Brief report

Exposure to the Tobacco Power Wall Increases Adolescents' Willingness to Use E-cigarettes in the Future

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Abstract

Introduction: Adolescents' e-cigarette use is now more prevalent than their combustible cigarette use. Youth are exposed to e-cigarette advertising at retail point-of-sale (POS) locations via the tobacco power wall (TPW), but no studies have assessed whether exposure to the TPW influences susceptibility to future e-cigarette use.

Methods: The study was conducted in the RAND Store Lab (RSL), a life-sized replica of a convenience store developed to experimentally evaluate how POS advertising influences tobacco use risk under simulated shopping conditions. In a between-subjects experiment, 160 adolescents (M age = 13.82; 53% female, 56% white) were randomized to shop in the RSL under one of two conditions: (1) TPW located behind the cashier ($n = 80$); or (2) TPW hidden behind an opaque wall ($n = 80$). Youths rated willingness to use e-cigarettes ("If one of your best friends were to offer you an e-cigarette, would you try it?"; 1 = definitely not, 10 = definitely yes) before and after exposure. Linear regression assessed differences in pre-post changes in willingness to use across conditions.

Results: Ever-use of e-cigarettes was 5%; use of cigarettes was 8%; use of both e-cigarettes and cigarettes was 4%. There were no differences between TPW conditions on these or other baseline variables (eg, age, gender). Compared to the hidden condition, TPW exposure was associated with greater increases in willingness to use e-cigarettes in the future ($B = 1.15$, standard error [SE] = 0.50, $p = .02$).

Conclusions: Efforts to regulate visibility of the TPW at POS may help to reduce youths' susceptibility to initiating e-cigarettes as well as conventional tobacco products like cigarettes.

Implications: Past work suggests that exposure to the TPW in common retail settings, like convenience stores, may increase adolescents' susceptibility to smoking cigarettes. This experimental study builds upon prior research to show that exposure to the TPW at retail POS similarly increases adolescents' willingness to use e-cigarettes in the future. Efforts to regulate the visibility of the TPW in retail settings may help to reduce youths' susceptibility to initiating nicotine and tobacco products, including e-cigarettes.

Introduction

Electronic cigarettes or electronic nicotine delivery systems (hereafter, e-cigarettes) are now the most commonly used nicotine/tobacco products among youth in the United States.^{1,2} Although evidence suggests that e-cigarettes are less risky to health than combustible tobacco products,^{3–5} they are not without harm (eg, users risk nicotine dependence; eg, ref.⁶), and long-term health risks of e-cigarette use are yet unknown. Moreover, recent longitudinal studies suggest that e-cigarette use by adolescents and young adults is associated with progression to using more harmful tobacco products.⁷ Thus, the current “epidemic” of e-cigarette use by youth is a serious public health concern.⁸

Use of e-cigarettes has risen in line with increased tobacco industry spending on e-cigarette advertising,⁹ suggesting that increased availability and awareness of these products has bolstered popularity among youth. Survey research suggests that exposure to e-cigarette advertising is correlated with increased e-cigarette use in adolescents¹⁰ and increased susceptibility to future use among non-users.^{11,12} E-cigarettes have also become more prominent in retail spaces recently, and sales in settings like convenience stores have increased substantially.¹³ The most common source of exposure to e-cigarette advertising is the retail point-of-sale (POS) setting.^{9,12} Annually, over 14 million youth in the United States—more than half of middle and high school students—are exposed to e-cigarette advertising at retail POS.⁹ Advertising in this setting includes billboard advertising and the “tobacco power wall” (TPW): prominent, expansive displays of many different tobacco products—including e-cigarettes—at the POS location. Emerging evidence suggests that exposure to the TPW is associated with susceptibility to future cigarette smoking.¹⁴ However, little is known about the impact of exposure to the TPW at retail POS on susceptibility to e-cigarette use.

The current study experimentally examined the effect of exposure to a TPW that displayed combustible tobacco, smokeless tobacco, and e-cigarettes on susceptibility to future ENDS use—specifically, willingness to use e-cigarettes—among adolescents. The study utilized the RAND Store Lab (RSL), an innovative convenience store retail laboratory that “sells” tobacco products in addition to other products typically found in such stores.¹⁴ The RSL allows for manipulation of key ingredients of the POS retail environment, including placement of TPW displays, in a highly controlled, but externally and ecologically valid way. In this between-subjects experimental study, we compared two conditions (TPW visible behind a cashier; TPW hidden from view) to examine the impact of exposure to the TPW on youths’ willingness to use e-cigarettes in the future. Findings have implications for regulation of e-cigarette advertising at retail POS.

Methods

Participants

Participants in this study were 160 middle and high school students, ages 11–17 years ($M = 13.69$, $SD = 1.98$). Individuals were recruited using print, internet, and radio advertisements around the city of Pittsburgh in 2014–2015. Advertisements indicated that the study was about teens’ convenience store purchasing habits. Recruitment materials contained no information about smoking or tobacco to reduce potential sample biases. Parents of interested participants telephoned the study center to complete a brief eligibility screening and provided written consent. Adolescents assented to their own participation.

Procedure

Data collection occurred at the RSL, a life-sized replica of a convenience store, located within an office building in Pittsburgh that is only open to study participants. Details about the development of the RSL and photographs of its interior are published elsewhere.¹⁴ The RSL stocks over 650 unique products (eg, dairy products, snack foods, beverages), and stocking and product arrangement adhere to industry guidelines. Product posters appear on the walls, shelves, and windows of the store. Posters for tobacco products appear in the windows and doors of the RSL, as well as on the TPW (the same tobacco posters appeared on the RSL windows and doors, regardless of experimental condition).

Prior to the experiment, research assistants explained general parameters of the study to participants and parents (eg, the study involved adolescents’ convenience store shopping habits; involved minimal risk), and stated that some parts of the study could not be revealed beforehand because that knowledge could affect study outcomes. Participants and parents were informed that they would be provided with all information about the study upon completion. Their consent/assent indicated agreement to participate in the study without full knowledge of the details of the study. The study was approved by RAND’s Human Subjects Protection Committee.

Before entering the RSL, participants completed a questionnaire that assessed demographic information, history of smoking and other forms of tobacco use, and convenience store shopping habits. Participants were then randomized to one of two experimental conditions: 1) the *cashier condition*, in which the TPW appeared behind the cashier; and 2) the *hidden condition*, in which the TPW was hidden from view by an opaque wall behind the cashier; a sign on the wall read “Tobacco Sold Here.” In the *cashier condition*, the TPW displayed primarily cigarettes (~80% of the total display area), with brands corresponding to the US market share for cigarettes. The TPW also displayed smokeless tobacco products, cigars/cigarillos, and e-cigarettes (5–10% of the display area).

Upon entering the RSL, participants were provided with \$10 and instructed to shop for whatever items they wanted. They were told to check-out and pay for the items as they would in any convenience store; there was no limit imposed on time spent “shopping.” A research assistant acted as the RSL cashier when participants were ready to complete their “purchases.” After exiting the RSL, participants completed a questionnaire that included items assessing willingness to use e-cigarettes in the future. Participants were then debriefed, shown a 20-minute video about cigarette advertising and media literacy, and given a \$50 gift card.

Measures

Dependent Variables

Willingness to Use E-cigarettes. In both baseline and post-shopping questionnaires, participants rated their willingness to use e-cigarettes in the future, one index of susceptibility to future product use,^{15,16} on a 10-point scale (1 = definitely not, 10 = definitely yes) in response to the following: “If one of your best friends were to offer you an e-cigarette, would you try it?”¹⁶ In addition, because youth show more favorable attitudes toward flavored e-cigarettes,¹⁷ a separate item asked specifically about flavored e-cigarettes: “If one of your best friends were to offer you a flavored e-cigarette (chocolate, mint, apple, etc.), would you try it?” (*flavored*).¹⁸ The two items were

summed to create a total willingness score (Cronbach's $\alpha = .95$). Pre-shopping willingness scores were subtracted from post-shopping scores to create change scores for analysis.

Baseline Questionnaire Measures

Lifetime and Past-Month Tobacco Use. Participants were asked if they had ever used cigarettes or e-cigarettes in their lifetime. They also reported whether they had used these products in the past month.

Past-Month Exposure to E-cigarette Advertising. Participants reported how often (never, hardly ever, some of the time, most of the time) they had seen advertisements for e-cigarettes in the past month ("During the past 30 days, about how often have you seen advertisements for electronic cigarettes or e-cigarettes...").⁹ Separate items asked about exposure through each of the following channels: convenience stores, print magazines or newspapers, outdoor billboards or signs, television programs, or while visiting websites.

Demographics. Participants reported their age, race/ethnicity (white, black, Asian, Hispanic/Latino, multiple races/ethnicities, other race/ethnicity), and gender.

Analyses

We used *t*-tests and chi-square analyses to assess bivariate associations between participant characteristics (demographics, tobacco use, self-reported e-cigarette advertising exposure) and TPW condition. Analysis of covariance (ANCOVA) assessed the association between TPW condition (cashier vs. hidden) and pre-post shopping change scores in willingness to use e-cigarettes in the future. The model controlled for age, race/ethnicity, gender, ever-use of cigarettes, ever-use of e-cigarettes, and self-reported frequency of past-month exposure to e-cigarette advertising in convenience stores. We also conducted exploratory post hoc analyses to assess whether the effect of the TPW on change scores was moderated by participant age (continuous) or age category (11–13 years old vs. 14 to 17 years old; based on median split).

Results

Participant characteristics are shown in Table 1. There were no differences between TPW conditions on demographic characteristics, cigarette use, e-cigarette use, or self-reported past-month exposure to e-cigarette advertising ($ps > .16$). The sample ($n = 160$) was 47% male, 56% non-Hispanic white, 28% non-Hispanic black, 2% Asian, 4% multiple races/ethnicities, 5% Hispanic, 5% other races/ethnicities. Youth averaged 13.82 ($SD = 1.98$) years old. Approximately 5% of participants reported lifetime use of e-cigarettes; 8% reported having used cigarettes, and 4% reported having used both e-cigarettes and cigarettes. Slightly more youth reported past-month e-cigarette use (3%) than cigarette use (2%); all past-month cigarette users also reported past-month e-cigarette use.

Convenience stores were the most common source of exposure to e-cigarette advertising: over three-quarters (78%) reported some exposure to e-cigarette advertising in stores, and 14% reported seeing e-cigarette ads in convenience stores most of the time. Television was the next most common source of advertising exposure, with over two-thirds (68%) of youth endorsing some exposure; 5% of

Table 1. Participant Characteristics

	Mean (SD)/percent
	Total N = 160
Demographics	
Age	13.69 (1.98)
Gender	
Male	45.28%
Female	54.72%
Race/ethnicity	
Non-Hispanic white	55.63%
Non-Hispanic black	28.13%
Non-Hispanic Asian	1.88%
Hispanic	5.00%
Multiple/Other	9.38%
Tobacco use	
Ever use	
Cigarettes	8.23%
E-cigarettes	5.00%
Both	3.80%
Past-month use	
Cigarettes	1.88%
E-cigarettes	2.50%
Both	1.88%
Past-month exposure to e-cigarette advertising	
Convenience store	
Never	21.88%
Hardly ever	30.00%
Some of the time	33.75%
Most of the time	14.38%
Print	
Never	41.77%
Hardly ever	31.65%
Some of the time	22.78%
Most of the time	3.80%
Billboard	
Never	33.54%
Hardly ever	36.08%
Some of the time	23.42%
Most of the time	6.96%
TV	
Never	31.88%
Hardly ever	31.88%
Some of the time	31.25%
Most of the time	5.00%
Internet	
Never	35.22%
Hardly ever	38.99%
Some of the time	22.64%
Most of the time	3.14%

participants reported seeing e-cigarette ads on television most of the time.

Table 2 shows baseline and post-exposure ratings of willingness to use e-cigarettes in the future, by TPW condition. There were no differences in baseline total willingness scores across conditions ($p = .36$). Controlling for demographic characteristics, ever-use of cigarettes and e-cigarettes, and past-month exposure to e-cigarette advertising in convenience stores, exposure to the visible TPW was associated with significant increases in willingness to use e-cigarettes in the future ($B = 1.15$, standard error [SE] = 0.50, $p = .02$). Effects did not differ by participant age or age category.

Table 2. Effect of Tobacco Power Wall Exposure on Willingness to Use E-cigarettes in the Future

	Power wall hidden			Power wall visible			Group difference in pre-post change score ^a
	Pre	Post	Change	Pre	Post	Change	
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	<i>p</i>
Total willingness score	4.16 (4.65)	4.10 (4.44)	-0.04 (2.77)	4.03 (4.19)	5.21 (5.24)	1.19 (3.65)	.02

Bolded values are means (SDs) and do not have as associated statistical test. No *p*-value additional *p*-values should be listed in this table.

ANCOVA = analysis of covariance.

^aANCOVA assessed the effect of power wall condition on pre-post change in total willingness score, and controlled for age, race/ethnicity, gender, ever-use of cigarettes, and ever-use of e-cigarettes.

Discussion

This study is the first to experimentally examine the effect of exposure to a TPW in a retail POS environment on adolescents' susceptibility to future e-cigarette use. The current study builds upon prior work examining TPW exposure and susceptibility to cigarette smoking to show that exposure to the TPW that primarily displays combustible products can similarly increase youths' willingness to use e-cigarettes in the future.

Consistent with past research,^{9,12} retail POS was the most common source of past-month e-cigarette advertising exposure reported by youth. Controlling for demographics, prior tobacco use, and self-reported recent exposure to e-cigarette advertising in convenience store settings, exposure to a visible TPW was associated with increased willingness to use e-cigarettes in the future. Our findings align with recent correlational studies, which suggest that adolescents' self-reported exposure to advertising at retail POS correlates with increased susceptibility to using e-cigarettes in the future.^{11,12}

These findings have important implications for efforts to mitigate the impact of nicotine and tobacco product advertising at POS on adolescent e-cigarette use. In 2009, the Family Smoking Prevention and Tobacco Control Act¹⁹ gave the FDA authority to regulate how cigarettes and smokeless tobacco are advertised. Further, under the "deeming" rule,²⁰ effective August 2016, FDA assumed the authority to regulate advertising of additional tobacco products, including e-cigarettes. Under the Family Smoking Prevention and Tobacco Control Act, the FDA can restrict some forms of POS advertising and provide guidance for states and local communities to regulate advertising at POS. Because POS advertising is the most common channel through which youths are exposed to e-cigarette advertising,^{9,12} these findings suggest that policies aimed at limiting exposure to e-cigarette and other tobacco advertising at POS help reducing the impact of industry advertising efforts on future nicotine and tobacco product use among adolescents.

This study was subject to limitations. First, although similar self-reported measures of susceptibility have been shown to predict adolescents' future e-cigarette use,¹⁵ we did not assess actual ENDS use behavior in this experiment. Further, the TPW display was dominated by cigarette products; it is unclear how different product mixes within the TPW and/or differential placement of e-cigarette advertising in the POS environment may affect youths' susceptibility to using and perceptions of e-cigarettes. Future research is needed to address these questions, particularly as e-cigarettes gain an increasingly prominent presence in retail environments that have

historically been dominated by combustible products. Although the RSL is closely modeled after a real convenience store, it is an artificial environment; this experimental investigation may not be a perfect proxy for effects of POS advertising on adolescent e-cigarette use in the real world. These limitations notwithstanding, our findings suggest the need to consider policies that limit e-cigarette and other tobacco advertising at retail POS settings to mitigate the effects of industry advertising on adolescents' use of e-cigarettes.

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Declaration of Interests

None declared.

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