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## “Technophilia”: a new risk factor for electronic cigarette use among early adolescents?

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### Abstract

**Purpose:** Develop and validate a scale that measures Technophilia (positive orientation towards new technology) and use it to address orientation toward new technologies to explain e-cigarette trial and adoption, especially in relatively low risk adolescents.

**Methods:** Survey data were obtained from students of the three largest cities in Mexico (n=8123). We developed eight questions involving access, use and pleasure from different electronic media to measure technophilia. Exploratory factor analysis (EFA) was conducted. Linear GEE models were used when regressing technophilia on covariates. When regressing e-cigarette and conventional cigarette trial and use, logistic GEE models were used. Finally, we used multinomial logistic regression to evaluate the associations between the technophilia and e-cigarettes as the first tobacco product.

**Results:** Technophilia were correlated with theoretically-related variables. Unadjusted and adjusted models regressing e-cigarette trial and use indicated that students in the highest quartile for technophilia were more likely to have tried e-cigarettes compared with the lowest quartile (AOR<sub>Q4 vs Q1</sub> =1.36, 95% CI 1.14–1.62). Technophilia was not independently associated with current e-cigarette use in adjusted models. Students with higher technophilia were more likely to have first tried e-cigarettes in both crude and adjusted models (AOR<sub>Q4vQ1</sub>=1.66, 95% CI 1.20–2.31; AOR<sub>Q3vQ1</sub>=1.43, 95% CI 1.02–2.01). Technophilia did not have a statistically significant, independent association with first use of other tobacco products.

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#### AUTHORS CONTRIBUTIONS

IB conceived of the article, participated in its design and coordination and drafted the manuscript; PL participated in the design and interpretation of the data, performed the statistical analysis, and helped to draft the manuscript; EA participated in the design of the study and helped to draft the manuscript; PM participated in the design of the study and helped to draft the manuscript; RM participated in the design of the study and helped to draft the manuscript; LR participated in the design of the study and helped to draft the manuscript; JT conceived of the study, and participated in its design and coordination and helped to draft the manuscript. All authors read and approved the final manuscript.

#### CONFLICT OF INTERES

The authors declare that they have not conflict of interest.

**Conclusion:** This study suggests that technophilia is associated with trial of e-cigarettes among youth. The measure we developed appears useful for understanding why some youth are open to trying novel, technologically oriented ways to consume nicotine.

### Keywords

Electronic cigarette; E-cigarettes; Mexico; Adolescents; Internet; Technophilia

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## 1. INTRODUCTION

The use of e-cigarettes has grown rapidly over the last decade (Giovenco, Hammond, Corey, Ambrose, & Delnevo, 2015; Zhu et al., 2013). Because e-cigarettes have lower levels of toxicants than conventional cigarettes, some have proposed their use as a harm reduction alternative for adult smokers who cannot quit cigarettes (Cherng, Tam, Christine, & Meza, 2016; Levy et al., 2017; Royal College of Physicians, 2015). However, e-cigarette use among youth is potentially worrisome (Fairchild, Bayer, & Colgrove, 2014), as longitudinal studies of adolescents in the US and Mexico suggest that e-cigarette trial and use increase the risk of subsequent cigarette smoking (Leventhal et al., 2015; Lozano et al., 2017; Primack, Soneji, Stoolmiller, Fine, & Sargent, 2015; Soneji et al., 2017; Stratton et al., 2018; Unger, Soto, & Leventhal, 2016; Thomas A Wills et al., 2016). The current study aimed to assess adolescents' orientation toward new technologies as a way to explain e-cigarette trial and adoption, as prior research suggests that this orientation may be a risk factor that is unique to e-cigarette use.

Technophilia is the positive orientation towards new technology, drawing attention to the pleasure and emotional qualities that accompany the adoption of new technologies (Ronit, 2011; Thrasher et al., 2016). Indeed, e-cigarettes are heavily marketed as a high-tech alternative to smoking, which could make them attractive to adolescents who are drawn to technology (Grana & Ling, 2014; Mackey, Miner, & Cuomo, 2015). The evidence linking technophilia to e-cigarette use is scarce, yet, a recent qualitative study found that young adults perceived e-cigarettes as another "toy", comparable to mobile phone or a flash drive (McDonald & Ling, 2015). Furthermore, prior cross-sectional research in Mexico indicated that early adolescents who had tried e-cigarettes, but not conventional cigarettes, possessed significantly more technological devices when compared to those who had tried conventional cigarettes or those who had not tried either cigarettes or e-cigarettes (Thrasher et al., 2016). However, this proxy measure of technophilia was relatively limited because it did not assess the affective or behavioral dimensions of this construct.

Technophilia is likely to be associated with greater use of electronic media (Camenga et al., 2018). As such, its impact on e-cigarette use may be explained by the greater likelihood of exposure to online messages about e-cigarettes, including online advertising (Thrasher et al., 2016). Indeed, e-cigarette advertisements are present on social networking sites such as Twitter (Ayers et al., 2017; Chu et al., 2015; Clark et al., 2016; Dai, Deem, & Hao, 2017; Huang, Kornfield, Szczypka, & Emery, 2014; Lazard et al., 2016; van der Tempel et al., 2016; Zhan, Liu, Li, Leischow, & Zeng, 2017), YouTube (Camenga et al., 2018; Cantrell et al., 2017; Huang, Kornfield, & Emery, 2016; Sears et al., 2017) and Facebook (Camenga et

al., 2018; Emery, Vera, Huang, & Szczypka, 2014). Moreover, exposure to e-cigarette marketing may influence subsequent e-cigarette use among youth. For example, a longitudinal study in the US found that exposure to e-cigarette ads on Facebook at baseline was associated with subsequent e-cigarette use at follow-up (Camenga et al., 2018). As e-cigarette marketing is mainly through the internet (Duke et al., 2014; Noel, Rees, & Connolly, 2010), it may be the primary channel through which youth are exposed to marketing in countries that have restricted or banned e-cigarette marketing and sales, as is the case of Mexico (Comisión Federal contra Riesgos Sanitarios (COFEPRIS) & Secretaría de Salud, 2012).

In this study, a new technophilia scale was developed that not only includes questions related to technology ownership, but also pleasure from and frequency of use of electronic media (e.g., social media, music sharing, streaming videos, videogames), which are particularly relevant to early adolescents in Mexico. To evaluate the construct validity of this new scale, we hypothesized that technophilia would be associated with higher socioeconomic status (SES) (i.e., higher parental education and higher household affluence), higher sensation seeking, and higher exposure to online advertising. Finally, we hypothesized that technophilia would be independently associated with trial and current use of e-cigarettes, but not with trial or current use of conventional cigarettes. Furthermore, we expected that adolescents with relatively higher levels of technophilia would be more likely to report that e-cigarettes were the first nicotine product they used. Among adolescents with higher technophilia, e-cigarettes should be more appealing than conventional cigarettes, and assessing first product used will inform research indicating that e-cigarettes are a “gateway” to subsequent cigarettes among adolescents (Soneji et al., 2017). Indeed, some evidence from Mexico (Thrasher et al., 2016) and the US (T A Wills, Knight, Williams, Pagano, & Sargent, 2015) indicates that e-cigarettes recruit into nicotine product use relatively low risk youth who would have otherwise not tried nicotine products. Technophilia may help explain this phenomenon.

## 2. METHODS

### 2.1. Study Population

Survey data were obtained from adolescents who participated in the second wave of a population-based, longitudinal study of students from 57 randomly selected public middle schools in the three largest cities in Mexico (Mexico City, Guadalajara, Monterrey). Elsewhere, we published a detailed description of the multi-stage school selection procedure and the baseline response rate (84%) for all eligible first-year students who responded to the survey in February and March 2015 (Thrasher et al., 2016). The follow up survey in October and November 2016 was administered in the last year of secondary school, wherein students could participate whether they were surveyed at baseline or not. Passive parental consent was used, with students providing active consent. The study protocol was approved by the ethics committee at the Mexican National Institute of Public Health (INSP).

Among all students who participated in the second survey (n=8718), students were excluded if they had missing data on technophilia scale items (n=281), any dependent variable (i.e., e-cigarette trial/use, conventional cigarette trial/use, first nicotine product used) evaluated

(n=116), or covariates used in the adjusted models (n=198). The final sample size for all analyses was with 8123 students.

## 2.2. Measures

A self-administered Spanish-language questionnaire was used, based on prior, validated surveys, with questions pretested to ensure student comprehension (Thrasher et al., 2016).

**Technophilia:** We developed eight questions involving access, use and pleasure from different electronic media (e.g., social media, music sharing, streaming videos, videogames) that are relevant to early adolescents in Mexico to measure technophilia. Question wording and interpretation were evaluated in 20 semi-structured cognitive interviews (Willis, 2004), conducted in students from a low (n=10) and a high (n=10) SES neighborhood in Cuernavaca, Mexico. Quotas for participants ensured balance by gender and academic achievement, with students selected by school staff. Two independent coders analyzed interview transcripts, and results were discussed with Mexican researchers to select and decide on the final wording for the questions.

In the survey, eight items measured technophilia. One item was a summative index used in prior research (Thrasher et al., 2016), whereby students reported on the electronic devices (i.e., computers, smartphones, tablets) they had in their room (range=0–3). Students also were asked about the frequency of internet activities that reflected higher levels of engagement than just searching for online information: “*How often do you share music, audios or videos online?*”; “*In the last 30 days how frequently have you used online social media such as Facebook, Snapchat, Twitter o Instagram?*”; “*In the last 30 days how frequently have you seen or downloaded movies on internet sites such as Vidocio, Veocine, Divxonline, or YouTube?*”. Responses included “Never”, “Rarely”, “Occasionally”, “Frequently” and “Very frequently”. Students were also asked about the pleasure from internet engagement (i.e., “*How much fun do you have on the internet?*”) and from learning about new technologies (“*How much do you like being informed about new technological products, like apps, videogames, computers or smartphones?*”), with the same response options for both (“None”, “A little”, “Some”, “A lot,” “Very much”). Students were also asked about videogame use (“*On average, how much time per day do you spend playing video games?*”) with response options ranging from one to five hours per day. Finally, students were asked if they had access to internet in their room (yes/no).

Responses to each question were normalized because of the different response scales used. Final items included in the scale were averaged for analyses when it was used as dependent variable (Cronbach’s alpha 0.70). Students were also divided into quartiles for analyses when technophilia was used as an independent variable, for ease of interpretation and assessment of potential threshold effects.

**E-cigarette trial and use:** Questions about e-cigarettes followed a written description and pictures of them. Students were asked if they had ever used e-cigarettes (yes/no) (Thrasher et al., 2016), as well as the number of times they had used e-cigarettes in the last month. Students who reported using e-cigarettes once or more in the past month were categorized as current users. All others were defined as nonusers of e-cigarettes.

**Conventional cigarette trial and use:** We measured trial of conventional cigarettes by asking students if they had ever tried conventional cigarettes (yes/no). Students who reported using one or more cigarette in the past month were defined as current smokers, and all others were defined as nonsmokers.

**First tobacco product used:** Students were asked which type of tobacco product they tried first (never tried tobacco products, conventional cigarette with no flavor, regular menthol cigarettes, regular cigarette with flavor capsules, e-cigarette, other types of tobacco products, such as hookah, chewing tobacco or cigars). Responses were recoded into three categories, using indicator variables: never used tobacco products (reference group), e-cigarettes, and all other tobacco products.

**Covariates:** Established risk factors for e-cigarette and cigarette use were chosen as covariates because of their potential to confound results. Measures of sociodemographic characteristics included age, sex, parental educational attainment (i.e., highest reported for either parent: primary, secondary, high school, university, unknown), and the family affluence using the Family Affluence Scale (FAS) (Boyce, Torsheim, Currie, & Zambon, 2006), which combines answers from four questions to measure household wealth (i.e. “How many cars does your family own?”, “Do you have your own room?”, “In the last 12 months how many times has your family gone on vacation?”, “How many computers are in your house?”). To assess use of nicotine products among family members, adolescents were asked if any family members who lived at home used e-cigarettes (yes/no) or cigarettes (yes/no). Friend use of nicotine products was measured by asking how many of their five best friends used e-cigarettes (none, 1 of 5, 2 of 5, 3 of 5, 4 of 5, 5 of 5), with a separate parallel question on friend use of cigarettes (Berg et al., 2015; Morello, Perez, et al., 2016; Vogel, Ramo, & Rubinstein, 2018). Because of their skewed distributions, response options for both questions were dichotomized to indicate that at least one of their friends used e-cigarette/cigarettes vs. “none” of them. Responses to questions about both products were then combined for product use among family (i.e., no family member used either product; only users of e-cigarettes; only cigarette smokers; users of both products) and friends (i.e., no friends used either product; only users of e-cigarettes; only cigarette smokers; users of both products). Ever use of alcohol (Brown et al., 2010; Unger et al., 2016) and drugs (marijuana or cocaine) was also assessed (Leventhal et al., 2015; Morello, Pérez, et al., 2016; Thrasher et al., 2016). A four-item scale of sensation seeking was used (e.g., “I like to do frightening things”; alpha 0.80), which was previously validated for Mexican youth (Primack et al., 2015; Thomas A Wills et al., 2016). Students reported the frequency of exposure to internet advertisements in the last 30 days for cigarettes or other tobacco products and, in a separate question, for e-cigarettes. Response options were combined into three levels (Never = “I don’t use the internet” or “never”; Sometimes = “rarely” or “sometimes”; Often = “often” or “very often”).

### 2.3. Analysis

We calculated unweighted descriptive statistics for all variables of interest. Exploratory factor analysis (EFA) was conducted for the eight technophilia items, using common factors analysis with oblique rotation (varimax method). When estimating regression models,

Generalized Estimating Equations (GEE) were used to account for the nested structure of the data at the school level (Fleischer et al., 2015). Linear GEE models with a normal distribution and an identity link were used when regressing technophilia on hypothesized covariates (i.e., sex, SES, sensation seeking, internet ad exposure). When regressing e-cigarette and conventional cigarette trial and use on study variables, logistic GEE models with log-binomial models were used. The internet ad exposure variable used in these models was specific to the dependent variable assessed. Finally, we used multinomial logistic regression models (using STATA's `mlogit` command) adjusting for clustering by schools, to evaluate the unadjusted and adjusted associations between the technophilia scale and use of e-cigarettes or other products as the first tobacco product, with use of neither product as the reference group.

### 3. RESULTS

About half of the sample was female (51%), and most students were 13 years old (76%) and had parents with secondary school education or less (57%). Approximately one-tenth (11%) of the sample were current smokers, and one quarter (24%) had tried cigarettes but not in the prior month. Similarly, 12% currently used e-cigarettes and one-fifth (19%) had tried them, but not in the past month (see Table 1).

#### 3.1. Technophilia measurement

When assessing all potential technophilia items using EFA, only one Eigenvalue was greater than 1 and only one Eigenvalue was above the “elbow” in the scree plot, suggesting a single factor (DeVellis, 2011). Factor loadings for two items were below 0.4 (i.e., frequency of sharing music online, frequency of playing videogames) and internal consistency for the scale ( $\alpha=0.70$ ) did not change upon their elimination. Re-running the EFA after eliminating these items also provided evidence of a single factor underlying the data. Hence, the six-item scale was used.

Technophilia scale scores were regressed on hypothesized correlates (Table 2). In both crude and adjusted analyses, hypothesized correlates were associated in the expected manner with higher levels of technophilia: higher educational attainment ( $\beta_{\text{adjusted}}=0.34$ , 95% CI 0.28–0.38, University vs. primary school) and higher FAS ( $\beta_{\text{adjusted}}=0.08$ , 95% CI 0.07–0.08); greater sensation seeking tendencies ( $\beta_{\text{adjusted}}=1.12$ , 95% CI 0.10–0.13); and greater likelihood of exposure to online tobacco ads ( $\beta_{\text{adjusted}}=0.31$ , 95% CI 0.25–0.37). These results provide evidence of construct validity (DeVellis, 2011). In other words, technophilia scale scores were correlated with theoretically-related variables (convergent validity).

#### 3.2. Correlates of e-cigarette and cigarette trial and use:

Unadjusted and adjusted models regressing e-cigarette trial and use on study variables (Table 3) indicated that students in the highest quartile for technophilia were more likely to have tried e-cigarettes compared to those in the lowest quartile ( $\text{AOR}_{\text{Q4 vs Q1}}=1.36$ , 95% CI 1.14–1.62), with statistically significant differences also found between the lowest and the middle quartiles of technophilia ( $\text{AOR}_{\text{Q3 vs Q1}}=1.23$ , 95% CI 1.04, 1.46;  $\text{AOR}_{\text{Q2 vs Q1}}=1.30$ , 95% CI 1.10, 1.54;). In crude models, the likelihood of being a current e-cigarette user was



significantly higher for the highest vs lowest quartile of technophilia ( $AOR_{Q4 \text{ vs } Q1} = 1.47$ , 95% CI 1.22–1.78), although no significant difference was found when comparing other quartiles of technophilia. Technophilia was not independently associated with current e-cigarette use in adjusted models.

Models regressing conventional cigarette trial and use on study variables indicated that technophilia was not an independent, statistically significant correlate (Table 4).

### 3.3. Correlates of first tobacco product used

Multinomial regression models assessed correlates of the first type of tobacco product used (Table 5). Students with relatively higher technophilia were more likely to have first tried e-cigarettes in both crude and adjusted models ( $AOR_{Q4 \text{ vs } Q1} = 1.66$ , 95% CI 1.20–2.31;  $AOR_{Q3 \text{ vs } Q1} = 1.43$ , 95% CI 1.02–2.01). Technophilia did not have a statistically significant, independent association with first use of other tobacco products.

## 4. DISCUSSION

This study aimed to validate a new scale to measure technophilia and to assess whether technophilia was associated with e-cigarette initiation and use among early adolescents. Results indicate that the scale has good measurement properties, with good internal consistency ( $\alpha = 0.7$ ) and evidence of construct validity, as indicated by its association with theoretically-related variables (i.e., convergent validity), its association with e-cigarette initiation, and its lack of association with cigarette initiation and use (i.e., discriminant validity). Hence, this measure may be useful for understanding the increasingly important phenomenon of e-cigarette initiation among early adolescents.

Technophilia was positively associated both with e-cigarette trial and report of e-cigarettes as the first tobacco product tried. Traditional smoking risk factors (i.e., trial of alcohol, trial of drugs, family and friend use of cigarettes) were more weakly associated with these outcomes than with cigarette smoking outcomes. This is consistent with previous studies that suggest that e-cigarettes may appeal to relatively low risk adolescents who would otherwise be unlikely to use conventional cigarettes (Thrasher et al., 2016; T A Wills et al., 2015).

Our results were somewhat consistent with expectations based on prior qualitative research, which found that young adults perceived e-cigarettes to be like other relatively novel technological devices they used, wherein the technological aspects of e-cigarettes (i.e., plugging in and charging of e-cigarettes) were appealing (McDonald & Ling, 2015). However, while we found that higher levels of technophilia were independently associated with e-cigarette trial, they were not associated with current e-cigarette use. This unexpected result suggests that when explaining the continuation of e-cigarette use, other factors besides technophilia are important, including greater wealth, peer use, online marketing exposures, sensation seeking, and use of other substances (Barrington-Trimis et al., 2015; Kong, Morean, Cavallo, Camenga, & Krishnan-Sarin, 2015; Leung, Ho, Chen, Wang, & Lam, 2018; Pepper et al., 2017; Pepper, Farrelly, & Watson, 2018; Pepper & Brewer, 2014; Sutfin, McCoy, Morrell, Hoepfner, & Wolfson, 2013; T A Wills et al., 2015), as was also found in

our study. The illegality of e-cigarettes in Mexico may also have impeded progression of use among more technophilic adolescents, especially those who are otherwise relatively low risk for substance use and who may therefore be less likely to break the law. Hence, studies in countries with weaker e-cigarette regulations may find different results. Longitudinal studies, including in other contexts, are needed to better assess the potential associations between technophilia and e-cigarette uptake and progression.

Our results are consistent with previous research that has identified exposure to online e-cigarette ads as an important predictor of e-cigarette use (Camenga et al., 2018). These ads are present on various social media sites (Ayers et al., 2017; Camenga et al., 2018; Cantrell et al., 2017; Chu et al., 2015; Clark et al., 2016; Dai et al., 2017; Emery et al., 2014; Huang et al., 2016, 2014; Lazard et al., 2016; Sears et al., 2017; van der Tempel et al., 2016; Zhan et al., 2017), and our measure of technophilia includes assessment of the frequency of social media use. As expected, we found that the frequency of exposure to online e-cigarette ads was not only associated with technophilia but also with e-cigarette trial and use. Our data suggest that many Mexican youth are exposed to online ads for e-cigarettes and tobacco products even though these ads are banned in Mexico. As regulation of online tobacco marketing is more challenging than for traditional media (TV, radio, print media, billboards), efforts to reduce youth exposure to online ads for tobacco products may require use of online filtering technologies and parental controls.

This study has some limitations. Our measure of technophilia could be improved. For example, a recently published study in Estonia (Martínez-Córcoles, Teichmann, & Murdvee, 2017) (conducted after our study) developed a technophilia scale with three dimensions (i.e., enthusiasm, dependency, “techno-reputation”) using 18 items. Although they did not validate the scale for electronic cigarettes, future research may consider integrating items from this other scale. Another potential limitation of our cross-sectional study involves potential concerns around reverse causality. However, because e-cigarette trial and use do not seem likely to have promoted technophilia, we do not believe this is a significant concern. Still, longitudinal studies that assess the predictive validity of technophilia could strengthen our conclusions about its utility for studying e-cigarettes.

Although we had a representative sample of public schools from the three largest cities in Mexico, the results may not be generalizable to other cities or to rural areas, where access to technology, the internet and e-cigarettes is lower than in urban areas. However, since more than 75% of the Mexican population lives in urban areas (Consejo Nacional de Población, 2014), we expect that our results are broadly representative. In this study, we only included participants from public schools, as about 90% of Mexican adolescents attend them. Students who attend private schools are likely to be from higher socioeconomic status groups than public school students, and, as expected, we found that family wealth was consistently associated with e-cigarette use. Private school students are also likely to have easier access to technological devices and the internet and may therefore exhibit stronger technophilia. Thus, our data from public school students may underestimate e-cigarette consumption, technophilia, and the strength of their association. Nevertheless, all models examined in this study controlled for SES (i.e., parental education) and family wealth (i.e., FAS) in order to reduce the likelihood that these factors would provide alternative



explanations for our findings. Also, this study did not consider different types of e-cigarettes products used (i.e., nicotine strength, flavoring, device generation), for which there is evidence of differences in the efficiency of nicotine delivery (Etter, 2016; Hecht et al., 2015; Shahab et al., 2017). More research is necessary to assess which factors, including technophilia, influence use of specific e-cigarette types, including new devices such as JUUL (which looks like a USB flash drive) that have rapidly gained market share and appear to attract teenagers because they can easily hide from parents and teachers (Huang et al., 2018). Such factors may help explain differences in initiation rates or progression to more regular use.

## 5. CONCLUSIONS

Despite its limitations, this study suggests that technophilia – a positive orientation toward novel technology use – is associated with trial of e-cigarettes among youth. The measure we developed appears useful for understanding why some youth are open to trying novel, technologically oriented ways to consume nicotine. These findings suggest that public health campaigns are needed to inform parents and youth about the dangers of e-cigarettes. Parents should be encouraged to monitor their children’s online behaviors, establishing rules that help minimize the likelihood of online exposure to tobacco product advertising. Future public health campaigns may also need to consider adolescent populations with higher technophilia when developing messages to prevent e-cigarette use and, by extension, to impede progression to other, more dangerous tobacco products, particularly cigarettes.

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**Table 1.**

Sample characteristics. Mexican adolescents from public schools of the three largest cities of México (Mexico City, Guadalajara & Monterrey), 2016 (N=8,123)

Variables	(%)
<b>Sex</b>	
Male	49
Female	51
<b>Age</b>	
11 to 12	8
13	76
14 or more	16
<b>Parental education</b>	
Primary	15
Secondary	42
High school	21
University	18
Unknown	5
FAS <sup>a</sup> (1-9) *	4.05
Sensation seeking (1-5) *	3.86
<b>Tried alcohol</b>	
Yes	64
<b>Tried drugs</b>	
Yes	14
<b>Online tobacco ad exposure</b>	
Never	78
Sometimes	17
Often	5
<b>Online E-Cig ad exposure</b>	
Never	67
Sometimes	28
Often	5
<b>Family Nicotine Use</b>	
Neither	34
Tobacco only	54
E cig only	2
Dual use	10
<b>Friend smoking</b>	
Neither	39
Tobacco only	25
E cig only	7
Dual use	29
<b>Smoking status</b>	



Variables	(%)
Never	65
Tried (not current)	24
Current use	11
<b>E-cigarette status</b>	
Never	69
Tried (not current)	19
Current use	12

\* Mean value,

<sup>a</sup> Family Affluence Scale

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**Table 2.**

Correlation between technophile scale and hypothesized covariates

Variables	$\beta$ 95% CI	$\beta_{\text{adjusted}}$ 95% CI
<b>Sex</b>		
male	0	0
female	0.01 [-0.01, 0.04]	0.03 [0.005,0.055]
<b>Parental education</b>		
Primary	0	0
Secondary	0.22 [0.18,0.26]	0.19 [0.15,0.22]
High school	0.38 [0.34,0.43]	0.30 [0.26,0.35]
University	0.50 [0.45,0.55]	0.34 [0.30,0.39]
Unknown	0.18 [0.11,0.25]	0.15 [0.08,0.21]
<b>FAS<sup>a</sup></b>	0.10 [0.09,0.10]	0.07 [0.07,0.08]
<b>Sensation seeking</b>	0.15 [0.13,0.16]	0.11 [0.10,0.13]
<b>Tobacco online ads</b>		
Never	0	0
Sometimes	0.25 [0.21,0.29]	0.14 [0.11,0.18]
Often	0.39 [0.32,0.45]	0.23 [0.17,0.30]
<b>E-Cigs online ads</b>		
Never	0	0
Sometimes	0.18 [0.15,0.21]	0.09 [0.06,0.12]
Often	0.39 [0.33,0.45]	0.20 [0.13,0.26]

<sup>a</sup>Family Affluence Scale

**Table 3.**

Crude and adjusted odds of e- cigarette trial and current use by technophilia level in Mexican adolescents from public schools of the three largest cities of México (Mexico City, Guadalajara & Monterrey), 2016 (N=8,123)

Variable	% <sup>b</sup>	E-cigarette trial		% <sup>c</sup>	E-cigarette current use	
		OR 95% CI	AOR 95% CI		OR 95% CI	AOR 95% CI
<b>Technophilia</b>						
Quartile 1	23	1	1	11	1	1
Quartile 2	30	<b>1.46 [1.27,1.68]</b>	<b>1.30 [1.10,1.54]</b>	11	1.09 [0.89,1.32]	0.92 [0.74,1.15]
Quartile 3	32	<b>1.57 [1.36,1.80]</b>	<b>1.23 [1.04,1.46]</b>	12	1.11 [0.91,1.35]	0.80 [0.64,1.00]
Quartile 4	37	<b>1.98 [1.72,2.27]</b>	<b>1.36 [1.14,1.62]</b>	15	<b>1.47 [1.22,1.78]</b>	0.92 [0.73,1.16]
<b>Sex</b>						
male	33	1	1	13	1	1
female	28	<b>0.79 [0.71,0.86]</b>	<b>0.67 [0.59,0.75]</b>	11	<b>0.85 [0.74,0.97]</b>	<b>0.77 [0.66,0.90]</b>
<b>Parent education</b>						
Primary	32	1	1	17	1	1
Secondary	30	0.93 [0.81,1.08]	1.03 [0.87,1.23]	11	<b>0.61 [0.51,0.74]</b>	<b>0.64 [0.52,0.79]</b>
High school	31	0.97 [0.82,1.13]	1.17 [0.96,1.43]	11	<b>0.61 [0.49,0.76]</b>	<b>0.66 [0.52,0.85]</b>
University	30	0.93 [0.79,1.10]	1.07 [0.87,1.33]	11	<b>0.59 [0.47,0.74]</b>	<b>0.62 [0.47,0.81]</b>
Unknown	26	0.75 [0.58,0.97]	0.98 [0.71,1.34]	12	<b>0.64 [0.46,0.91]</b>	0.75 [0.50,1.12]
<b>FAS<sup>az</sup></b>	4	<b>1.10 [1.07,1.12]</b>	<b>1.05 [1.02,1.08]</b>	5	<b>1.12 [1.09,1.16]</b>	<b>1.09 [1.05,1.14]</b>
<b>Sensation seeking<sup>*</sup></b>	4	<b>1.71 [1.60,1.82]</b>	<b>1.13 [1.05,1.22]</b>	4	<b>1.57 [1.44,1.72]</b>	1.04 [0.95,1.16]
<b>Tried alcohol</b>						
No	13	1	1	5	1	1
Yes	40	<b>4.23 [3.75,4.78]</b>	<b>1.74 [1.51,2.01]</b>	16	<b>3.31 [2.77,3.95]</b>	<b>1.30 [1.06,1.61]</b>
<b>Tried drugs</b>						
No	25	1	1	9	1	1
Yes	65	<b>5.77 [5.05,6.59]</b>	<b>1.75 [1.48,2.06]</b>	32	<b>5.06 [4.36,5.88]</b>	<b>1.66 [1.37,2.00]</b>
<b>Exposure to E-Cig Online ads</b>						
Never	23	1	1	8	1	1
Sometimes	42	<b>2.38 [2.15,2.64]</b>	<b>1.59 [1.40,1.80]</b>	19	<b>2.80 [2.43,3.24]</b>	<b>1.83 [1.55,2.15]</b>
Often	53	<b>3.67 [2.99,4.50]</b>	<b>1.73 [1.36,2.22]</b>	31	<b>5.40 [4.28,6.81]</b>	<b>2.59 [1.97, 3.39]</b>
<b>Family nicotine use</b>						
Neither	19			6		
Cigarette only	33	<b>2.10 [1.88,2.36]</b>	<b>1.37 [1.20,1.57]</b>	13	<b>2.40 [2.00,2.87]</b>	<b>1.52 [1.24, 1.85]</b>
E-Cig only	32	<b>2.00 [1.40,2.84]</b>	<b>1.58 [1.05,2.38]</b>	16	<b>3.15 [1.99,4.97]</b>	<b>2.59 [1.57, 4.29]</b>
Dual use	51	<b>4.30 [3.64,5.09]</b>	<b>2.34 [1.922,86]</b>	27	<b>5.88 [4.71,7.35]</b>	<b>2.99 [2.32,3.84]</b>
<b>Friend nicotine use</b>						
	13			3		
Cigarette only	28	<b>2.61 [2.26,3.01]</b>	<b>1.33 [1.13,1.56]</b>	9	<b>3.08 [2.40,3.96]</b>	<b>1.52 [1.17, 1.99]</b>
E-Cig only	44	<b>5.07 [4.19,6.14]</b>	<b>3.76 [3.04,4.66]</b>	19	<b>7.21 [5.43,9.58]</b>	<b>5.03 [3.73,6.78]</b>
Dual use	53	<b>7.61 [6.68,8.69]</b>	<b>3.56 [3.07,4.14]</b>	25	<b>10.20 [8.19,12.70]</b>	<b>4.44 [3.50,5.63]</b>

Variable	E-cigarette trial			E-cigarette current use		
	% <sup>b</sup>	OR 95% CI	AOR 95% CI	% <sup>c</sup>	OR 95% CI	AOR 95% CI
<b>Smoking status</b>						
Never	15	1	1	6	1	1
Tried	52	<b>6.02 [5.36,6.76]</b>	<b>3.74 [3.27,4.27]</b>	17	<b>3.31 [2.81,3.91]</b>	<b>1.79[1.48,2.17]</b>
Current use	70	<b>12.77 [10.84,15.04]</b>	<b>5.73 [4.70,6.99]</b>	40	<b>11.01 [9.21,13.18]</b>	<b>4.65 [3.70,5.84]</b>

\* Mean value for students that had tried or use e-cigarettes,

<sup>a</sup> Family Affluence Scale,

<sup>b</sup> Prevalence of e-cigarette trail by sample characteristics,

<sup>c</sup> Prevalence of e-cigarette use by sample characteristics, Bolded results are statistically significant.

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**Table 4.**

Crude and adjusted odds of conventional cigarette trial and current use by technophilia level in Mexican adolescents from public schools of the three largest cities of México (Mexico City, Guadalajara & Monterrey), 2016 (N=8,123)

Variable	% <sup>b</sup>	Conventional cigarette trial		% <sup>c</sup>	Conventional cigarette current use	
		OR 95% CI	AOR 95% CI		OR 95% CI	AOR 95% CI
<b>Technophilia</b>						
Quartile 1	31	1	1	10	1	1
Quartile 2	36	<b>1.22 [1.07,1.38]</b>	1.04 [0.88,1.23]	10	1.05 [0.86,1.29]	0.89 [0.69,1.13]
Quartile 3	35	<b>1.18 [1.04,1.35]</b>	0.92 [0.77,1.09]	11	1.19 [0.98,1.46]	1.00 [0.79,1.29]
Quartile 4	38	<b>1.36 [1.19,1.55]</b>	0.97 [0.81,1.15]	11	1.20 [0.98,1.46]	0.90 [0.70,1.17]
<b>Sex</b>						
male	36	1	1	11	1	1
female	34	0.92 [0.84,1.01]	0.94 [0.83,1.05]	11	1.00 [0.87,1.15]	1.02 [0.86,1.21]
<b>Parent education</b>						
Primary	41	1	1	15	1	1
Secondary	37	<b>0.83 [0.73,0.95]</b>	1.01 [0.85,1.19]	11	<b>0.69 [0.57,0.84]</b>	0.83 [0.66,1.04]
High school	31	<b>0.63 [0.54,0.74]</b>	<b>0.78 [0.64,0.95]</b>	9	<b>0.55 [0.44,0.69]</b>	<b>0.73 [0.55,0.96]</b>
University	30	<b>0.62 [0.53,0.73]</b>	0.87 [0.70,1.08]	9	<b>0.55 [0.43,0.70]</b>	0.86 [0.63,1.16]
Unknown	30	<b>0.62 [0.49,0.79]</b>	0.89 [0.65,1.22]	11	0.73 [0.51,1.03]	1.12 [0.73,1.72]
FAS <sup>*2</sup>	4	1.01 [0.99,1.03]	<b>0.96 [0.94,0.99]</b>	4	1.86 [0.99,1.06]	0.98 [0.94,1.03]
Sensation seeking <sup>*</sup>	4	<b>1.86 [1.75,1.98]</b>	<b>1.32 [1.23,1.43]</b>	4	<b>1.87 [1.69,2.06]</b>	<b>1.21 [1.08,1.36]</b>
<b>Tried alcohol</b>						
No	11	1	1	2	1	1
Yes	48	<b>7.22 [6.36,8.20]</b>	<b>4.05 [3.51,4.69]</b>	15	<b>7.82 [6.05,10.12]</b>	<b>3.09 [2.33,4.10]</b>
<b>Tried drugs</b>						
No	27	1	1	5	1	1
Yes	85	<b>15.92 [13.40,18.90]</b>	<b>7.60 [6.28,9.21]</b>	42	<b>12.28 [10.50,14.36]</b>	<b>5.20 [4.36,6.19]</b>
<b>Exposure to tobacco online ads</b>						
Never	32	1	1	9	1	1
Sometimes	44	<b>1.65 [1.47,1.86]</b>	<b>1.18 [1.02,1.37]</b>	16	<b>1.87 [1.58,2.21]</b>	<b>1.31 [1.07,1.61]</b>
Often	50	<b>2.12 [1.73,2.60]</b>	1.25 [0.96,1.62]	18	<b>2.27 [1.73,2.97]</b>	1.18 [0.85,1.64]
<b>Family Nicotine Use</b>						
Neither	22			4		
Cigarette Only	41	<b>2.46 [2.21,2.74]</b>	<b>1.53 [1.34,1.75]</b>	13	<b>3.41 [2.79,4.18]</b>	<b>1.92 [1.53,2.41]</b>
E-Cig Only	32	<b>1.70 [1.19,2.41]</b>	1.25 [0.81,1.91]	5	1.06 [0.49,2.31]	0.59 [0.25,1.38]
Dual use	48	<b>3.26 [2.76,3.84]</b>	<b>1.28 [1.04,1.58]</b>	17	<b>4.60 [3.55,5.96]</b>	<b>1.57 [1.16,2.12]</b>
<b>Friend nicotine use</b>						
Neither	18			2		
Cigarette Only	43	<b>3.57 [3.15,4.06]</b>	<b>2.05 [1.77,2.39]</b>	16	<b>9.97 [7.50,13.24]</b>	<b>5.18 [3.83,7.00]</b>
E-Cig Only	32	<b>2.26 [1.86,2.74]</b>	1.03 [0.81,1.30]	6	<b>3.30 [2.15,5.07]</b>	1.37 [0.86,2.16]

Variable	Conventional cigarette trial			Conventional cigarette current use		
	% <sup>b</sup>	OR 95% CI	AOR 95% CI	% <sup>c</sup>	OR 95% CI	AOR 95% CI
Dual use	53	<b>5.22 [4.63,5.91]</b>	<b>1.80 [1.55,2.10]</b>	19	<b>12.81 [9.71,16.91]</b>	<b>3.70 [2.73,5.00]</b>
<b>Vaping status</b>						
Never	21	1	1	4	1	1
Tried	65	<b>6.86 [6.07,7.76]</b>	<b>4.23 [3.66,4.88]</b>	18	<b>4.62 [3.85,5.55]</b>	<b>2.15 [1.74,2.65]</b>
Current use	69	<b>8.35 [7.19,9.70]</b>	<b>3.86 [3.22,4.63]</b>	35	<b>11.81 [9.83,14.18]</b>	<b>4.91 [3.94,6.12]</b>

\* Mean value for students that had tried or use e-cigarettes,

<sup>a</sup> Family Affluence Scale,

<sup>b</sup> Prevalence of e-cigarette trail by sample characteristics,

<sup>c</sup> Prevalence of e-cigarette use by sample characteristics, Bolded results are statistically significant.

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**Table 5.**

Multinomial regression for first tobacco product used vs never use of any product by technophilia level in Mexican adolescents from public schools of the three largest cities of México (Mexico City, Guadalajara & Monterrey), 2016 (N=8,123)

	First tobacco product was e-cigarette (ref=never used)			First tobacco product was not an e-cigarette (ref=never used)		
	%	OR 95% CI	AOR 95% CI	%	OR 95% CI	AOR 95% CI
<b>Technophilia</b>						
Quartile 1	4	1	1	30	1	1
Quartile 2	5	<b>1.47 [1.06,2.03]</b>	1.19 [0.85,1.66]	31	1.06 [0.91,1.23]	0.92 [0.77,1.10]
Quartile 3	7	<b>2.05 [1.46,2.86]</b>	<b>1.43 [1.02,2.01]</b>	32	1.13 [0.96,1.33]	0.93 [0.76,1.13]
Quartile 4	8	<b>2.68 [1.92,3.73]</b>	<b>1.66 [1.20,2.31]</b>	34	<b>1.30 [1.07,1.58]</b>	1.00 [0.81,1.24]
<b>Sex</b>						
male	6	1	1	33	1	1
female	6	1.01 [0.84,1.21]	0.90 [0.75,1.09]	31	<b>0.90 [0.81,1.00]</b>	<b>0.82 [0.72,0.92]</b>
<b>Parent education</b>						
Primary	5	1	1	40	1	1
Secondary	5	1.05 [0.78,1.42]	1.01 [0.76,1.34]	34	<b>0.76 [0.67,0.88]</b>	0.88 [0.75,1.02]
High school	7	1.25 [0.93,1.67]	1.11 [0.84,1.47]	27	<b>0.56 [0.47,0.68]</b>	<b>0.69 [0.58,0.82]</b>
University	6	1.17 [0.82,1.65]	1.00 [0.72,1.40]	27	<b>0.56 [0.46,0.70]</b>	<b>0.77 [0.63,0.94]</b>
Unknown	7	0.97 [0.64,1.48]	1.09 [0.71,1.66]	27	<b>0.54 [0.42,0.69]</b>	<b>0.73 [0.55,0.97]</b>
FAS <sup>ad</sup>	5	<b>1.12 [1.07,1.17]</b>	1.04 [0.99,1.09]	4	1.01 [0.98,1.04]	0.98 [0.95,1.01]
Sensation seeking <sup>*</sup>	4	<b>1.55 [1.41,1.70]</b>	<b>1.17 [1.06,1.29]</b>	4	<b>1.82 [1.69,1.95]</b>	<b>1.29 [1.20,1.40]</b>
<b>Tried alcohol</b>						
No	4	1	1	12	1	1
Yes	7	<b>2.90 [2.30,3.67]</b>	<b>1.83 [1.43,2.36]</b>	43	<b>5.90 [5.35,6.50]</b>	<b>3.42 [3.09,3.80]</b>
<b>Tried drugs</b>						
No	6	1	1	24	1	1
Yes	5	<b>4.18 [3.00,5.81]</b>	<b>2.59 [1.86,3.60]</b>	80	<b>15.66 [12.75,19.25]</b>	<b>8.74 [7.11,10.74]</b>
<b>Exposure to Ecig Online ads</b>						
Never	4	1	1	27	1	1
Sometimes	8	<b>2.44 [1.99,2.99]</b>	<b>1.62 [1.27,2.07]</b>	39	<b>1.87 [1.67,2.10]</b>	<b>1.24 [1.09,1.42]</b>
Often	10	<b>3.99 [2.83,5.63]</b>	<b>2.29 [1.49,3.54]</b>	50	<b>3.20 [2.51,4.08]</b>	<b>1.50 [1.12,2.01]</b>
<b>Exposure to tobacco online ads</b>						
Never	5	1	1	30	1	1
Sometimes	8	<b>1.86 [1.52,2.27]</b>	1.07 [0.84,1.36]	39	<b>1.64 [1.46,1.85]</b>	1.09 [0.95,1.25]
Often	6	<b>1.60 [0.97,2.64]</b>	0.67 [0.38,1.18]	48	<b>2.31 [1.88,2.85]</b>	1.14 [0.90,1.44]
<b>Family Nicotine Use</b>						
Neither	4	1	1	19	1	1
Cigarette Only	6	<b>1.81 [1.41,2.33]</b>	<b>1.47 [1.14,1.90]</b>	37	<b>2.57 [2.32,2.86]</b>	<b>1.75 [1.57,1.95]</b>
E-Cig Only	7	1.97 [0.91,4.27]	1.55 [0.70,3.43]	30	<b>1.90 [1.36,2.66]</b>	<b>1.53 [1.03,2.29]</b>

	%	First tobacco product was e-cigarette (ref=never used)		%	First tobacco product was not an e-cigarette (ref=never used)	
		OR 95% CI	AOR 95% CI		OR 95% CI	AOR 95% CI
Dual use	9	<b>3.60 [2.52,5.15]</b>	<b>2.24 [1.53,3.28]</b>	47	<b>4.17 [3.51,4.96]</b>	<b>2.24 [1.86,2.71]</b>
<b>Friend nicotine use</b>						
Neither	3			15		
Cigarette Only	4	<b>1.81 [1.28,2.57]</b>	<b>1.43 [1.02,2.00]</b>	45	<b>3.93 [3.43,4.52]</b>	<b>2.44 [2.12,2.81]</b>
E-Cig Only	4	<b>4.37 [2.99,6.39]</b>	<b>3.26 [2.18,4.88]</b>	41	<b>2.58 [2.07,3.22]</b>	<b>1.78 [1.37,2.31]</b>
Dual use	11	<b>5.86 [4.65,7.37]</b>	<b>3.66 [2.85,4.70]</b>	29	<b>6.10 [5.12,7.26]</b>	<b>3.09 [2.59,3.68]</b>

\* Mean value,

<sup>a</sup> Family Affluence Scale, Bolded results are statistically significant.

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