about e-cigarettes, which is consistent with our hypothesis that the predicted negative health expectancy change would generalize to other expectancies. Additionally, the negative health harm and potency expectancies were found to be positively correlated, so there likely was an overall stronger negative impact stemming from the combined effects of negative health harm and potency expectancies.

Furthermore, even though those who watched the FDA PSA rated e-cigarettes as significantly less harmful than combustible cigarettes at baseline, they rated e-cigarettes and combustible cigarettes as comparably harmful post-manipulation. Moreover, those who viewed the FDA PSA rated e-cigarettes as less effective for smoking cessation. Additionally, they rated e-cigarettes as the least effective cessation product when compared to nicotine gum, nicotine patches, and smoking cessation medications. Lastly, viewing the FDA PSA resulted in lower switching motivation. Therefore, our findings show that adults smokers who view the FDA PSA would be less likely to consider e-cigarettes for smoking cessation.

The outcome variables of effectiveness of e-cigarettes for smoking cessation and switching motivation were observed to be partially mediated by positive expectancies including affect regulation, satisfaction, nicotine craving reduction and stimulation, such that lower scores

on these expectancy variables were associated with lower scores on both outcomes. Additionally, partial mediation was found with harmfulness of e-cigarette ratings, such that higher scores on this mediator variable was associated with lower scores on both outcomes. Thus, these mediator variables were found to mediate a portion of the relationship between the video and each outcome variable. These mediational findings add to previous correlational analyses showing associations between positive e-cigarette expectancies and smoking cessation (Harrell et al., 2015).

Motivation to quit smoking

With respect to the overall motivation to quit smoking, measured by the Contemplation Ladder, we found no differences between conditions. However, this is the only measured variable for which we had missing data. Given that twenty-three participants did not complete this measure, we may not have captured overall changes on this measure. Furthermore, this measure may not be sensitive enough to capture small changes in motivation occurring over such a brief duration.

Urge to Smoke

Psychological factors, such as negative affect, can influence desire to smoke (Baker et al., 2004). In this study, those who viewed the control video reported higher urges to smoke, relative to those who viewed the FDA PSA, measured by the QSU. The FDA and control videos were found not to produce any between-group differences in affect or disgust elicitation; thus, this difference in urge to smoke likely is not attributable to affect regulation. Rather, the lower urges reported by those who viewed the FDA PSA could be attributable to a tarnishing effect in which negative messages about one product, such as e-cigarettes, generalize to another, such as cigarettes (Grummon et al., 2020). Accordingly, consistent with past research finding support for

this tarnishing effect (Brewer et al., 2019; Gummon et al., 2020), anti-vaping advertising may make both e-cigarettes and combustible cigarettes unappealing. However, the duration of this tarnishing effect is unknown. Consequently, when an urge reemerges, it could be that those who are exposed to this negative e-cigarette messaging may be less likely to utilize a product shown to be beneficial for smoking cessation and less harmful than combustible cigarettes. Fortunately, the PSA did not appear to cause this tarnishing effect with respect to the other smoking cessation products, including the other nicotine delivery products (NRT). Consequently, smokers may be more inclined to use these other methods.

Public Health Implications

The purpose of the present study was to assess whether public health campaigns designed to scare youth away from vaping may have unintended consequences for adults who are exposed to these ads and other materials, such that the negative messaging may ultimately deter adult smokers from switching to a safer product and effective aid for smoking cessation (Abrams et al., 2018; Beaglehole et al., 2019). Results showed that adult smokers' exposure to an FDA-distributed youth-targeted anti-vaping PSA produced lower scores on all variables relevant to harm reduction (i.e., switching from combustible to e-cigarettes), compared to viewing a control video. In terms of public health, our results suggest that anti-vaping youth campaigns could ultimately produce the opposite effects that Dave et al. (2019) and Kim et al. (2015) found with e-cigarette advertisements, previously shown to increase motivation to quit smoking.

These unintended consequences seemingly occurred, at least in part, via modification of adults' expectancies about e-cigarettes, and the generalization of those expectancies to other aspects of e-cigarettes, such as their potential for smoking cessation. Specifically, the negative information about e-cigarettes conveyed in the PSA decreased positive expectancies and

increased negative expectancies about them. These changes in expectancies then extended to reduced beliefs about their efficacy as a smoking cessation aid and increased beliefs about their harmfulness. In turn, these changes directly discourage their use for smoking cessation, given that they are seen as ineffective as a smoking cessation aid and as harmful as combustible cigarettes. In sum, youth-targeted anti-vaping campaigns may have deleterious effects for adult smokers who might otherwise consider switching to e-cigarettes, potentially as a means to discontinue nicotine use overall. Moreover, to date, no data have been provided by the FDA showing that these advertisements are effective at their purported goal of youth deterrence. Thus, the net public health impact of the messages is unknown.

Limitations

The results of this study should be considered within the context of several methodological issues. First, the extent to which participants attended to the videos and survey questionnaires is unknown. Although all participants passed the attention check criterion for data to be included in analyses, 4% of the sample failed the attention check question that was embedded within a questionnaire (as opposed to being a text box or stand-alone question). Additionally, if the study were conducted in the laboratory, participants would not have had access to alternative sources of distraction, including smoking (two participants endorsed having done so, but the total remains unknown), as they would have in a home setting. Second, the null moderation findings must be addressed. It is likely the case that the study was underpowered to detect significant interactions.

Although the effect sizes of the video manipulation appear modest, it is important to recognize that these effects emerged from a single exposure to the FDA PSA. In the real world, individuals are likely to see the PSA multiple times with possible cumulative effects. Finally,

limitations from the design of the experiment and the data analysis should be addressed. The e-cigarette expectancy scales (SCQ) used in this study were adapted from cigarette questionnaires, and they have not yet been validated for e-cigarettes. Moreover, the potency items that were added have not been previously utilized or assessed for psychometric properties in combination with the other items. Additionally, some scales were composed of a single-item (e.g., negative social impression), which limits the ability to assess internal-consistency reliability and potentially limits their validity. These measurement issues could have also impacted the mediation analyses such that we may not have adequately captured variables that fully mediate the relation between the video and outcome variables. Results from this study should be interpreted in light of these considerations.

Conclusions

This study utilized a between-subjects experimental design to test the effects of an FDA-distributed youth-targeted anti-vaping PSA upon adult smokers. Findings indicated that a single exposure to the PSA had the presumably unintended consequence of deterring adult smokers from the likelihood of using a safer alternative (i.e., switching from combustible to e-cigarettes). Consequently, these ads could have the net effect of maintaining smoking behavior. Although the current study identified changes in vaping expectancies and intentions via a controlled study with high internal validity, complementary naturalistic research is needed to quantify the effect upon adult smokers exposed to this ad and other anti-vaping messaging in their daily lives. The study demonstrates the importance of considering all potential audiences of, and their reactions to, public health campaigns – particularly ones with alarmist messaging and images, such as the FDA's ad studied in this experiment. Surveys have found that the public tends to overestimate the risks of vaping compared to smoking (Brose et al., 2015; Majeed et al., 2017; Malt et al.,

2020), most likely based on asymmetrical media reports and public health campaigns that prioritize discouraging vaping onset among youth. Future policy should attend to the full public health impact of these messages.

REFERENCES

Abrams, D. B., Glasser, A. M., Pearson, J. L., Villanti, A. C., Collins, L. K., & Niaura, R. S. (2018). Harm minimization and tobacco control: Reframing societal views of nicotine use to rapidly save lives. *Annual Review of Public Health, 39*, 193-213.

Abrams, D., & Niaura, R. (1987). Social learning theory of alcohol use and abuse. In *Psychological theories of drinking and alcoholism* (pp. 131-178). Guilford Press.

Allem, J. P., Dharmapuri, L., Unger, J. B., & Cruz, T. B. (2018). Characterizing Juul-related posts on Twitter. *Drug and Alcohol Dependence*, *190*, 1-5.

Baker, T. B., Piper, M. E., McCarthy, D. E., Majeskie, M. R., & Fiore, M. C. (2004). Addiction motivation reformulated: an affective processing model of negative reinforcement. *Psychological review*, *111*(1), 33. doi: 10.1037/0033-295X.111.1.33

Balfour, D. J., Benowitz, N. L., Colby, S. M., Hatsukami, D. K., Lando, H. A., Leischow, S. J., ... & West, R. (2021). Balancing Consideration of the Risks and Benefits of E-Cigarettes. *American Journal of Public Health*, (0), e1-e12.

Banerjee, S. C., Shuk, E., Greene, K., & Ostroff, J. S. (2015). Content analysis of trends in print magazine tobacco advertisements. *Tobacco Regulatory Science*, *1*(2), 103-120.

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191. doi: 10.1016/0146-6402(78)90002-4

Bao W., Xu G., Lu J., Snetselaar L. G., Wallace R. B. (2018). Changes in Electronic Cigarette Use Among Adults in the United States, 2014-2016. *JAMA, 319(19),* 2039–2041. doi:https://doi.org/10.1001/jama.2018.4658

Beaglehole, R., Bates, C., Youdan, B., & Bonita, R. (2019). Nicotine without smoke: fighting the tobacco epidemic with harm reduction. *The Lancet*, *394*(10200), 718-720.

Benedetti, F., Carlino, E., & Pollo, A. (2011). How placebos change the patient's brain. *Neuropsychopharmacology, 36,* 339–354.

Benitez, B., & Goldman, M. S. (2019). Using future-oriented expectancy associates to probe real-time variations in motivation to consume alcohol. *Psychology of Addictive Behaviors*, *33*, 540-552.

Berry, K. M., Fetterman, J. L., Benjamin, E. J., Bhatnagar, A., Barrington-Trimis, J. L., Leventhal, A. M., & Stokes, A. (2019). Association of electronic cigarette use with subsequent initiation of tobacco cigarettes in US youths. *JAMA network open*, *2*(2), e187794-e187794.

Biener, L., & Abrams, D. B. (1991). The Contemplation Ladder: validation of a measure of readiness to consider smoking cessation. *Health Psychology*, *10*(5), 360-365.

Brandon, T. H., & Baker, T. B. (1991). The Smoking Consequences Questionnaire: The subjective expected utility of smoking in college students. *Psychological Assessment: A Journal of Consulting and Clinical Psychology*, *3*(3), 484.

Brandon, T. H., Goniewicz, M. L., Hanna, N. H., Hatsukami, D. K., Herbst, R. S., Hobin, J. A., ... & Viswanath, K. (2015). Electronic nicotine delivery systems: a policy statement from the American Association for Cancer Research and the American Society of Clinical Oncology. *Clinical Cancer Research*, *21*(3), 514-525.

Brandon, T. H., Herzog, T. A., Irvin, J. E., & Gwaltney, C. J. (2004). Cognitive and social learning models of drug dependence: Implications for the assessment of tobacco dependence in adolescents. *Addiction, 99*(Suppl1), 51-77. doi:10.1111/j.1360-0443.2004.00737.x

Brandon, T. H., Juliano, L. M., & Copeland, A. L. (1999). Expectancies for tobacco smoking. In Kirsh, Irving (Ed.), *How expectancies shape experience* (pp. 263-299). Washington, DC: American Psychological Association.

Brewer, N. T., Jeong, M., Hall, M. G., Baig, S. A., Mendel, J. R., Lazard, A. J., ... & Ribisl, K. M. (2019). Impact of e-cigarette health warnings on motivation to vape and smoke. *Tobacco Control*, *28*(e1), e64-e70.

Brose, L. S., Brown, J., Hitchman, S. C., & McNeill, A. (2015). Perceived relative harm of electronic cigarettes over time and impact on subsequent use. A survey with 1-year and 2-year follow-ups. *Drug and Alcohol dependence*, *157,* 106-111.

Brown, C. J., & Cheng, J. M. (2014). Electronic cigarettes: Product characterisation and design considerations. *Tobacco Control, 23* (Suppl 2), ii4-10. doi: 10.1136/tobaccocontrol-2013-051476

Brown, S. A., Christiansen, B. A., & Goldman, M. S. (1987). The Alcohol Expectancy Questionnaire: an instrument for the assessment of adolescent and adult alcohol expectancies. *Journal of Studies on Alcohol*, *48*(5), 483-491.

Bynion, T. M., & Feldner, M. T. (2017). Self-assessment manikin. *Encyclopedia of Personality and Individual Differences*, 1-3.

Caponnetto P, Campagna D, Cibella F, Morjaria JB, Caruso M, et al. (2014) EffiCiency and Safety of an eLectronic cigAreTte (ECLAT) as Tobacco Cigarettes Substitute: A

Prospective 12-Month Randomized Control Design Study. PLOS ONE 9(1): 10.1371/annotation/e12c22d3-a42b-455d-9100-6c7ee45d58d0. https://doi.org/10.1371/annotation/e12c22d3-a42b-455d-9100-6c7ee45d58d

CDC. (2017). Quitting smoking among adults—United States, 2000–2015. *MMWR. Morbidity and Mortality Weekly Report*, *65*.

Christiansen, B. A., Goldman, M. S., & Inn, A. (1982). Development of alcohol-related expectancies in adolescents: separating pharmacological from social-learning influences. *Journal of Consulting and Clinical Psychology*, *50*, 336-344.

Christiansen, B. A., Smith, G. T., Roehling, P. V., & Goldman, M. S. (1989). Using alcohol expectancies to predict adolescent drinking behavior after one year. *Journal of consulting and Clinical Psychology*, *57*, 93-99.

Chivers, L. L., Hand, D. J., Priest, J. S., & Higgins, S. T. (2016). E-cigarette use among women of reproductive age: Impulsivity, cigarette smoking status, and other risk factors. *Preventive Medicine*, *92*, 126-134.

Colder, C. R., O'Connor, R. M., Read, J. P., Eiden, R. D., Lengua, L. J., Hawk Jr, L. W., & Wieczorek, W. F. (2014). Growth trajectories of alcohol information processing and associations with escalation of drinking in early adolescence. *Psychology of Addictive Behaviors*, *28*, 659-670.

Copeland, A. L., Brandon, T. H., & Quinn, E. P. (1995). The Smoking Consequences Questionnaire-Adult: Measurement of smoking outcome expectancies of experienced smokers. *Psychological Assessment*, *7*(4), 484.

Copp, S. R., Collins, J. L., Dar, R., & Barrett, S. P. (2015). The effects of nicotine stimulus and response expectancies on male and female smokers' responses to nicotine-free electronic cigarettes. *Addictive Behaviors, 40,* 144-147. doi: 10.1016/j.addbeh.2014.09.013

Cyders, M. A., Littlefield, A. K., Coffey, S., & Karyadi, K. A. (2014). Examination of a short English version of the UPPS-P Impulsive Behavior Scale. *Addictive behaviors, 39,* 1372-1376.

Darkes, J., & Goldman, M. S. (1993). Expectancy challenge and drinking reduction: experimental evidence for a mediational process. *Journal of Consulting and Clinical Psychology, 61,* 344-353.

Darkes, J., & Goldman, M. S. (1998). Expectancy challenge and drinking reduction: Process and structure in the alcohol expectancy network. *Experimental and Clinical Psychopharmacology, 6,* 64-76.

Dave, D., Dench, D., Grossman, M., Kenkel, D. S., & Saffer, H. (2019). Does e-cigarette advertising encourage adult smokers to quit?. *Journal of Health Economics, 68,* 102227.

Dawkins, L., Turner, J., Hasna, S., & Soar, K. (2012). The electronic-cigarette: effects on desire to smoke, withdrawal symptoms and cognition. *Addictive Behaviors, 37*(8), 970-973. doi: 10.1016/j.addbeh.2012.03.004

Dawkins, L., Turner, J., Roberts, A., & Soar, K. (2013). 'Vaping' profiles and preferences: An online survey of electronic cigarette users. *Addiction, 108*(6), 1115-1125. doi: 10.1111/add.12150

Ebbert, J. O., Agunwamba, A. A., & Rutten, L. J. (2015). Counseling patients on the use of electronic cigarettes. *Mayo Clinic Proceedings, 90*(1), 128-134. doi: 10.1016/j.mayocp.2014.11.004

Eissenberg, T., Bhatnagar, A., Chapman, S., Jordt, S. E., Shihadeh, A., & Soule, E. K. (2020). Invalidity of an Oft-Cited Estimate of the Relative Harms of Electronic Cigarettes.

Evans, S. E., & Hoffman, A. C. (2014). Electronic cigarettes: Abuse liability, topography and subjective effects. *Tobacco Control, 23 Suppl 2*, ii23-29. doi: 10.1136/tobaccocontrol-2013-051489

Fagerström, K., Etter, J.-F., & Unger, J. B. (2015). E-cigarettes: A disruptive technology that revolutionizes our field? *Nicotine & Tobacco Research, 17*(2), 125-126. doi: 10.1093/ntr/ntu240

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior Research Methods, 39, 175-191.

Gentzke, A. S., Creamer, M., Cullen, K. A., Ambrose, B. K., Willis, G., Jamal, A., & King, B. A. (2019). Vital signs: tobacco product use among middle and high school students—United States, 2011–2018. *Morbidity and Mortality Weekly Report*, *68*(6), 157.

Goldman, M. S. (1999). Expectancy operation: Cognitive–neural models and architectures. In Kirsh, Irving (Ed.), *How expectancies shape experience* (pp. 263-299). Washington, DC: American Psychological Association.

Goldman, M. S. (2002). Expectancy and risk for alcoholism: The unfortunate exploitation of a fundamental characteristic of neurobehavioral adaptation. *Alcoholism: Clinical and Experimental Research*, *26*, 737-746.

Goldman, M. S., Brown, S. A., & Christiansen, B. A. (1987). Expectancy theory-Thinking about drinking. In Blane & KE Leonard (Eds.), *Psychological theories of drinking and alcoholism* (pp. 181-226). New York, NY: Guilford Publications.

Goldman, M. S., Del Boca, F. K., & Darkes, J. (1999). Alcohol expectancy theory: The application of cognitive neuroscience. In Blane & KE Leonard (Eds.), *Psychological theories of drinking and alcoholism* (2nd ed.; pp. 203-246). New York, NY: Guilford Publications.

Gottlieb, A. M., Killen, J. D., Marlatt, G. A., & Taylor, C. B. (1987). Psychological and pharmacological influences in cigarette smoking withdrawal: Effects of nicotine gum and expectancy on smoking withdrawal symptoms and relapse. *Journal of Consulting and Clinical Psychology, 55*(4), 606-608. doi: 10.1037/0022-006X.55.4.606

Grant, J. E., Lust, K., Fridberg, D. J., King, A. C., & Chamberlain, S. R. (2019). E-cigarette use (vaping) is associated with illicit drug use, mental health problems, and impulsivity in university students. *Annals of Clinical Psychiatry: Official Journal of the American Academy of Clinical Psychiatrists, 31*, 27-37.

Gross, J. J., & Levenson, R. W. (1995). Emotion elicitation using films. *Cognition & Emotion, 9*(1), 87-108.

Grummon, A. H., Hall, M. G., Mitchell, C. G., Pulido, M., Sheldon, J. M., Noar, S. M., ... & Brewer, N. T. (2020). Reactions to messages about smoking, vaping and COVID-19: two national experiments. *Tobacco Control*.

Haardörfer, R., Cahn, Z., Lewis, M., Kothari, S., Sarmah, R., Getachew, B., & Berg, C. J. (2017). The advertising strategies of early e-cigarette brand leaders in the United States. *Tobacco regulatory science, 3*(2), 222-231.

Hajek, P., Corbin, L., Ladmore, D., & Spearing, E. (2015). Adding e-cigarettes to specialist stop-smoking treatment: City of London pilot project. *Journal of Addiction Research and Therapy, 6*244), 2. DOI: 10.4172/2155-6105.1000244

Hajek, P., Phillips-Waller, A., Przulj, D., Pesola, F., Myers Smith, K., Bisal, N., ... & Ross, L. (2019). A randomized trial of e-cigarettes versus nicotine-replacement therapy. *New England Journal of Medicine, 380*(7), 629-637.

Harrell, P. T., Brandon, T. H., England, K. J., Barnett, T. E., Brockenberry, L. O., Simmons, V. N., & Quinn, G. P. (2019). Vaping Expectancies: A Qualitative Study among Young Adult Nonusers, Smokers, Vapers, and Dual Users. *Substance Abuse: Research and Treatment, 13*, 1178221819866210.

Harrell, P. T., Marquinez, N. S., Correa, J. B., Meltzer, L. R., Unrod, M., Sutton, S. K., Simmons, V. N., & Brandon, T. H. (2015a). Expectancies for cigarettes, e-cigarettes, and nicotine replacement therapy among e-cigarette users ("vapers"). Nicotine & Tobacco Research, 17, 193-200. PMID: 25168035, PMCID: PMC4438353

Harrell, P. T., Simmons, V. N., Piñeiro, B., Correa, J. B., Menzie, N. S., Meltzer, L. R., ... & Brandon, T. H. (2015b). E-cigarettes and expectancies: why do some users keep smoking?. *Addiction, 110*(11), 1833-1843.

Hartmann-Boyce, J., McRobbie, H., Bullen, C., Begh, R., Stead, L. F., & Hajek, P. (2016). Electronic cigarettes for smoking cessation. *The Cochrane Library*. doi: 10.1002/14651858.CD010216.pub3

Hauser, D., Paolacci, G., & Chandler, J. J. (2018). Common concerns with MTurk as a participant pool: Evidence and solutions.

Hauser, D. J., & Schwarz, N. (2016). Attentive Turkers: MTurk participants perform better on online attention checks than do subject pool participants. *Behavior Research Methods, 48*(1), 400-407.

Hatsukami, D., Meier, E., Lindgren, B. R., Anderson, A., Reisinger, S., Norton, K., ... &

Carmella, S. (2019). A Randomized Clinical Trial Examining the Effects of Instructions for Electronic Cigarette Use on Smoking-Related Behaviors, and Biomarkers of Exposure. *Nicotine & Tobacco Research*.

Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford publications.

Huang, J., Duan, Z., Kwok, J., Binns, S., Vera, L. E., Kim, Y., ... & Emery, S. L. (2019). Vaping versus Juuling: How the extraordinary growth and marketing of Juul transformed the US retail e-cigarette market. *Tobacco Control*, *28*(2), 146-151.

Hughes, J. R., Hatsukami, D. K., Pickens, R. W., Krahn, D., Malin, S., & Luknic, A. (1984). Effect of nicotine on the tobacco withdrawal syndrome. *Psychopharmacology*, *83*(1), 82-87. doi:10.1007/BF00427428

Hull, J. G., & Bond, C. F. (1986). Social and behavioral consequences of alcohol consumption and expectancy: A meta-analysis. *Psychological Bulletin, 99*(3), 347-360. doi: 10.1037/0033-2909.99.3.347

Ickes, M., Hester, J. W., Wiggins, A. T., Rayens, M. K., Hahn, E. J., & Kavuluru, R. (2019). Prevalence and reasons for Juul use among college students. *Journal of American College Health*, 1-5.

Jester, J. M., Wong, M. M., Cranford, J. A., Buu, A., Fitzgerald, H. E., & Zucker, R. A. (2015). Alcohol expectancies in childhood: change with the onset of drinking and ability to predict adolescent drunkenness and binge drinking. *Addiction*, *110*, 71-79.

Juliano, L. M., & Brandon, T. H. (2002). Effects of nicotine dose, instructional set, and outcome expectancies on the subjective effects of smoking in the presence of a stressor. *Journal of Abnormal Psychology, 111*(1), 88-97. doi: 10.1037/0021-843X.111.1.88

Kim, A. E., Arnold, K. Y., & Makarenko, O. (2014). E-cigarette advertising expenditures in the US, 2011–2012. *American Journal of Preventive Medicine*, *46*(4), 409-412.

Kim, A. E., Lee, Y. O., Shafer, P., Nonnemaker, J., & Makarenko, O. (2015). Adult smokers' receptivity to a television advert for electronic nicotine delivery systems. *Tobacco Control*, *24*(2), 132-135.

King, B. A., Patel, R., Nguyen, K., & Dube, S. R. (2014). Trends in awareness and use of electronic cigarettes among US adults, 2010-2013. *Nicotine & Tobacco Research*, ntu191. doi: 10.1093/ntr/ntu191

Kornfield, R., Huang, J., Vera, L., & Emery, S. L. (2015). Rapidly increasing promotional expenditures for e-cigarettes. *Tobacco Control*, *24*(2), 110-111.

Krishnan-Sarin, S., Jackson, A., Morean, M., Kong, G., Bold, K. W., Camenga, D. R., ... & Wu, R. (2019). E-cigarette devices used by high-school youth. *Drug and Alcohol Dependence*, *194*, 395-400.

Leventhal, A. M., & Schmitz, J. M. (2006). The role of drug use outcome expectancies in substance abuse risk: An interactional–transformational model. *Addictive Behaviors*, *31*(11), 2038-2062.

Lynam, D. R. (2013). Development of a short form of the UPPS-P Impulsive Behavior Scale. Unpublished Technical Report.

Lynam, D. R., Smith, G. T., Whiteside, S. P., & Cyders, M. A. (2006). The UPPS-P: Assessing five personality pathways to impulsive behavior. *West Lafayette, IN: Purdue University*.

Majeed, B. A., Weaver, S. R., Gregory, K. R., Whitney, C. F., Slovic, P., Pechacek, T. F., & Eriksen, M. P. (2017). Changing perceptions of harm of e-cigarettes among US adults, 2012–2015. *American Journal of Preventive Medicine*, *52*(3), 331-338.

Malt, L., Verron, T., Cahours, X., Guo, M., Weaver, S., Walele, T., & O'Connell, G. (2020). Perception of the relative harm of electronic cigarettes compared to cigarettes amongst US adults from 2013 to 2016: analysis of the Population Assessment of Tobacco and Health (PATH) study data. *Harm Reduction Journal*, *17*(1), 1-12.

Maniaci, M. R., & Rogge, R. D. (2014). Caring about carelessness: Participant inattention and its effects on research. *Journal of Research in Personality, 48,* 61-83. doi:10.1016/j.jrp.2013.09.008

Manzoli, L., Flacco, M. E., Fiore, M., La Vecchia, C., Marzuillo, C., Gualano, M. R., ... & Boccia, S. (2015). Electronic cigarettes efficacy and safety at 12 months: Cohort study. *PloS one*, *10*(6), e0129443.

Marlatt, G. A., Demming, B., & Reid, J. B. (1973). Loss of control drinking in alcoholics: an experimental analogue. *Journal ofAbnormal Psychology, 81,* 233-241.

McMillen, R. C., Gottlieb, M. A., Shaefer, R. M. W., Winickoff, J. P., & Klein, J. D. (2014). Trends in electronic cigarette use among U.S. adults: Use is increasing in both smokers and nonsmokers. *Nicotine & Tobacco Research*. doi: 10.1093/ntr/ntu213

McNeill, A., Brose, L. S., Calder, R., Bauld, L., & Robson, D. (2018). Evidence review of e-cigarettes and heated tobacco products 2018. *A report commissioned by Public Health England. London: Public Health England*, *6*.

McNeill, A., Brose, L. S., Calder, R., Hitchman, S. C., Hajek, P., & McRobbie, H. (2015). E-cigarettes: An evidence update. *Public Health England*, *3*.

McRobbie, H., Bullen, C., Hartmann-Boyce, J., & Hajek, P. (2014). Electronic cigarettes for smoking cessation and reduction. *Cochrane Database of Systematic Reviews, 12*. doi: 10.1002/14651858.CD010216.pub2

Mehrabian, A., & Russell, J. A. (1974). *An approach to environmental psychology*. Cambridge, MA: MIT.

National Academies of Sciences, Engineering, and Medicine. (2018). *Public health consequences of e-cigarettes*. National Academies Press.

Morris, J. D. (1995). Observations: SAM: The Self-Assessment Manikin; an efficient cross-cultural measurement of emotional response. *Journal of Advertising Research, 35(6),* 63–68.

Norton, K. J., June, K. M., & O'Connor, R. J. (2014). Initial puffing behaviors and subjective responses differ between an electronic nicotine delivery system and traditional cigarettes. *Tobacco Induced Diseases, 12*(1), 17. doi: 10.1186/1617-9625-12-17

O'Connell, G., Pritchard, J. D., Prue, C., Thompson, J., Verron, T., Graff, D., & Walele, T. (2019). A randomised, open-label, cross-over clinical study to evaluate the pharmacokinetic profiles of cigarettes and e-cigarettes with nicotine salt formulations in US adult smokers. *Internal and Emergency Medicine*, 1-9.

Patel, D., Davis, K. C., Cox, S., Bradfield, B., King, B. A., Shafer, P., ... & Bunnell, R. (2016). Reasons for current E-cigarette use among US adults. *Preventive Medicine*, *93*, 14-20.

Patel, M., Cuccia, A., Willett, J., Zhou, Y., Kierstead, E. C., Czaplicki, L., . . . Vallone, D. (2019). JUUL use and reasons for initiation among adult tobacco users. *Tobacco Control, 28*(6), 681-686.

Payne, J. D., Orellana-Barrios, M., Medrano-Juarez, R., Buscemi, D., & Nugent, K. (2016, July). Electronic cigarettes in the media. In *Baylor University Medical Center Proceedings* (Vol. 29, No. 3, pp. 280-283). Taylor & Francis.

Piñeiro, B., Correa, J. B., Simmons, V. N., Harrell, P. T., Menzie, N. S., Unrod, M., ... & Brandon, T. H. (2016). Gender differences in use and expectancies of e-cigarettes: Online survey results. *Addictive behaviors*, *52*, 91-97.

Polosa, R., Caponnetto, P., Maglia, M., Morjaria, J. B., & Russo, C. (2014). Success rates with nicotine personal vaporizers: a prospective 6-month pilot study of smokers not intending to quit. *BMC public health*, *14*(1), 1159.

Pokhrel, P., Fagan, P., Herzog, T. A., Laestadius, L., Buente, W., Kawamoto, C. T., ... & Unger, J. B. (2018). Social media e-cigarette exposure and e-cigarette expectancies and use among young adults. *Addictive Behaviors*, *78*, 51-58.

Pokhrel, P., Herzog, T. A., Muranaka, N., & Fagan, P. (2015). Young adult e-cigarette users' reasons for liking and not liking e-cigarettes: a qualitative study. *Psychology & Health*, *30*(12), 1450-1469.

Pokhrel, P., Little, M. A., Fagan, P., Muranaka, N., & Herzog, T. A. (2014). Electronic cigarette use outcome expectancies among college students. *Addictive Behaviors*, *39*(6), 1062-1065.

Prochaska, J. O., DiClemente, C. C., & Norcross, J. C. (1993). In search of how people change: Applications to addictive behaviors. *Addictions Nursing Network*, *5*(1), 2-16.

Rohsenow, D. J. (1983). Drinking habits and expectancies about alcohol's effects for self versus others. *Journal of Consulting and Clinical Psychology, 51*(5), 752–756

Rottenberg, J., Ray, R.R., & Gross, J.J. (2007). Emotion elicitation using films. In J.A. Coan & J.J.B Allen (Eds.), *The Handbook of Emotion Elicitation and Assessment*. New York: Oxford University Press.

Royal College of Physicians of London. (2016). *Nicotine Without Smoke: Tobacco Harm Reduction*. Royal College of Physicians of London.

Scott-Sheldon, L. A., Terry, D. L., Carey, K. B., Garey, L., & Carey, M. P. (2012). Efficacy of expectancy challenge interventions to reduce college student drinking: A meta-analytic review. *Psychology of Addictive Behaviors*, *26*, 393-405.

Siegel, M. B., Tanwar, K. L., & Wood, K. S. (2011). Electronic cigarettes as a smoking-cessation tool: Results from an online survey. *American Journal of Preventative Medicine, 40*(4), 472-475. doi: 10.1016/j.amepre.2010.12.006

Sears, C. G., Walker, K. L., Hart, J. L., Lee, A. S., Siu, A., & Smith, C. (2017). Clean, cheap, convenient: Promotion of electronic cigarettes on YouTube. *Tobacco Prevention & Cessation*, *3*.

Soneji, S. S., Sung, H. Y., Primack, B. A., Pierce, J. P., & Sargent, J. D. (2018). Quantifying population-level health benefits and harms of e-cigarette use in the United States. *PLoS One, 13*(3), e0193328.

Tate, J. C., Stanton, A. L., Green, S. B., Schmitz, J. M., Le, T., & Marshall, B. (1994). Experimental analysis of the role of expectancy in nicotine withdrawal. *Psychology of Addictive Behaviors, 8*(3), 169. doi: 10.1037/0893-164X.8.3.169

Trtchounian, A., Williams, M., & Talbot, P. (2010). Conventional and electronic cigarettes (e-cigarettes) have different smoking characteristics. *Nicotine & Tobacco Research, 12*(9), 905-912. doi: 10.1093/ntr/ntq114

USDHHS. (2014). *The health consequences of smoking-50 years of progress: A report of the Surgeon General*. Atlanta (GA): Centers for Disease Control and Prevention (US).

US Surgeon General. (2016). E-cigarette use among youth and young adults: A report of the Surgeon General. Office of the Surgeon General, Public Health Service, US Department of Health and Human Services, Rockville, MD.

Walker, N., Parag, V., Verbiest, M., Laking, G., Laugesen, M., & Bullen, C. (2020). Nicotine patches used in combination with e-cigarettes (with and without nicotine) for smoking cessation: A pragmatic, randomised trial. The Lancet Respiratory Medicine, 8, 54-64. doi: 10.1016/S2213-2600(19)30269-3

Wang T. W., Asman K., Gentzke A. S., et al. (2018). Tobacco Product Use Among Adults—United States, 2017. *MMWR. Morbidity and Mortality Weekly Report 2018; 67(44):* 1225-1232. doi:10.15585/mmwr.mm6744a2

Warner, K. E., & Mendez, D. (2018). E-cigarettes: comparing the possible risks of increasing smoking initiation with the potential benefits of increasing smoking cessation. *Nicotine and Tobacco Research*, *21*(1), 41-47.

Willett, J. G., Bennett, M., Hair, E. C., Xiao, H., Greenberg, M. S., Harvey, E., ... & Vallone, D. (2019). Recognition, use and perceptions of Juul among youth and young adults. *Tobacco Control*, *28*(1), 115-116.

Yingst, J. M., Veldheer, S., Hrabovsky, S., Nichols, T. T., Wilson, S. J., & Foulds, J. (2015). Factors associated with electronic cigarette users' device preferences and transition from first generation to advanced generation devices. *Nicotine & Tobacco Research*. doi: 10.1093/nt

Zhu, S. H., Zhuang, Y. L., Wong, S., Cummins, S. E., & Tedeschi, G. J. (2017). E-cigarette use and associated changes in population smoking cessation: evidence from US current population surveys. *bmj*, *358*, j326