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Original investigation

Share of Advertising Voice at the Point-of-Sale and Its Influence on At-Risk Students' Use of Alternative Tobacco Products

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Abstract

Introduction: As adolescent tobacco use shifts from traditional cigarettes to alternative products, it is important to understand the influence of point-of-sale (POS) advertising on product use. This research investigated whether the percentage of POS advertising for a particular product, known as the share of advertising voice (SAV), moderated the relationship between exposure to POS tobacco advertisements and tobacco use among at-risk youth.

Methods: Longitudinal self-report data from 746 students attending 20 alternative high schools in southern California was merged with observational data cataloging 2101 advertisements for cigarettes, e-cigarettes, cigars, and smokeless tobacco from 87 tobacco retail outlets within a half mile of the schools. Four multilevel Poisson regression models examined whether SAV interacted with POS tobacco advertising exposure to influence the use of tobacco products 1 year later.

Results: Adolescent exposure to POS tobacco advertisements was significantly associated with increased use of all four tobacco products ($p < .02$). When SAV was added to the model as a moderator, the results showed a significant interaction, such that increasing the SAV for e-cigarettes was associated with greater use of that product ($\beta = 0.27$, SE = 0.07, $p < .001$). The same moderating effect was found for smokeless tobacco ($\beta = 0.56$, SE = 0.19, $p = .004$) but no moderating effect was observed for cigarettes or cigars.

Conclusion: POS SAV has the potential to influence at-risk students' use of alternative tobacco products and may be a contributing factor to recent nationwide shifts in youth tobacco use.

Implications: Future studies should monitor changes in SAV to gain insight into POS marketing trends that may be impacting youth tobacco use. In addition, state and local governments should consider implementing policies that limit the volume and proportion of POS tobacco advertising for all nicotine and tobacco products available in retail environments near schools. Restrictions placed on a single product may cause unintended shifts in product selection rather than a reduction in youth tobacco use.

Introduction

A Shift in Youth Tobacco Use

Despite the millions of dollars spent on tobacco prevention campaigns, tobacco use among youth in the United States remains high and unchanged in recent years.[1] The trend is especially alarming among vulnerable populations such as adolescents who fall behind in their education or have been expelled from school. These students are frequently enrolled in alternative high schools (AHSs) and exhibit high rates of substance use.[2–7] The average adolescent tobacco use rate (past 30 days) in the United States is 25%, but among AHS students it reaches anywhere from 37% to 56%. The majority (72%) of AHS students report using tobacco in their lifetime compared to 38% of students at traditional high schools.[8–10]

Although cigarette use among high school students in the United States has substantially declined in recent years from 15.8% in 2011 to 9.3% in 2015, the use of alternative tobacco products and polytobacco has increased.[1,10,11] Electronic cigarettes (e-cigarettes) have recently become the most prevalent product among students, with 16% reporting current e-cigarette use.[12,13] Simultaneously, there has been a major investment in e-cigarette advertising by tobacco companies, up from $6.4 million in 2011 to more than $100 million in 2015.[12,14] Other examples of changes in tobacco use patterns among youth include the increased use of smokeless tobacco[15] and cigars.[16,17] The trend for at-risk youth is similar. As much as 54% of California AHS students have tried cigars in addition to cigarettes, which is much higher than the national average of 26%.[8,16] Although traditional cigarettes are still prioritized in research, shifts in both marketing expenditures and youth preferences highlight the need to investigate the impact of advertising across a broader range of tobacco products.

Point-of-Sale Tobacco Advertising

Point-of-sale (POS) tobacco advertising has been shown to be an effective technique for influencing adolescents.[18] Meta-analyses and systematic literature reviews provide evidence that POS tobacco advertising is a significant predictor of smoking initiation, escalation, and brand choice among young people.[19,20] A strong positive association between adolescent *exposure* to POS tobacco advertising and tobacco use has also been documented.[20–22] Current laws try to limit exposure of adolescents to tobacco advertising; however, the average adolescent reports seeing 325 tobacco brand impressions per week.[23] Research shows that 85% of middle and high school students are exposed to POS tobacco advertising at stores.[24–26] Although adolescent tobacco users and nonusers perceive advertising differently, both groups are susceptible to POS advertising. When exposed to POS tobacco advertising, nonsmokers are more likely to initiate smoking and smokers are more likely to increase their tobacco use.[27–31] There is also evidence that POS tobacco advertisements affect adolescents' brand preference and product use.[32]

The relationship between exposure to POS tobacco advertising and adolescent tobacco use has been well studied. However, only a few studies have explored the influence of tobacco advertising by *product type* and traced its influence on at-risk adolescents' tobacco use.[21] As POS tobacco advertising continues to evolve, adolescents may be persuaded to experiment with products that function as a gateway to the use of traditional cigarettes. Consequently, it is important to understand what factors may influence tobacco product selection and use.

No study to our knowledge has examined the importance of the proportion of advertising for specific tobacco *product types*, known as share of advertising voice (SAV).[33] SAV has been long used in the research and marketing strategy for consumer goods, and it is well known to be significantly related to the market share of brands and products.[34] However, the few tobacco studies that focus on SAV have examined its influence on brand choice as opposed to the use of different classes of tobacco products. These studies point to the importance of SAV in tobacco marketing, suggesting that cigarette brand SAV has a strong impact on smoking and a stronger impact on youth compared to adults.[35] Yet, these studies have focused only on cigarettes and not the entire range of tobacco products available to students.

The purpose of the current investigation was to examine how the SAV for specific *types* of tobacco products advertised near schools influences AHS students' tobacco use. Specifically, we wanted to understand whether SAV moderates the relationship between adolescent exposure to POS advertising and the use of tobacco products 1 year later. We expected that adolescents would increase their use of specific tobacco products not only if they were exposed to POS tobacco advertising at retail stores, but also if these retail stores had a higher *proportion* of advertising for that product.

Methods

Data Sources

This study combined data from two different sources—longitudinal self-report data from AHS students and independent observational POS advertisement data from tobacco retail outlets (TROs) within a half mile of the students' schools. STROBE guidelines were used to ensure the proper reporting of this observational study.[36]

Student Data

Sampling

Using data from the California Department of Education, 183 eligible schools were identified and contacted. Schools were eligible if they had at least 100 AHS students and were within 100 miles of the program offices in Claremont, California. Interested schools were enrolled on a first-come-first-serve basis until 29 sites agreed to participate.

Assessment

Recruiters visited the 29 schools between October 2014 and May 2015. Interest forms were distributed to 6870 AHS students. A total of 2726 students returned a completed form. Parental consent and student assent were obtained for individuals under the age of 18. After acquiring consent, participants completed a web-based survey programmed with Inquisit 4 software. Upon completion of the approximately 90-minute survey, participants received a $45 gift card. Institutional Review Board approval was obtained before participant recruitment and assessment.

A total of 1060 AHS students completed the initial assessment. Participants were then tracked using established procedures.[37] One-year follow-up assessments were administered on a web-enabled device via Inquisit or Qualtrics. Participants who did not have access to a web-enabled device (3.4%) were given the option to take a computer-assisted phone interview. Each participant that completed an assessment received a $50 gift card. The retention rate was 87.1%. A total of 137 participants did not complete a follow-up

assessment due to withdrawal from the study (5.8%), incarceration (0.7%), or failure to respond to repeated contact attempts (93.5%).

Nine schools did not have any active TROs within a half mile. Students from these schools were removed from the analytic dataset. The final sample contained 746 students nested within 20 schools. The retention rate for this subsample was 86.9%.

POS Advertisement Data

Sampling

Licensing records from the California State Board of Equalization indicated that 129 TROs were within a half mile of the 20 schools. A half mile distance was selected because this range is defined as "walking distance."[25] Field assessments revealed that 17 TROs had stopped selling tobacco products or were no longer in operation, and 25 of the TROs did not permit photography. Images from the 87 remaining TROs were captured between July and August 2014.

Assessment

Two trained coders visited each TRO and independently photographed all interior and exterior tobacco advertisements using a Samsung Galaxy S III phone. The images from the TROs generated a dataset of 2101 POS tobacco advertisements. Each advertisement was classified as promoting (1) cigarettes; (2) e-cigarettes, vaporizers, or vape pens; (3) cigars, cigarillos, or little cigars; or (4) chewing tobacco, snuff, or dip. Interrater reliability between the two coders was high ($\kappa = .96$). An independent consensus coder resolved discrepancies before analysis.

The price of the most common brand of cigarettes (Marlboro), e-cigarettes (blu), cigars (Swisher Sweets), and smokeless tobacco (Grizzly) was documented, and the pretax cost of the cheapest package for each brand was recorded.[38] Interrater reliability between the two coders was excellent (intraclass correlation coefficient > 0.925). A consensus coder resolved disagreements before the average price across TROs was determined.

Measures

Share of Advertising Voice

SAV was calculated by dividing the number of advertisements for a specific product by the total number of tobacco advertisements. Advertisements that promoted multiple products were counted proportionally. For example, an advertisement for both cigarettes and e-cigarettes was treated as half an advertisement for cigarettes and half an advertisement for e-cigarettes. SAV was scaled and grand mean centered so that a one-unit increase represented an increase of 10 percentage points. The SAV per product for each school was then merged with student survey responses.

Demographics

Participants were asked to indicate their gender and ethnicity. They also provided their birthdate, which was used to calculate their age.

Exposure to POS Tobacco Advertising ($\alpha = .74$)

A seven-item scale adapted from prior research[39] assessed exposure to POS tobacco advertising by measuring the frequency with which students visited convenience stores, small grocery stores, liquor stores, large supermarkets, gas stations, drug stores, and tobacco stores. For each type of TRO, participants were asked to indicate whether they went "Never," "Once a month," "Two or three times a month," "Once a week," "Two or three times a week," or "Almost every day."

Exposure to Other Forms of Tobacco Advertising ($\alpha = .84$)

A four-item scale modeled on questions in the Youth Tobacco Survey[40] assessed the extent to which participants had been exposed to alternative forms of tobacco advertising in the past 30 days. This included advertisements distributed on the Internet, radio, television, and newspapers or magazines. Response options included "None," "1–3 times in the past 30 days," "1–3 times per week," "Daily or almost daily," and "More than once a day."

Tobacco Use

To facilitate comparisons across different types of tobacco products, a previously validated drug use questionnaire[41] was modified to inquire about (1) cigarettes; (2) e-cigarettes, vaporizers, or vape pens; (3) cigars, cigarillos, or little cigars; and (4) chewing tobacco, snuff, or dip. Participants were asked how many times they had used each product in the past year. This timeframe was selected to capture the full range of behavior in the year following the initial assessment. Response options included "0 times," "1–10 times," "11–20 times," "21–30 times," "31–40 times," "41–50 times," "51–60 times," "61–70 times," "71–80 times," "81–90 times," and "91+ times." The responses provided at the 1-year follow-up assessment were selected as the dependent variable. The responses at the initial assessment were converted into a dichotomous variable that adjusted for the prior use of all tobacco products.

Analysis

The analytic dataset had 746 students nested within 20 schools. The intraclass correlation coefficient was calculated at 0.062 for cigarettes, 0.045 for e-cigarettes, and 0.031 for cigars, and 0.001 for smokeless tobacco. The dependent variables exhibited a count distribution and consisted of only nonnegative integers. Consequently, a multilevel Poisson regression was used in all analyses. All continuous level 1 predictors were group-mean centered.

An examination of missing data revealed that although only 13.1% of the students in the analytic dataset did not complete a follow-up assessment, the use of list-wise deletion eliminated up to 27.9% of the observations because students had the right to refuse to answer specific questions. A sensitivity analysis confirmed that the missing responses could be classified as missing at random. Parameter estimates were obtained through a multiple imputation analysis performed using SAS PROC MI and MIANALYZE.[42] SAS PROC GLIMMIX was used to fit two sets of models. The first set of models examined the effect of SAV and exposure to POS tobacco advertising as independent predictors of product use 1 year later. Gender, ethnicity, age, prior use of tobacco products, and exposure to other forms of tobacco advertising were included as covariates. The second set of models assessed the cross-level interaction between SAV and exposure to POS tobacco advertising. Each model consisted of random intercepts and an unstructured covariance matrix. Model fit was evaluated using twice the negative log-likelihood (–2 log-likelihood), Akaike information criterion, and Bayesian information criterion.

Results

Descriptive Statistics

The sample was balanced in terms of gender (52.1% female) and the mean age was 17.4 (SD = 0.9). Three-quarters (75.6%) of the students self-identified as Hispanic, 8.7% as non-Hispanic white,

10.8% as African American, and 4.9% as Other. Additional descriptive statistics are provided in Table 1.

Cigarettes were the most heavily promoted tobacco product in the TROs around schools. Averaged across schools, the SAV was 60% for cigarettes, 24.4% for e-cigarettes, 7.5% for cigars, and 8.2% for smokeless tobacco. SAV between schools varied from 49.2% to 72.4% for cigarettes, 11.9% to 44.4% for e-cigarettes, 0% to 20.7% for cigars, and 0% to 17.4% for smokeless tobacco. Two schools had no POS advertising for cigars and two schools had no POS advertising for smokeless tobacco.

Blu e-cigarettes cost an average of $10.10 (SD = $1.30) for a single disposable unit. Marlboro cigarettes cost $5.35 (SD = $0.73) per pack and Grizzly moist snuff cost $3.74 (SD = $0.63) per tin. Swisher Sweets cigars were $1.03 (SD = $0.37) for a pack of two cigars.

Table 1. Descriptive Statistics for 746 Students From 20 Alternative High Schools

Level 1: students	
Gender, *n* (%)	
Male	355 (47.9)
Female	386 (52.1)
Ethnicity, *n* (%)	
Hispanic	545 (75.6)
African American	78 (10.8)
Non-Hispanic white	63 (8.7)
Other	35 (4.9)
Age, mean (SD)	17.4 (.9)
Exposure to other forms of tobacco advertising,[a] mean (SD)	1.1 (1.0)
Exposure to point-of-sale tobacco advertising,[b] mean (SD)	2.0 (0.9)
Tobacco products used in the past year, *n* (%)	
Cigarettes	177 (25.0)
Electronic cigarettes, vaporizers, and vape pens	225 (31.9)
Cigars, cigarillos, and little cigars	132 (19)
Chewing tobacco, snuff, and dip	27 (3.9)
Polytobacco use in the past year, *n* (%)	
No product use	407 (59.8)
Use of one product	114 (16.8)
Use of two or more products	159 (23.4)
Tobacco products used in the past year at the 1-year follow-up, *n* (%)	
Cigarettes	154 (24.9)
Electronic cigarettes, vaporizers, and vape pens	155 (25.1)
Cigars, cigarillos, and little cigars	119 (19.3)
Chewing tobacco, snuff, and dip	30 (4.9)
Polytobacco use in the past year at the 1-year follow-up, *n* (%)	
No product use	384 (63.0)
Use of one product	98 (16.1)
Use of two or more products	127 (20.9)
Level 2: schools	
Number of advertisements, mean (SD)	
Cigarettes	62.0 (49.4)
Electronic cigarettes, vaporizers, and vape pens	23.7 (18.0)
Cigars, cigarillos, and little cigars	10.1 (11.2)
Chewing tobacco, snuff, and dip	11.4 (14.9)
Share of advertising voice, mean % (SD %)	
Cigarettes	60.0 (7.1)
Electronic cigarettes, vaporizers, and vape pens	24.4 (7.5)
Cigars, cigarillos, and little cigars	7.5 (6.0)
Chewing tobacco, snuff, and dip	8.2 (5.2)

[a]Based on a five-point scale from 0 = "None" to 4 = "More than once a day."
[b]Based on a six-point scale from 0 = "Never" to 5 = "Almost every day."

Self-report data from the initial assessment revealed that 40.2% of students had used at least one tobacco product in the past year and 23.4% had used two or more products. At the 1-year follow-up assessment, use of at least one tobacco product decreased to 37% and the use of two or more products fell to 20.9%. E-cigarettes were the most commonly used tobacco product with 31.9% of students reporting use at the initial assessment and 25.1% reporting use 1 year later. Smokeless tobacco use increased from 3.9% to 4.9% and cigar use rose slightly from 19% to 19.3%. Cigarette use was relatively stable at 25.0% at the initial assessment and 24.9% 1 year later.

Multilevel Models

Parameter estimates from the first set of models showed that exposure to POS tobacco advertising was a statistically significant predictor of product use 1 year later ($p < .02$; see Table 2). Students who were female, Hispanic, or African American were less likely to use most products ($p < .002$). The only exception was the use of cigars by African Americans ($p = .146$). Prior use of tobacco products was a significant predictor ($p < .001$) for all products except smokeless tobacco. Exposure to other forms of tobacco advertising was significant only for e-cigarettes and cigars ($p < .05$). SAV was not a statistically significant predictor for any product.

The second set of models is presented in Table 3. An examination of the fit indices (−2 log-likelihood, Akaike information criterion, and Bayesian information criterion) indicated that the addition of a cross-level interaction between SAV and exposure to POS advertising did not improve the model for cigarettes or cigars. However, the indices did suggest an improvement in the other models. Significant interactions were observed for e-cigarettes ($B = 0.27$, SE = 0.07, $p < .001$) and smokeless tobacco ($B = 0.56$, SE = 0.19, $p = .004$). These cross-level interactions suggest that the effects of exposure to POS tobacco advertising may be moderated by the local SAV, such that the higher the SAV for a specific tobacco product, the greater the predictive effect of exposure to POS advertising on the use of that product. Figure 1 depicts this relationship for e-cigarettes and smokeless tobacco. Product use (*y*-axis) as a function of POS advertising exposure (*x*-axis) is shown for the mean SAV across schools, 1 SD below the mean, and 1 SD above the mean.

Discussion

SAV and Youth Tobacco Use

The purpose of this study was to investigate whether the SAV for specific tobacco products is related to at-risk youth tobacco use, and more specifically whether SAV moderated the relationship between exposure to POS tobacco advertising and tobacco use. On the surface, the association between SAV and tobacco use appeared unlikely, given that SAV was not a statistically significant predictor for any product (Table 2). However, the results showed that the relationship is more complex and should incorporate the interaction between exposure to POS advertising and SAV (Table 3).

Youth exposure to POS tobacco advertising was significantly associated with use of all four tobacco products. Moreover, when SAV was added to the models, the results showed a significant moderating effect, such that an increased proportion of POS advertising for e-cigarettes or smokeless tobacco magnified the effect of POS exposure on

Table 2. Multilevel Models Examining Share of Advertising Voice and Exposure to Point-of-Sale (POS) Advertising as Independent Predictors of Product Use 1 Year Later Among Alternative High School Students ($N = 746$)

	Cigarettes			Electronic cigarettes, vaporizers, and vape pens			Cigars, cigarillos, and little cigars			Chewing tobacco, snuff, and dip		
Variables	β	SE	*p*	β	SE	*p*	β	SE	*p*	β	SE	*p*
Fixed effects												
Level 1: students												
Gender: male	0.31	0.09	.001	0.60	0.10	<.001	0.78	0.11	<.001	0.98	0.22	<.001
Ethnicity: Hispanic	−0.87	0.14	<.001	−0.67	0.13	<.001	−0.96	0.19	<.001	−1.19	0.24	<.001
Ethnicity: African American	−0.89	0.20	<.001	−0.85	0.22	<.001	−0.29	0.20	.146	−1.34	0.38	<.001
Ethnicity: Other	−0.39	0.21	.063	0.14	0.21	.498	−0.32	0.23	.172	−1.51	0.65	.020
Age	−0.07	0.05	.171	0.00	0.06	.953	−0.04	0.06	.459	−0.08	0.11	.431
Prior use of tobacco products	0.88	0.10	<.001	0.98	0.12	<.001	0.46	0.12	<.001	0.20	0.20	.318
Prior exposure to other advertising	0.01	0.05	0.768	0.10	0.05	.030	0.13	0.05	.017	0.09	0.08	.230
Prior exposure to POS advertising	0.30	0.04	<.001	0.25	0.05	<.001	0.33	0.05	<.001	0.24	0.10	.014
Level 2: schools												
Share of advertising voice	0.12	0.22	.593	0.04	0.21	.856	0.03	0.29	.929	0.33	0.48	.497
Random effects												
Level 2: schools	0.46	0.19	.015	0.26	0.11	.021	0.40	0.18	.027	0.88	0.48	.066
2 log-likelihood	2678			2206			2199			935		
AIC	2701			2228			2221			957		
BIC	2711			2239			2232			968		

AIC = Akaike information criterion; BIC = Bayesian information criterion.

Table 3. Multilevel Models Examining Whether Share of Advertising Voice Moderates the Relationship Between Exposure to Point-of-Sale (POS) Advertising and Product Use 1 Year Later Among Alternative High School Students ($N = 746$)

	Cigarettes			Electronic cigarettes, vaporizers, and vape pens			Cigars, cigarillos, and little cigars			Chewing tobacco, snuff, and dip		
Variables	β	SE	*p*	β	SE	*p*	β	SE	*p*	β	SE	*p*
Fixed effects												
Level 1: students												
Gender: male	0.31	0.09	<.001	0.63	0.10	<.001	0.78	0.11	<.001	0.96	0.22	<.001
Ethnicity: Hispanic	−0.86	0.14	<.001	−-0.60	0.14	<.001	−0.97	0.19	<.001	−1.23	0.24	<.001
Ethnicity: African American	−0.90	0.20	<.001	−-0.84	0.22	<.001	−0.30	0.20	.136	−1.38	0.38	<.001
Ethnicity: Other	−-0.39	0.21	.069	0.17	0.21	.403	−0.33	0.23	.167	−1.52	0.64	.019
Age	−-0.07	0.05	.182	0.01	0.06	.918	−0.04	0.06	.462	−0.07	0.11	.484
Prior use of tobacco products	0.88	0.10	<.001	0.97	0.12	<.001	0.46	0.12	<.001	0.23	0.20	.256
Prior exposure to other advertising	0.01	0.05	.780	0.11	0.05	0.025	0.13	0.05	.017	0.11	0.08	.170
Prior exposure to POS advertising	0.30	0.04	<.001	0.29	0.05	<.001	0.34	0.05	<.001	0.17	0.10	.107
Level 2: schools												
Share of advertising voice	0.13	0.23	.577	−-0.05	0.22	.839	0.03	0.29	.907	0.25	0.49	.612
Cross-level interaction												
Exposure to POS advertising × share of advertising voice	−-0.04	0.06	.550	0.27	0.07	<.001	−0.05	0.07	.418	0.56	0.19	.004
Random effects												
Level 2: schools	0.46	0.19	.015	0.28	0.12	.019	0.40	0.18	.027	0.87	0.47	.068
−2 log-likelihood	2677			2179			2197			922		
AIC	2702			2204			2221			946		
BIC	2713			2215			2233			957		

AIC = Akaike information criterion; BIC = Bayesian information criterion.

the use of these products among adolescents 1 year later. The form of the interactions depicted in Figure 1 strongly suggest an exacerbating effect of SAV, in which greater SAV leads to stronger, positive effects of marketing exposure. This is a reasonable mechanism because the more pervasive the advertising is, in relation to competing product advertisements, the more adolescents may notice and encode the marketing message for that product when they are exposed.

These findings are in line with previous research, suggesting that exposure to POS tobacco advertising increases the likelihood of tobacco use among adolescents.[20,22] Similar in some ways to this study, Lovato et al.[43] linked observational data from tobacco retailers to student self-report data aggregated on a school level to examine the relationship between POS tobacco advertising and the prevalence of adolescent smoking in schools. They found that student smoking

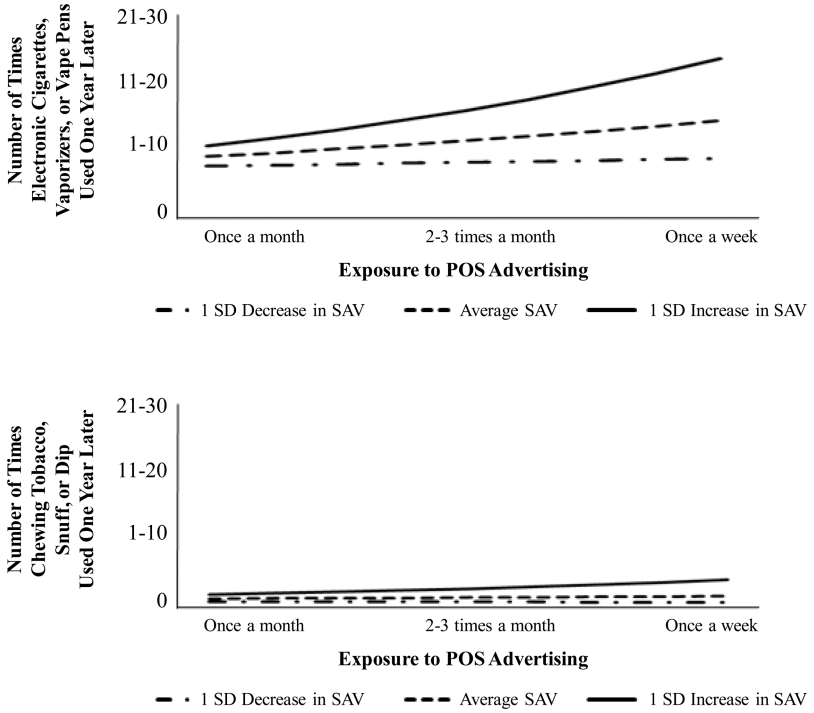

Figure 1. Plot of the interaction between share of advertising voice (SAV) and exposure to point-of-sale (POS) advertising in the prediction of product use at the 1-year follow-up assessment.

rates are higher in neighborhoods with more prevalent POS tobacco advertising. However, the current study also revealed an important interaction with SAV, which appears to intensify the effects of POS exposure. This study also expands earlier findings and extends them to the broader range of tobacco products by examining this relationship across product types.

The interaction between SAV and exposure to POS tobacco advertising did not reach statistical significance in the models for cigarettes or cigars, potentially because of the wide prevalence and previous saturation of cigarette advertising and because of the perceived similarities between cigarettes and cigars.[17] Moreover, these two products may not provide some of the benefits that entice adolescents to use e-cigarettes and smokeless tobacco, such as novelty and discreteness. Recent reporting suggests that the ability to use products in schools without being caught may be a factor contributing to youth tobacco use.[44]

Overall, the results point to the importance of including SAV in research investigations to better understand how the marketing of specific tobacco products may influence their use by vulnerable populations. The current findings are consistent with commercial marketing research on other product categories, suggesting that the proportion of advertisements for specific products may increase the demand for those products.[34] Further, the present results show that the advertisement proportion has an exacerbating effect on exposure to advertisements. To our knowledge, this exacerbation has not previously been studied in either commercial marketing or health communication.

This study also provides further evidence that adolescent tobacco use may be shifting between products rather than declining.[45] As reported by the Surgeon General,[13] e-cigarettes are the most used tobacco product among adolescents. This was confirmed in the current sample of AHS students where 31.9% of students reported using e-cigarettes in the past year whereas only 25% reported using cigarettes. Moreover, 58.2% of adolescents who used tobacco products used more than one product, highlighting the increasing prevalence of polytobacco use among at-risk youth.[17] Combined with the influence that shifts in SAV may exert on tobacco product use, these rates indicate that researchers and policy makers should carefully monitor and regulate the full range of tobacco products. Failing to do so may permit changes in tobacco marketing to influence youth in ways that appear promising (ie, a decrease in cigarette use) but are in fact concealing critical trends (ie, a shift to e-cigarettes or polytobacco use).[16] This is especially true for at-risk adolescents who are more vulnerable to tobacco use and other risk behaviors.[46]

Although restrictions on tobacco advertising are often challenged on the grounds of free speech as well as other federal laws preempting local regulation, policy makers should take note of the authority granted by the 2009 Family Smoking Prevention and Tobacco Control Act that gave state and local governments the right to restrict the time, place, and manner of tobacco advertising. Lange et al.[47] recently outlined a variety of strategies that would enable state and local governments to regulate POS tobacco marketing specifically targeting youth. City governments in New York and Massachusetts have successfully implemented some of these policies and may serve as an effective model that can be emulated.

When crafting new policies, it is also important to consider the potential risks of marketing restrictions that may inadvertently lower SAV for one product whereas increasing SAV for another. Recent meta-analyses suggest that youth who are current users of e-cigarettes are 4.3 times more likely to become current users of cigarettes.[48] Consequently, it is conceivable that a hastily implemented restriction on POS marketing for e-cigarettes may cause a sudden increase in the use of regular cigarettes if equivalent restrictions are not applied simultaneously to cigarettes and related products such as cigars and

smokeless tobacco. Policy makers should factor this unintended consequence into proposed regulations of tobacco marketing or sales.

Limitations and Future Research

A key limitation of this study is that the limited sample size required SAV to be calculated at the school level rather than the store level. Prior research has demonstrated that SAV differs by store type.[49] It is therefore possible that the presence of specific types of TROs near schools are driving the differences in school-level SAV and consequently affecting the detected cross-level interaction. In addition, the local SAV was determined by as few as one store with 15 advertisements to as many as 10 stores with 15–82 advertisements. This may have introduced bias into the analyses in two ways. One possibility is that a single TRO may have the strongest influence when it is the only choice in the area. Alternatively, the influence of a single TRO may be magnified by the presence of other TROs such that the combined effect of all stores' POS tobacco advertising is synergistic. Future studies may find it fruitful to explore how the proportion of different types of TROs near schools and the ratio of TROs to other retail outlets may influence student tobacco use across a range of products.

This study was also limited to a one-time assessment of SAV. Future research might consider assessing whether changes in POS tobacco advertising, and particularly SAV, coincide with changes in tobacco use among adolescents over time. Such studies may illuminate why SAV for certain products, such as e-cigarettes or smokeless tobacco, may influence youth tobacco use but SAV for other products, such as cigarettes, appear to have little or no effect. It may be the case that after crossing a critical threshold (eg, 25% of all advertising) the moderating effects of SAV begin to diminish. Although this contention requires further research, it is clear that SAV has important moderating effects on whether exposure to tobacco advertising is related to elevated rates of future tobacco use.

Another limitation of this investigation is that the calculation for SAV did not incorporate product displays, which have been shown to influence adolescent smoking.[50] Similarly, the calculation was restricted to the SAV among tobacco products rather than the SAV among all products. It is also important to remember that the sample was limited to at-risk adolescents in southern California who were predominantly Hispanic (75.6%). Replication of these findings in other geographic areas with different demographics and product offerings would bolster the generalizability of the results.

Despite these limitations, this study offers important insights for policy makers. Previous research has demonstrated that youth are sensitive to variations in the price of tobacco products.[19] This evidence has led to the enactment of legislation that attempts to reduce youth tobacco use through tax increases. Although these efforts are commendable, alternative approaches may also be necessary. Evidence from this investigation revealed that e-cigarettes were the most popular product even though the average cost per unit for the most common brand was 1.9 times greater than cigarettes and 9.8 times greater than cigars. This suggests that other factors, such as POS advertising, may be overpowering the effect of price, and alternative tactics may be necessary to effectively curb the use of alternative tobacco products among vulnerable youth.

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Declaration of Interests

None declared.

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