

Title: Who, me? Optimism bias about US teenagers' ability to quit vaping

Running Head: Optimism bias about vaping cessation

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Abstract

Background and aims: The vaping rate among US teenagers has doubled in the last 2 years, which may be explained in part by teenagers' optimism that they would have relatively little trouble in quitting. The aim of this study was to estimate the extent to which teenagers exhibited optimism bias, what characteristics are associated with optimism bias, and which factors are related to respondents' perceptions of how hard it would be for them to quit.

Design: a national, online, cross-sectional survey in 2018 using quota sampling.

Setting: USA

Participants: Respondents were $n=1,610$ teenagers aged 14-18 who had ever tried or heard of JUULs or e-cigarettes generally.

Measurements: Optimism bias was defined as respondents' perceptions of their own difficulty quitting vaping compared with that of an average US person of their own age. Linear regression was used to examine associations between respondents' characteristics with both optimism bias and their own perceived difficulty quitting vaping.

Findings: Over 60% of teenagers were optimistically biased about their ability to quit vaping. Smoking ($b=-0.69$, $p<0.01$) and JUULing ($b=-0.62$, $p<0.01$) were negatively associated with optimism bias but reduced-price school lunch eligibility (0.24 , $p=0.02$) and school satisfaction were positively associated ($b=0.05$, $p=0.02$). Smoking ($b=0.84$, $p<0.01$) was associated with an increased perception of the difficulty of quitting. That association was negative for Black respondents ($b=-0.81$, $p=0.01$) and those eligible for reduced-priced lunches ($b=-0.48$, $p=0.01$), and positive for Hispanic respondents ($b=0.47$, $p=.04$).

Conclusions. On average, US teenagers appear to show optimism bias about their ability to quit vaping, which decreases with smoking and vaping and increases with eligibility for reduced-price school lunches.

I. Introduction

Vaping by US teenagers has doubled in the last two years (1). This upward trend is troubling as it undermines the reduction in teens' use of combustible cigarettes over time (2). The trend in vaping may be explained in part by the sleek and high-tech look of e-cigarettes and the availability of many teen-appealing flavors (3–6). Also, JUUL e-cigarettes in particular have been marketed heavily to teens and have captured 75% of the vaping market (7). Now that JUUL has removed most of their flavors, substitute flavored e-cigarettes (largely disposables) have gained market share. Adding to the increasing trend in vaping is a perception by teenagers that vaping is considered to be less harmful than smoking (3,8), and that it is easier to quit vaping as compared to smoking (9). The latter may be true even though most JUULs have nicotine levels of typical combustible cigarettes and the nicotine is absorbed into the body at almost the same rate (10). Importantly, optimism bias about the ease of quitting may contribute to the decision to start vaping which in turn can lead to a lifetime of addiction (9). Indeed, data from the US Population Assessment on Tobacco and Health (PATH) study indicate that 45% of adolescents who vape are seriously interested in quitting, and 25% made a past-year quit attempt (11).

In addition to teenagers' misperceptions about the overall ease of quitting vaping, teens may falsely believe that they can quit more easily in relation to others. That is, they may be overly optimistic about their own ability to resist addiction but may, on average, have a better understanding of the actual risk when they think more dispassionately about other teens. This tendency is termed *Optimism Bias (OB)*, or the 'better than average heuristic' (12,13).

This phenomenon means that a person systematically overestimates their own ability to quit relative to the ability of other, similar people, even when they themselves might not have greater ability to resist addiction (14,15). This bias may occur because individuals want to view themselves in a more favorable light, maintain a strong self-image, perceive themselves to have more control than others (perhaps incorrectly), or are egocentric, among other reasons (13,16).

Optimism bias and other consumer optimization errors with respect to combustible cigarettes have been documented in a rich literature from the fields of psychology and behavioral economics. These errors can include time inconsistency (delay discounting), risk misperceptions, and optimism bias, among others (17). OB has been documented for smoking, but no research has specifically examined vaping-related health risks in youths. OB in smoking has been identified in adults with respect to the chances of avoiding smoking-related disease and death as compared to the actuarial risks (although some studies find that smokers overestimate their smoking-related risks (18,19)). However, there appear to be few articles examining OB with respect to potential addiction for smoking, and none for vaping (20). One study finds that adults exhibit optimism bias about the ability to quit smoking combustible cigarettes (14). Other studies suggest that both adults and adolescents exhibit optimism bias with respect to beliefs about ability to quit smoking combustible cigarettes; and these studies also find evidence that adults and adolescents perceive that they could quit smoking relatively easily (15,21). Importantly, OB about the ease of quitting may contribute to the decision to start vaping which in turn can lead to a lifetime of addiction (9).

Given the lack of evidence on OB with respect to e-cigarettes, we aim to address the following questions:

1) *To what extent do youths exhibit OB with respect to quitting vaping?* We survey teenagers about perceptions of their own and that of others' ability to quit vaping and use these data to measure the extent of OB. Based on previous literature on OB for combustible cigarettes, we hypothesize that on average, respondents will report that they would have an easier time quitting than others; and that the magnitude of this difference would increase with social distance. A friend is more familiar to the respondent *and is thus socially less distant compared to an average teenager who is more socially distant*.

2) *What factors affect youths' OB?* We examine factors that are associated with OB. Associations may suggest pathways to combat (e.g. de-bias) such misperceptions and may identify those groups who are most vulnerable to the bias and thus consequent harms.

3) *What factors affect youths' perceived quit difficulty?* Evidence on which factors are related to respondents' perceptions of how hard it would be for them to quit provide additional insight into the formulation of OB.

II. Methods

Survey Procedures and Sample

We conducted an online, cross-sectional survey in December 2018 of 1,610 teenagers aged 14-18 who had ever heard of or tried JUULs or e-cigarettes. Eligible individuals provided consent prior to participation and were informed that their answers would only be used for research. Recruitment was conducted through *Qualtrics Online Research Panels*. To make our survey more representative of the US population, we provided quotas of respondents for *Qualtrics*. Quotas were derived from the 2015 US census for a total of 2,000 participants. Quotas were defined by age (separately for each 14 to 18), region (New England, Mid Atlantic, Midwest, South, Mountain, Pacific), gender (female, male), and race (white, non-white). All quotas were at least partially filled. By region, the percentages of filled quotas are: Mid Atlantic (93%), Midwest (98%), Mountain (91%), New England (92%), Pacific (90%) and South (58%). We provide the specific quotas in Appendix 1. The Yale Human Subjects Committee approved this study.

Promoting data quality

The online survey was pilot-tested on 100 respondents whose feedback was used to improve the final survey. To encourage respondents to answer accurately we provided: a prompt to answer the survey truthfully; narrative and visual information describing the products, instructions, definitions, and a practice question. "Forced responses" prevented respondents from skipping survey questions. A minimum time threshold identified and removed respondents who rushed through. We also removed respondents who appeared to be duplicates (e.g. identical socio-demographics). In addition, respondents were required to move sliders prior to proceeding to the next question to ensure an active response (see Appendix 2). Qualtrics delivered a total of 1,621 completed surveys within the quotas. We removed 11 observations for failing to meet inclusion criteria (age or awareness of e-cigarettes) which gave the final analytic sample of 1,610 respondents.

Measures

Dependent variables

Perception of difficulty quitting vaping

Data were collected from the respondents about their perceptions of how hard it would be to quit using e-cigarettes that contained nicotine—both for themselves and separately for other categories of youths. These categories were defined with increasing social distance (i.e. greater unfamiliarity to the respondent). Specifically, respondents were asked: “If you or the person/group below were to use e-cigarettes (including JUUL-types) with nicotine on a regular basis, how difficult do you think it would be for them to quit?” Separate sliders required responses referring to these categories: 1) you, 2) your best friend, 3) someone else your age at your school, at work or in your neighborhood, and 4) an average U.S. teenager of your age. The last three categories are increasing in social distance from one’s self. The slider responses ranged from 0, labeled ‘easy to quit’, to 10, labeled ‘hard to quit’. Data from these responses were used to calculate the variables on how hard it would be for the respondent categories above to quit. These measures are of interest on their own and also form the basis of the OB variables that are the focus of this research.

Optimism bias

Following previous literature, we measure OB by comparing reports of perception of own ability to quit to the respondents’ perceived ability to quit of those of similar age but of increasing social distance (e.g. an average U.S. teenager is more socially distant than a best friend). As the social distance increases, it is thought that respondents become more realistic about the actual risks and/or may convey less of their own ‘better-than-average’ heuristic to the more socially distant groups. Optimism bias could also be measured by comparing one’s own risk to their actuarial risks. But the actuarial risks of youths trying to quit vaping are not yet known to scientists let alone youths, so we used the approach of measuring social distance.

The dependent variable used in the empirical analyses is calculated by subtracting the answer to ‘how hard would it be for you to quit using e-cigarettes that contained nicotine’ from the answer in response to the same question but for an average US teen ‘your’ age. We asked this question for multiple flavor options and calculated an average response across all flavors. We chose the specification (own to average teen) of OB as it compares the response for self to the most socially distant group; and it follows previous literature (13). While it may be that some teens will find it easier to quit than others, it should not be that more than half of the population would be able to quit more readily than the US average teen. Thus, a straightforward test of whether teens display OB in the sample is if over 50% of them seem to have OB.

Covariates

Smoking and vaping.

For respondents who reported having ever smoked or vaped, the survey also asked about smoking and vaping in the last 30 days; these measures were used as control variables that could affect perceptions through experience (22–25). Specifically, the question asked about past 30-day use of traditional cigarettes, e-cigarettes, and JUUL resulting in three separate binary (0/1) use variables: one for each tobacco product. We also asked about knowledge of lung cancer: “do you know what lung cancer is (yes/no/maybe)?” This variable may capture knowledge that could be associated with perceptions about how hard it might be to quit vaping and smoking.

Additional participant characteristics

The survey collected information regarding socioeconomic and demographic characteristics. Control variables in our regression models include age, gender, race, ethnicity, rural residency, parents' highest level of education, and state of residence. Respondents were also asked about school satisfaction: "How satisfied at school were you during your last year of school" on a scale of 0: not at all satisfied to 10: completely satisfied. Another question asked if the respondent was participating in a free or reduced-price lunch program (yes, no), which is intended as a broad proxy measure for socioeconomic status.

Analytic approach

We first use descriptive statistics to investigate the extent to which OB exists in this sample of youths. We use a Student's t-test of the mean of the OB variable versus 0 (i.e. the OB scale midpoint, which ranges from -10 to 10). Next, we investigate whether and how youths' OB is related to sociodemographic and behavioral variables (see Table 1). Finally, to gain insight into the formation of OB, we estimate whether and how the variables are related to own reported perception of the difficulty of quitting.

To determine which factors are associated with teens' OB, we estimate the following ordinary least squares regression model:

$$OB\ avteen_i = \alpha_0 + \beta_x X_i + \varepsilon_i \quad (1)$$

Where $OB\ avteen_i$ is the *calculated OB* perception comparing reported own difficulty quitting versus that of an average teen, as described above. X_i is the set of individual characteristics in Table 1 and also includes age and state fixed effects. In addition, we include a dichotomous variable of whether the respondent's own perceived ability to quit is high (i.e. own quit difficulty <5). We include this variable to 'anchor' the measure of OB because OB is measured as the difference between perception of own and others' ability to quit. If own ability to quit is high, this would mathematically compress the difference between own and other as the maximum level of difficulty is 10. β_x captures the association of OB and youths' characteristics. α_0 is a constant, and ε_i is the error term and is assumed to be iid normally distributed.

To provide additional insight into the formulation of OB we investigated associations between perceived quit difficulty and individuals' characteristics. This analysis provides evidence on which factors are related respondents' perceptions of how hard it would be for them to quit. This analysis mirrors that of equation 1 but with the dependent variable being, 'how hard it would be for you to quit?'

STATA (version 14) was used for estimation. We also estimated ordered logit models to examine the sensitivity of our estimates. The coefficients followed similar patterns of direction and significance. We retained the OLS specification for relative ease of interpretation. The analysis was not pre-registered and therefore results should be considered exploratory.

III. Results

Participant characteristics

Table 1 presents descriptive characteristics of the respondents. Respondents had a mean age of 16.06 (SD = 1.39) and were 49% female; the majority were white/Caucasian (75%). Relatively few respondents were from rural areas (23%) and participated in free or reduced-price lunch programs (48%). The majority had parents that had completed “some college or more” (67%). On a scale of 0 to 10, respondents reported a 6.4 (SD = 2.74) point average school satisfaction rating.

Information on OB and quit difficulty is presented in Table 1 and Figure 1. On average, respondents believed that quitting vaping would be 2.76 Likert points (SD = 3.35) more difficult for the average US teenager, 2.46 points (SD = 3.27) more difficult for someone their age in their school, and 1.25 points (SD = 2.90) more difficult for their best friend, compared to themselves. In all cases, t-tests indicated that these values were statistically significantly different to zero ($p < 0.00$). As expected, the respondent is more optimistic about their ability to quit as opposed to others’ abilities. These data are displayed graphically in Figure 1, and show that as the social distance increases, so does the perception of the difficulty of others to quit.

Table 2 presents results of the ordinary least squares estimation of factors related to youths’ OB. We find that use of cigarettes ($b = -0.69$; $p < 0.01$) and separately JUUL ($b = -0.62$; $p < 0.01$) are associated with lower OB. The impact of use of e-cigarettes other than JUUL is not significant. We do not rule out collinearity; though pair-wise correlations among all three variables are very similar (Appendix 3) and the other coefficients do not appear problematic. Moreover, we estimated models including only cigarettes and JUUL, and separately models with only cigarettes and e-cigarettes, but with the full set of explanatory variables. In these cases, the JUUL parameter was similar in magnitude and significant to the results in the table; and the e-cigarette parameter was slightly larger but not statistically significant.

Respondents who believe it is easier for them to quit also display greater OB than those that believe it harder to quit ($b = 4.81$; $p < 0.001$). This is partially an artefact of there being more opportunity for them to display OB (i.e. more “room along the scale”), because their score of own quit difficulty is lower. Other variables that were significant were: Free Lunch ($b = 0.27$; $p = 0.02$) and Satisfied with School ($b = 0.05$; $p = 0.024$). The positive coefficients on these variables suggest that these each is associated with higher OB.

Table 3 presents regression results using perceptions of how hard it is to quit as the dependent variable. We find that smoking in the last 30 days ($b = 0.85$; $p < 0.001$) is associated with perception of quit difficulty. Black ($b = -0.81$; $p = 0.01$), Hispanic ($b = -0.47$, $p = 0.04$) and Free Lunch ($b = -0.48$; $p = 0.01$) are associated with reduced perceptions of own difficulty of quitting.

IV. Summary and Discussion

This paper is the first, we believe, to empirically examine OB in vaping in teens. Our findings that OB exists, along with our findings on own ability to quit, have important implications for policies that aim to prevent teens vaping initiation. The study adds to the broader literature on OB by providing evidence of the existence and extent of OB with respect to vaping in youths. Examining

perceptions of OB and ability to quit in parallel with each other gives additional insights and policy implications. Own perceived difficulty quitting may be directly related to the policy concern of initiating vaping.

Results indicate that over 60% of teenagers are optimistically biased about their ability to quit. While it may be that some teens will indeed find it easier to quit than others, more than half of the population should not be able to quit more readily than the US average teen. Thus, we conclude that OB in vaping exists for teenagers. As expected, respondents were more sanguine about their ability to quit as opposed to others' abilities. Specifically, as the social distance increased, so did the perception of the difficulty of others to quit. The existence of OB suggests that many teens may think that they can quit somewhat readily (better-than-average heuristics) but at some level understand that it would be difficult for others to quit; thus the wedge between perception of own and others ability to quit.

Tobacco history and some socio-economic and demographic variables were related to both OB and perceived difficulty quitting. Results suggest that past 30-day smoking and vaping JUULs were associated with reduced OB. Smoking in the last 30 days was also associated with increased perceived difficulty of own quitting vaping; smokers may learn the difficulties by experiences (21-23). Smoking experience may increase understanding of the difficulties for own quitting and may also increase an understanding of other's difficulties, but must do so more for own perception of difficulty to result in a negative impact on OB. The same may hold for vaping and e-cigarette use, but the evidence is weaker. E-cigarette use and JUULing were also positive for difficulty for own quitting but were not significant.

In our analyses we find that JUUL use and cigarette use are associated with a lower degree of OB, but not the use of e-cigarettes. This may imply that nicotine salt products (such as JUUL) are more addictive than freebase nicotine products (like many e-cigarettes); nicotine absorption from salt base nicotine is higher than for freebase nicotine (26). As a result, users may be more aware of their addiction.

Finally, results also indicate that black and Hispanic youths and those eligible for free lunch may underestimate their own difficulty in quitting and thus might be at higher risk for vaping, controlling for other factors (9). To the extent that these variables are correlated with a propensity to initiate vaping, optimism bias may exacerbate tobacco use disparities.

Contributions of this paper

This paper is the first, we believe, to empirically examine OB in vaping in teens in a recent, national sample. The sample was youths ages 14-18, a critical group in terms of initiation. Further, our sample was selected to include those who had heard of e-cigarettes, and thus it is informative of youths most likely to be at risk of future vaping. By developing the online survey, we were able to examine factors that might contribute to one's OB and one's view of the difficulty of quitting. The sample is large and national, and we used quotas to promote representativeness according to the demographics. Our attention to quality of the data also added to the integrity of our study.

Limitations

Participation in the survey was limited to youths ages 14-18. Therefore, our findings may not be generalizable outside this age group, yet this is a critical group terms of initiation. Further, the south is not as well represented as other regions. Although internet surveys may be subject to limitations by respondents, we pilot tested our study prior to implementation to make sure that terms were clear and well understood. Because the data is cross-sectional, we are unable to determine causal effects in our analyses. In addition, because it is not possible to know the actual ability of each respondent to quit if they were to vape, we cannot compare their perceptions to their actual ability. Finally, our use of quotas for sampling is a limitation. While the quotas promote representativeness according to the demographics, there are demographics on which we were unable to sample. Further, we cannot rule out that all observations from a given region come from a city in that region. Our control variables help to abate these issues. Of course, random sampling would have been preferred, but was not viable for this project.

Policy Implications

Although teens may be realistic about the ability of others to quit, we find that on average they tend to be optimistically biased about their own ability to quit. Policies and programs could try to directly address this wedge in expectations and aim to de-bias teenagers based on their understanding that it is difficult for others to quit. Although the literature has shown that it is difficult to debias beliefs (27,28), there is evidence that perceptions of e-cigarettes change over time (29,30). Changes in perceptions may be due to experiences (23–25), marketing (10), message framing (31), or federal or changes in state policy (32,33). Policy changes and enforcement at the state and Federal level to ban e-cigarettes in key flavors, tax e-cigarettes, and ban sales to those under 21 years of age may indirectly aid in the debiasing of perceptions. A better understanding of optimism bias and perceptions of addiction may encourage more effective policies and programs.

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Tables and Figures

Figure 1.

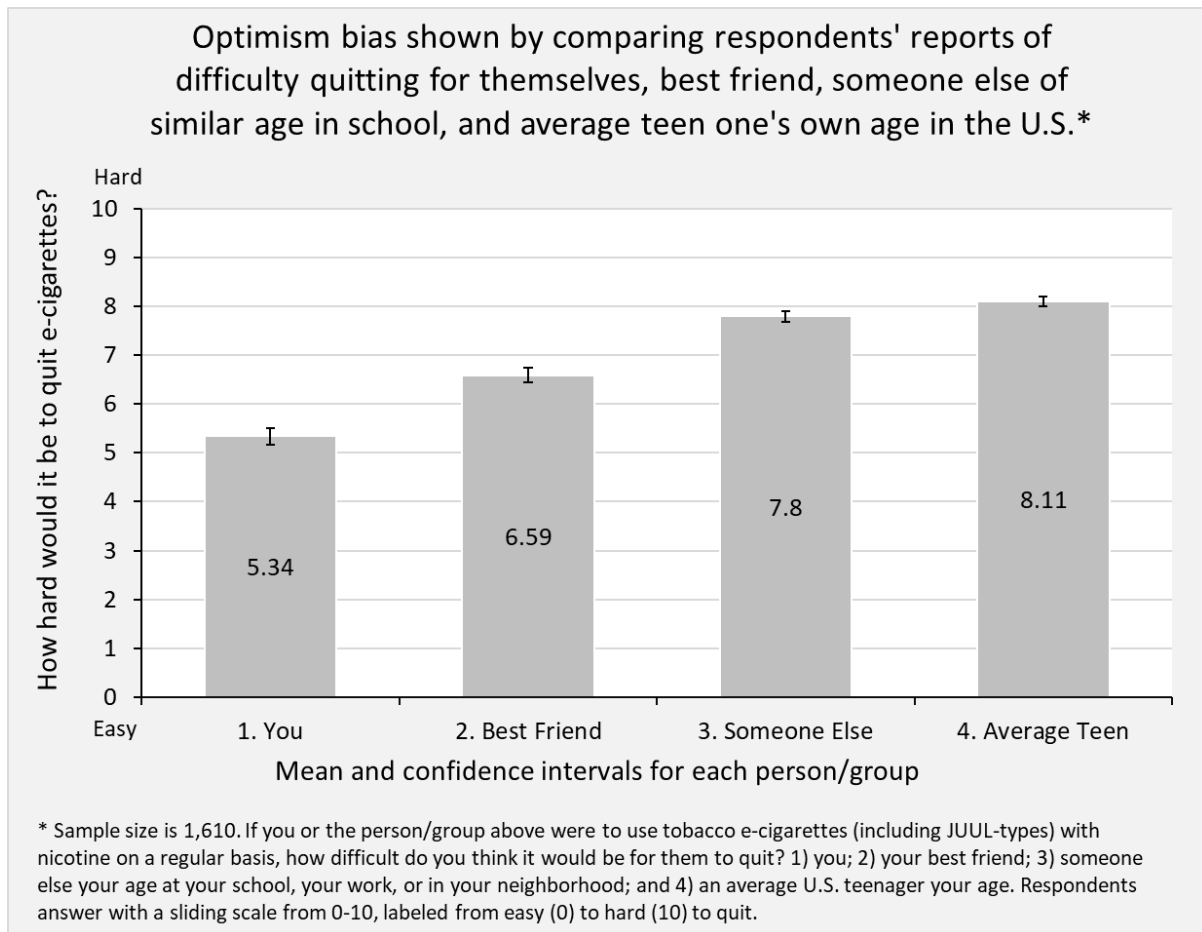


Table 1. Descriptive Characteristics of Study Participants.

Variables: Independent	Mean / %	std. dev.
<i>Demographics</i>		
Age	mean=16.06	(1.39)
14	18%	
15	20%	
16	20%	
17	22%	
18	20%	
Female	49%	
Parents Have Some College Edu	67%	
Free or Reduced Lunch Recipient	48%	
School Satisfaction (scale)	mean=6.40	(2.74)
<i>Race</i>		
Amer. Indian or Alaska Native	2%	
Asian	5%	
Black	9%	
Multiracial	7%	
Native Hawaiian or Pac. Islander	1%	
White	75%	
<i>Ethnicity</i>		
Hispanic	20%	
<i>Urbanicity</i>		
Rural	23%	
Suburban	54%	
Urban	23%	
<i>JUUL & E-Cigarette Use /Knowledge</i>		
Ever tried E-cigarettes	38%	
Ever tried JUUL	37%	
Past 30-day Cigarette use*	14%	
Past 30-day E-cigarette use*	18%	
Past 30-day JUUL use*	33%	
Lung cancer knowledge	96%	
Variables: Dependent	Mean / %	std. dev.
Optimism Bias**		
Your best friend	mean=1.25	(2.90)
Someone else your age in your school	mean=2.46	(3.27)
Average teenager in US your age	mean=2.76	(3.35)
How hard would it be to quit for:***		
You	mean=5.34	(3.50)
Best friend	mean=6.59	(3.09)
Others at school	mean=7.80	(2.27)
Average teen, US	mean=8.11	(2.26)
Percentage think they could easily quit	46%	

Notes: The total sample size is 1,610 respondents. *Sample size for “past use” variables are conditional on a “yes” response to “ever tried” variables, and thus smaller than the full sample. **Optimism bias is calculated using reports on perception of own difficulty in quitting relative to best friend, someone else in school, and average US teenager your age. ***Difficulty quitting is based on responses to a slider question where responses ranged from 0, labeled ‘easy to quit’, to 10, labeled ‘hard to quit’. “Easily quit” represents the percentage of participants with scores>5.

Table 2. Results of OLS models: characteristics predicting the degree of optimism bias.

VARIABLES	Coefficient on OB	Standard Error	P-value
Past Use			
Past 30 Day Combustible Cigarette Use	-0.692***	(0.188)	0.000
Past 30 Day E-Cigarette Use	-0.079	(0.187)	0.672
Past 30 Day JUUL Use	-0.621***	(0.162)	0.000
Could Easily Quit	4.806***	(0.119)	(0.000)
Knows Lung Cancer	0.330	(0.319)	0.302
Female	0.197	(0.115)	0.088
Race			
Asian	-0.033	(0.308)	0.914
Amer. Indian or Alaska Native	0.052	(0.426)	0.902
Native Hawaiian or Pac. Islander	-0.047	(0.501)	0.925
Multiracial	0.032	(0.223)	0.887
Black	-0.020	(0.231)	0.932
Hispanic	0.037	(0.163)	0.822
Urbanicity			
Rural	-0.137	(0.179)	0.444
Suburban	-0.058	(0.149)	0.697
Parents College Educated	0.154	(0.141)	0.275
Free Lunch	0.274*	(0.121)	0.024
School Satisfaction	0.051*	(0.022)	0.024
Age Indicators			
15	-0.148	(0.183)	0.418
16	-0.073	(0.185)	0.696
17	0.014	(0.182)	0.937
18	0.074	(0.204)	0.718
Constant	-0.493	(0.699)	

Notes: The number of respondents is 1,610. The dependent variable presented in this table is Optimism Bias (OB), which is calculated by subtracting the value of own difficulty quitting from the perception of difficulty for the average teen. Although not shown, all models included state-level fixed effects (51 separate indicators). *** p<0.001, ** p<0.01, * p<0.05

Table 3. Results of OLS models: characteristics predicting the degree of perceived own difficulty quitting vaping.

VARIABLES	Coefficient on Quit Difficulty	Standard Error	P-value
Past Use			
Past 30 Day Combustible Cigarette Use	0.849**	(-0.274)	0.002
Past 30 Day E-Cigarette Use	0.171	(-0.26)	0.509
Past 30 Day JUUL Use	0.215	(-0.226)	0.342
Knows Lung Cancer	-0.441	(-0.503)	0.381
Female	0.195	(-0.174)	0.263
Race			
Asian	-0.32	(-0.421)	0.447
Amer. Indian or Alaska Native	0.428	(-0.534)	0.423
Native Hawaiian or Pac. Islander	0.849	(-0.709)	0.231
Multiracial	0.084	(-0.327)	0.798
Black	-0.810*	(-0.323)	0.012
Hispanic	-0.468*	(-0.23)	0.042
Urbanicity			
Rural	-0.328	(-0.26)	0.207
Suburban	0.098	(-0.217)	0.651
Parents College Educated	0.211	(-0.207)	0.307
Free Lunch	-0.478*	(-0.188)	0.011
School Satisfaction	0.018	(-0.034)	0.597
Age Indicators			
15	0.042	(-0.29)	0.886
16	0.012	(-0.282)	0.967
17	0.379	(-0.276)	0.170
18	0.036	(-0.306)	0.907
Constant	5.929***	(0.930)	

Notes: The number of respondents is 1,610. The dependent variable presented in this table is (own) perception of difficulty to quit vaping. Although not shown, all models included state-level fixed effects (indicators). *** p<0.001, ** p<0.01, * p<0.05