Influence of Tobacco Displays and Ads on Youth: A Virtual Store Experiment

WHAT’S KNOWN ON THIS SUBJECT: Youth exposure to retail tobacco advertisements and displays is associated with smoking initiation. The Family Smoking Prevention and Tobacco Control Act of 2009 gives states and local governments legal authority to regulate the time, place, and manner of tobacco advertising.

WHAT THIS STUDY ADDS: This is the first experimental study using a virtual store environment to provide evidence that a policy banning tobacco product displays at the point of sale may deter youth from attempting to purchase tobacco products at retail stores.

abstract

OBJECTIVE: To examine the potential impact of banning tobacco displays and ads at the point of sale (POS) on youth outcomes.

METHODS: An interactive virtual convenience store was created with scenarios in which the tobacco product display at the POS was either openly visible (status quo) or enclosed behind a cabinet (display ban), and tobacco ads in the store were either present or absent. A national convenience sample of 1216 youth aged 13 to 17 who were either smokers or nonsmokers susceptible to smoking participated in the study. Youth were randomized to 1 of 6 virtual store conditions and given a shopping task to complete in the virtual store. During the shopping task, we tracked youth’s attempts to purchase tobacco products. Subsequently, youth completed a survey that assessed their perceptions about the virtual store and perceptions about the ease of buying cigarettes from the virtual store.

RESULTS: Compared with youth in the status quo condition, youth in the display ban condition were less aware that tobacco products were for sale (32.0% vs 85.2%) and significantly less likely to try purchasing tobacco products in the virtual store (odds ratio = 0.30, 95% confidence interval = 0.13–0.67, P < .001). Banning ads had minimal impact on youth’s purchase attempts.

CONCLUSIONS: Policies that ban tobacco product displays at the POS may help reduce youth smoking by deterring youth from purchasing tobacco products at retail stores. Pediatrics 2013;131:e88–e95

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KEY WORDS adolescence, tobacco advertising, tobacco control policy, tobacco use/smoking

ABBREVIATION POS—point of sale

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Despite significant progress in reducing youth smoking in the United States, the rates of decline have stalled in the past decade. States have experienced dramatic budget cuts for tobacco prevention programs, but the tobacco industry continues to market its products aggressively with nearly 90% of its $10 billion marketing expenditure spent on retailer incentives and price promotions at the point of sale (POS), making retail stores the most important advertising channel for the tobacco industry. The level of retail cigarette advertisements and promotions has increased over time, and cigarette products are prominently placed on shelves behind checkout counters, exposing all store customers, including youth, to tobacco products. Studies show that youth are highly aware of tobacco ads in stores, and such exposure influences youth perceptions regarding ease of access to cigarettes, smoking prevalence, and peer approval of smoking. Youth who are exposed to retail tobacco marketing are also more likely to experiment with smoking and to become smokers.

The Family Smoking Prevention and Tobacco Control Act of 2009 gives states and local governments legal authority to regulate the time, place, and manner of tobacco advertising. As states consider policies such as banning the display of tobacco products, empirical studies are needed to determine the potential impact of these regulations. Case studies in Ireland and Canada show that youth and adult awareness of POS tobacco marketing dropped significantly after a ban on tobacco displays and ads. Although these case studies suggest that banning POS tobacco displays and ads could help deter youth smoking, few studies have systematically examined the potential impact of these policies on smoking outcomes. In an experimental study, Wakefield and colleagues examined the potential impact of regulating POS tobacco product displays and ads by showing Australian youth photos in which cigarette packs were displayed with and without ads (status quo in retail stores), without ads, and with neither ads nor packs displayed. They found that exposure to tobacco product displays with and without ads was associated with increased perceptions that tobacco products were easy to purchase at the store compared with those who viewed the no cigarette display condition. In addition, they found that, compared with those in the no cigarette display condition, students who were exposed to the cigarette advertising condition perceived it would be less likely they would be asked for proof of age and that a greater number of stores would sell them cigarettes. A potential limitation of this study is that the stimuli were photographs shown in a classroom setting, which does not reflect real-world exposure to POS displays.

We extend the Wakefield et al study by using a virtual store to simulate a more interactive exposure to POS tobacco product displays and ad bans. Virtual reality applications are intended to simulate features of the real-world environment, which enables researchers to immerse participants into a hypothetical context and study their behavioral responses to environmental cues that may be difficult to assess in a real-life setting. Virtual reality environments have been used to study a wide range of behaviors including behaviors among young adults and to test the effect of smoking cues on smokers’ cravings for cigarettes in young adults and adults. However, to date, no studies have used virtual environments to study the impact of tobacco displays and ads on youth. We designed a virtual store and gave youth a specific shopping task to assess whether youth exposed to the display ban condition are less likely to attempt buying tobacco products in the virtual store and perceive that it is difficult to buy cigarettes at the virtual store. A secondary aim was to examine whether the presence of tobacco ads in the store moderates these relationships.

**METHODS**

**Study Design**

We designed a $3 \times 2$ experimental study with 3 variations of the POS tobacco product displays (open, enclosed, and with ads on cabinet) and 2 variations of tobacco ads in store (present, absent) for a total of 6 conditions (defined in Table 1 and exhibited in Figs 1 and 2).

An off-the-shelf model of a convenience store was purchased and extensively customized for this study by using Unity 3D interactive gaming software. The initial beta version of the virtual store was pilot tested with focus groups of 12 youth aged 14 through 17 who were current smokers or nonsmokers susceptible to smoking. The virtual store was updated on the basis of feedback from the focus groups (eg, improved navigation speed, expanded product selections).

**Participants and Virtual Shopping Task**

A national convenience sample of current smoker or nonsmoker susceptible to smoking youth aged 13 to 17 were recruited from Research Now’s e-Rewards online youth panel and via parents in their adult panel who indicated having children aged 13 to 17. Current smokers were defined as smoking at least 1 cigarette per day in the past 30 days. Non-smokers susceptible to smoking were defined as those who had not smoked in the past 30 days and answered “definitely yes, probably yes, or probably not” to any 1 of these 3 questions: “Do you think you will smoke a cigarette anytime during the next year?” “Do you think you will try a cigarette soon?” and “If one of your best friends offered you a cigarette, would you smoke it?”
E-mail invitations were sent, and 4189 panelists consented to participate and met the eligibility criteria (Fig 3). Participants initiated the study by clicking on a link that randomized them to 1 of 6 conditions. If participants already had the Unity 3D player installed on their computer, the virtual store application loaded, and they began the virtual shopping task. If participants did not have the Unity player, they were prompted to download the player.

For the virtual shopping task, participants were instructed to select 4 items for purchase: a snack from the aisles, a drink from the coolers, and 2 items of their choice from the checkout counter. Participants were not specifically instructed to purchase tobacco. Participants had a total of 10 minutes to complete their shopping task. As participants navigated through the store, they were exposed to one of two versions of the store environment in which tobacco ads were either present or absent (see Fig 2). When the participant moved to the checkout counter to purchase the last 2 items, he or she was exposed to 1 of the tobacco display conditions (Fig 1). At the checkout counter area, if the participant attempted to purchase tobacco by clicking on the tobacco product display, the animated cashier asked, “Do you want to buy tobacco products?” If the participant clicked “No,” the cashier responded “OK” and resumed talking on his phone. If the participant clicked “Yes,” the cashier responded “Sorry, you are not old enough to purchase this product” and resumed talking on his phone. Once the final 2 items from the checkout counter had been selected, the participant was exposed to the display for another 10 seconds before the shopping task ended and the participant was directed to the survey.

One thousand two hundred sixteen participants completed the study, and most were recruited from the parent panel (62%). There were no meaningful sociodemographic differences among youth who qualified (n = 4189) versus completed (n = 1216) the study. Youth received a $6.50 e-Rewards dollar incentive to be redeemed for products/services upon study completion. This study was approved by Institutional Review Boards at RTI International and the New York State Department of Health.

**Measures**

The 2 key study outcomes were whether youth perceived cigarettes as easy to purchase in the virtual store and whether youth tried to click and purchase tobacco in the virtual store. Perceived ease of access was measured with the following item: “Imagine that a real store like this virtual store was near where you live; how easy or hard would it be for you to buy cigarettes from this store?” Youth were defined as attempting to purchase tobacco if during their shopping task they clicked...
on the tobacco product display and confirmed they wanted to purchase tobacco. This information was captured by the Unity 3D software. We also assessed perceptions about the virtual store, including whether youth were aware that tobacco products were for sale in the virtual store and the extent to which they thought the virtual store resembled a real convenience store. We also measured the following covariates: smoking behavior, youth’s usual source of cigarettes (retail or nonretail), social influence to smoke (whether youth lives with smoker, number of best friends who smoke), sensation-seeking behavior (additive scale constructed from 4 items that assessed the extent to which youth like to explore new places, like to do frightening things, like new and exciting experiences, and prefer friends who are exciting and unpredictable), and key demographics (age, gender, race/ethnicity).

**Analysis**

Process data from the virtual store shopping tasks were linked to the survey data via unique identifiers for each study participant. We tested for potential differences in each outcome by condition. Logistic regression was used because the main outcomes were dichotomized. In general form, we estimated the following regression equation:

![Figure 2](image1.png)

**Figure 2**

Screenshots of tobacco ad conditions in virtual retail store. Note: in the conditions in which tobacco ads were present in the store (C4–C6), there were 2 ads on the exterior door along with 2 branded “pull” signs, 2 ads above the checkout counter, and 2 ads below the checkout counter. In the conditions in which tobacco ads were absent (C1–C3), there were no ads on the exterior door and ads for soft drink and lottery tickets above and below the checkout counter.

![Figure 3](image2.png)

**Figure 3**

Study sample. Note: “Did not install Unity player plug-in” indicates participants who did not already have the Unity player and were unwilling to download it. “Did not complete shopping task” indicates participants who did not have complete data from the virtual retail store. These participants may have ended their virtual shopping task early and thus did not have survey data. “Did not complete survey” indicates participants who completed the virtual retail store data but did not complete the survey.
College Station, TX). Mated by using Stata 11.0 (Stata Corp, College Station, TX).

The perceived ease of access to cigarettes and attempting to purchase tobacco did not show significant differences across conditions regarding perceived ease of access to cigarettes. Among nonsmokers susceptible to smoking, youth in condition C5 (enclosed display, no ads in store) were significantly less likely to believe that it would be hard to purchase cigarettes from the virtual convenience store than youth in condition C1 (open display, no ads in store + ads on cabinet) (48% for C2); this pattern holds when tobacco advertising was removed from the store, with 47.6% in the open display condition (C4) versus 40.5% in the enclosed condition (C5).

Table 3 presents adjusted odds ratios for the 6 experimental conditions for the key outcomes of perceived ease of access to cigarettes and attempting to purchase tobacco. Current smokers did not show significant differences across conditions regarding perceived ease of access to cigarettes. Among nonsmokers susceptible to smoking, youth in condition C5 (enclosed display, no ads in store) were significantly less likely to believe that it would be hard to purchase cigarettes from the virtual convenience store than youth in condition C1 (open display, no ads in store + ads on cabinet) (48% for C2). This pattern holds when tobacco advertising was removed from the store, with 47.6% in the open display condition (C4) versus 40.5% in the enclosed condition (C5).

In summary, we found that enclosing tobacco product displays significantly lowers the likelihood that youth will try to purchase tobacco in the virtual store but inconsistent results on whether they perceive cigarettes to be difficult to purchase. Whereas Wakefield and colleagues found that youth who were exposed to no display or ads were more likely to perceive tobacco as difficult to purchase from the store, we found opposite results among non-smokers. One possible explanation for this may be that youth in enclosed conditions may perceive cigarettes to be more difficult to access and thus are more likely to try and purchase because they see it as a challenge. Policies that restrict access to tobacco products may have the unintended consequences of youth perceiving these products as “forbidden fruit” that are more desirable because they are associated with being an adult. Tobacco industry documents reveal that tobacco advertising has explicitly attempted to convey the message that smoking cigarettes is synonymous with being an adult. In our experiment, although tobacco products were not visible in the enclosed conditions, the cabinets were labeled with the word “cigarettes,” which indicated cigarette products may be available for sale. Enclosing the display in this manner may have the unintended effect of emphasizing the message that tobacco is for adults, thereby increasing youth’s desire to use those products. We included this signage in our design because it resembled how stores in New York State and in other countries had implemented tobacco product display condition (C1; see Table 3). Current smokers in conditions C5 (enclosed display, no ads in store) and C6 (enclosed display, no ads in store + ads on cabinet) were less likely than current smokers in condition C4 (open display, no ads in store) to attempt purchasing tobacco.

**DISCUSSION**

In summary, we found that enclosing tobacco product displays significantly lowers the likelihood that youth will try to purchase tobacco in the virtual store but inconsistent results on whether they perceive cigarettes to be difficult to purchase. Whereas Wakefield and colleagues found that youth who were exposed to no display or ads were more likely to perceive tobacco as difficult to purchase from the store, we found opposite results among non-smokers. One possible explanation for this may be that youth in enclosed conditions may perceive cigarettes to be more difficult to access and thus are more likely to try and purchase because they see it as a challenge. Policies that restrict access to tobacco products may have the unintended consequences of youth perceiving these products as “forbidden fruit” that are more desirable because they are associated with being an adult. Tobacco industry documents reveal that tobacco advertising has explicitly attempted to convey the message that smoking cigarettes is synonymous with being an adult. In our experiment, although tobacco products were not visible in the enclosed conditions, the cabinets were labeled with the word “cigarettes,” which indicated cigarette products may be available for sale. Enclosing the display in this manner may have the unintended effect of emphasizing the message that tobacco is for adults, thereby increasing youth’s desire to use those products. We included this signage in our design because it resembled how stores in New York State and in other countries had implemented tobacco product display condition (C1; see Table 3). Current smokers in conditions C5 (enclosed display, no ads in store) and C6 (enclosed display, no ads in store + ads on cabinet) were less likely than current smokers in condition C4 (open display, no ads in store) to attempt purchasing tobacco.

**RESULTS**

Sample characteristics are summarized in Table 2. The distribution of demographics was similar across the 6 conditions. The majority of study participants were aged 15 to 17, male, and white. More than half of participants visit convenience stores more than once per week and 17.4% of current youth smokers report usually getting their cigarettes in a retail store. On average, participants took 172.3 seconds to complete the virtual store shopping task with ~32.1 seconds spent at the checkout counter. More than 80% of respondents agreed that the virtual store resembled a real convenience store.

The proportion of participants who reported seeing tobacco products for sale was highest in the open display condition with ads (C1, 85.2%) and lowest for the enclosed display condition with no ads (C5, 32.0%). When tobacco advertisements are present in the store, 24.3% of study participants clicked to purchase tobacco in the open display condition (C1) compared with only 9.0% in the enclosed display condition (C2). When no tobacco ads were present in the store, 16.4% of youth clicked to purchase tobacco in the open display condition (C4), compared with 10.8% in the enclosed display condition (C5).

The proportion of youth who perceived that it would be hard or very hard to buy cigarettes from the retail store was higher for youth in the open display condition with tobacco ads in store (51.5% for C1) than in the enclosed display condition (48% for C2). This pattern holds when tobacco advertising was removed from the store, with 47.6% in the open display condition (C4) versus 40.5% in the enclosed condition (C5).
bans and therefore represents a likely scenario of how such policies may be adopted in the United States. Although we found no evidence that enclosing the display decreased youth's perceived ease of access, we found that youth who were exposed to the enclosed display conditions were less likely to try purchasing tobacco in the virtual store. We believe that an observational measure of youth clicking on the tobacco product display and affirming that they want to purchase tobacco products may be a more valid measure of youth's desire and intention to buy cigarettes than a self-reported measure about how easy it would be to purchase cigarettes from a pictured store. It is better to observe what youth will actually do in a situation in which tobacco product displays are enclosed than to simply ask them about what they might do. Additionally, the virtual store may be a more realistic way to expose participants to potential display ban conditions than static images and to engage them with the environment by

### TABLE 2 Characteristics of Study Sample

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<thead>
<tr>
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<td>Smoking status, %</td>
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<tr>
<td>Open to smoking</td>
<td>60.5</td>
<td>59.9</td>
<td>60.2</td>
<td>60.6</td>
<td>61.8</td>
<td>60.6</td>
<td>60.0</td>
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<tr>
<td>Current smoker</td>
<td>39.5</td>
<td>40.1</td>
<td>39.8</td>
<td>39.4</td>
<td>38.2</td>
<td>39.4</td>
<td>40.0</td>
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<tr>
<td>Age, y (%)</td>
<td></td>
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<td>13</td>
<td>4.8</td>
<td>6.4</td>
<td>4.0</td>
<td>5.9</td>
<td>4.8</td>
<td>4.9</td>
<td>2.5</td>
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<td>13.8</td>
<td>11.9</td>
<td>14.4</td>
<td>14.8</td>
<td>14.5</td>
<td>8.9</td>
<td>18.5</td>
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<tr>
<td>15</td>
<td>21.1</td>
<td>23.8</td>
<td>17.9</td>
<td>22.2</td>
<td>19.8</td>
<td>22.2</td>
<td>20.5</td>
</tr>
<tr>
<td>16</td>
<td>30.1</td>
<td>33.2</td>
<td>26.9</td>
<td>31.5</td>
<td>30.9</td>
<td>31.0</td>
<td>27.0</td>
</tr>
<tr>
<td>17</td>
<td>30.3</td>
<td>24.8</td>
<td>36.8</td>
<td>25.6</td>
<td>30.0</td>
<td>33.0</td>
<td>31.5</td>
</tr>
<tr>
<td>Male, %</td>
<td>53.5</td>
<td>52.0</td>
<td>56.2</td>
<td>51.7</td>
<td>56.0</td>
<td>50.7</td>
<td>54.5</td>
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<tr>
<td>Race, %</td>
<td></td>
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<tr>
<td>White, non-Hispanic</td>
<td>72.4</td>
<td>68.3</td>
<td>72.6</td>
<td>76.4</td>
<td>69.1</td>
<td>72.9</td>
<td>75.0</td>
</tr>
<tr>
<td>Nonwhite, non-Hispanic</td>
<td>14.6</td>
<td>15.4</td>
<td>12.9</td>
<td>13.8</td>
<td>20.3</td>
<td>15.3</td>
<td>10.0</td>
</tr>
<tr>
<td>Hispanic</td>
<td>13.0</td>
<td>16.3</td>
<td>13.8</td>
<td>9.9</td>
<td>10.8</td>
<td>11.8</td>
<td>15.0</td>
</tr>
<tr>
<td>Sensation scale: 0 (lowest sensation seeking) → 20 (highest sensation seeking), avg (SD)</td>
<td>13.6 (3.8)</td>
<td>13.5 (3.8)</td>
<td>13.6 (3.2)</td>
<td>13.5 (3.3)</td>
<td>13.5 (3.4)</td>
<td>13.3 (3.4)</td>
<td>13.9 (3.3)</td>
</tr>
<tr>
<td>Current smokers who purchased from a convenience store, supermarket, or gas station, %</td>
<td>17.4</td>
<td>19.7</td>
<td>16.9</td>
<td>14.3</td>
<td>17.7</td>
<td>18.2</td>
<td>18.1</td>
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<tr>
<td>Live with smoker, %</td>
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<tr>
<td>32.3</td>
<td>32.0</td>
<td>32.0</td>
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<td></td>
</tr>
<tr>
<td>Said they have 2–5 best friends who smoke, %</td>
<td>38.2</td>
<td>38.3</td>
<td>39.3</td>
<td>40.6</td>
<td>34.3</td>
<td>40.4</td>
<td>36.4</td>
</tr>
<tr>
<td>Time spent in shopping aisles, s, avg (SD)</td>
<td>172.3 (91.0)</td>
<td>171.1 (87.7)</td>
<td>169.5 (81.4)</td>
<td>173.7 (83.5)</td>
<td>176.2 (109.8)</td>
<td>186.1 (87.6)</td>
<td>177.1 (93.5)</td>
</tr>
<tr>
<td>Time spent at counter, s, avg (SD)</td>
<td>32.1 (16.7)</td>
<td>32.4 (15.9)</td>
<td>30.8 (16.8)</td>
<td>31.0 (15.8)</td>
<td>33.9 (18.3)</td>
<td>32.3 (16.1)</td>
<td>32.1 (16.7)</td>
</tr>
<tr>
<td>Saw tobacco for sale, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>69.3</td>
<td>65.2</td>
<td>69.2</td>
<td>62.1</td>
<td>79.2</td>
<td>32.0</td>
<td>48.5</td>
<td>59.5</td>
</tr>
<tr>
<td>Saw tobacco advertisements, %</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>57.1</td>
<td>57.3</td>
<td>59.2</td>
<td>69.5</td>
<td>49.8</td>
<td>29.6</td>
<td>59.5</td>
<td>59.5</td>
</tr>
<tr>
<td>Said they go to convenience stores at least a few times a week, %</td>
<td>54.8</td>
<td>58.7</td>
<td>53.7</td>
<td>52.7</td>
<td>58.0</td>
<td>53.7</td>
<td>52.0</td>
</tr>
<tr>
<td>Tried to purchase tobacco, %</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>13.5</td>
<td>13.5</td>
<td>10.3</td>
<td>16.4</td>
<td>10.8</td>
<td>10.0</td>
<td>10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Said it would be hard or very hard to buy cigarettes in virtual store, %</td>
<td>45.0</td>
<td>51.5</td>
<td>48.0</td>
<td>40.9</td>
<td>47.6</td>
<td>40.5</td>
<td>41.7</td>
</tr>
</tbody>
</table>

avg, average.

a Dichotomized variable: reference category is 0–1 best friends who smoke.

b Dichotomized variable: reference category is the virtual store resembles real-world stores a lot, very, or somewhat.

c Dichotomized variable: reference category is those who go to convenience stores approximately once a week, once a month, or hardly ever.

d Dichotomized variable: reference category is those who said it would be very easy, easy, neither easy nor hard to buy cigarettes from the virtual store.
TABLE 3  Adjusted Odds Ratios (95% CI) for Perceived Ease of Access to Cigarettes and Attempting to Purchase Tobacco in the Virtual Store

<table>
<thead>
<tr>
<th>Display Conditions</th>
<th>Current Smokers</th>
<th>Open to Smoking</th>
<th>Current Smokers</th>
<th>Open to Smoking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N = 293)</td>
<td>(N = 681)</td>
<td>(N = 409)</td>
<td>(N = 723)</td>
</tr>
<tr>
<td>C1: Open display, ads in store</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>C2: Enclosed display, ads in store</td>
<td>0.65 (0.33–1.36)</td>
<td>0.49 (0.28–0.85)</td>
<td>0.30 (0.13–0.71)</td>
<td>0.28 (0.08–0.96)</td>
</tr>
<tr>
<td>C3: Enclosed display, ads in store + ads on cabinet</td>
<td>0.68 (0.35–1.35)</td>
<td>0.48 (0.28–0.85)</td>
<td>0.59 (0.27–1.32)</td>
<td>0.46 (0.16–1.33)</td>
</tr>
<tr>
<td>C4: Open display, no ads in store</td>
<td>0.68 (0.35–1.35)</td>
<td>0.48 (0.28–0.85)</td>
<td>0.59 (0.27–1.32)</td>
<td>0.46 (0.16–1.33)</td>
</tr>
<tr>
<td>C5: Enclosed display, no ads in store</td>
<td>0.65 (0.33–1.36)</td>
<td>0.49 (0.28–0.85)</td>
<td>0.30 (0.13–0.71)</td>
<td>0.28 (0.08–0.96)</td>
</tr>
<tr>
<td>C6: Enclosed display, no ads in store + ads on cabinet</td>
<td>0.68 (0.35–1.35)</td>
<td>0.48 (0.28–0.85)</td>
<td>0.59 (0.27–1.32)</td>
<td>0.46 (0.16–1.33)</td>
</tr>
</tbody>
</table>

All odds ratios adjusted for age, race, gender, sensation-seeking scale, number of best friends who smoke, living with a smoker, frequency of going to a convenience store, and virtual store resembles a real convenience store. Current smoker models also control for source of cigarettes (retail versus social source). Perceived ease of access to cigarettes model excludes those who attempted to purchase tobacco in the virtual store.

* Significant difference (P < .05) between C2 and C3 in current smoker model.

** Significant difference (P < .05) between C4 and C5 in open to smoking model.

### REFERENCES


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giving them a specific shopping task. Indeed, previous studies in the field of experimental psychology confer the benefits of using interactive virtual environments to simulate and test the impact of environments or situations that are difficult to study.28–30 In addition, we also confirmed that youth thought our virtual store was a realistic representation of convenience stores that they frequent. Despite these strengths, our study has some potential limitations. First, youth’s exposure to the conditions may not have been sufficient. We attempted to provide substantial exposure to the display conditions by having youth select multiple products at the checkout counter and having the animated retailer purposely keep the youth waiting by talking on his cell phone, but youth only spent an average of 3.4 minutes in the virtual store, which is considerably less than the average of 16 minutes teenagers typically spend when visiting convenience stores.51 However, a previous eye-tracking study52 found differences in outcomes when youth viewed tobacco ads for only 9 to 17 seconds, suggesting that the 32 seconds our study participants spent on average at the POS may have been adequate exposure to the display conditions. Second, it is possible that participants may have been aware that the virtual task was related to smoking. To select the right participants, the screener questions asked about smoking and, per institutional review board guidelines, the consent form mentioned that the survey would assess perceptions about smoking. This may have primed the respondent that the shopping task was about smoking. However, the shopping task itself did not mention anything about smoking and participants were not directed to purchase cigarettes. Furthermore, if priming occurred, it should affect participants across all conditions. Finally, our results have limited generalizability because Research Now’s panelists are a convenience sample recruited via non-probability-based online methods. However, because the purpose of our study was to test the potential impact of banning tobacco displays and ads, our primary concern was to minimize potential threats to internal validity at the cost of potentially limiting external validity. Using an online panel like Research Now provided the benefits of accessing a large number of youth who could be systematically screened and randomized to the virtual store conditions via the Internet.

### CONCLUSIONS

We found that enclosing tobacco product displays could deter youth from attempting to purchase tobacco in retail stores. These results provide support for policies that would ban the display of tobacco products at the POS. The virtual store application can be used to test the impact of other POS policies, such as whether antismoking messages at the POS could mitigate the impact of open tobacco displays or potentially strengthen the impact of enclosed tobacco displays on smoking-related outcomes for youth and adults.


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