

From Initiation to Addiction: Exploring Tobacco Use Behavior, Cessation Efforts, and Advertising Influence

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ABSTRACT: Annually, over 8 million people worldwide die from tobacco use, including an estimated 1.3 million people who do not smoke, but are exposed to second-hand smoke. This research aimed to 1) understand when individuals started smoking, their quit attempts, and the tools they utilized to quit, and 2) understand the role of advertising in making tobacco products appealing to youth (ages 15-26 years) using a case study. For Part 1, participants worldwide (N=82; primarily from the US, India, United Kingdom, and United Arab Emirates) answered survey questions about their smoking history and quit attempts. Results showed that most people who smoked started as young adults (ages 18-24 years). While many participants had attempted to quit, only 60% were successful. Most of the participants quit without any resources (e.g., 68% quit “cold turkey” or “through willpower”). For Part 2, using eye-tracking data, we showed that youth may spend more time looking at promotional messages on e-cigarette advertisements, which may eventually lead to nicotine dependence. Taken together, this research shows that people get exposed to smoking at a young age and have a hard time quitting later in life. In the case study, results showed that tobacco advertising is appealing to youth, and regulating specific advertising features could decrease the number of young adults addicted to tobacco.

KEYWORDS: Behavioral and Social Sciences, Physiological Psychology, Tobacco, Cessation, Survey.

■ Introduction

While there has been a significant decline in smoking in the last 30 years, tobacco consumption is still widely prevalent today. Globally, data from 2020 show that about 32.6% of adult men and 6.5% of adult women regularly use tobacco.¹ In the US, while the percentage of adult people who smoke has declined from about 21% in 2005 to 13% in 2021, the rates of electronic cigarettes (e-cigarettes) usage are high, with 10% of American High School students reporting use.² Some research suggests that e-cigarette use could lead to the use of more harmful products in the future, such as combustible cigarettes.³⁻⁷

Tobacco use, specifically cigarette smoking, has had a devastating impact on human health. Cigarettes contain over 7000 harmful chemicals, including nicotine, carbon monoxide, and formaldehyde.⁸ As a result, smoking is known to cause diseases such as cancer, heart disease, stroke, lung diseases, diabetes, and chronic obstructive pulmonary disease (COPD), which includes emphysema and chronic bronchitis. Smoking also increases the risk of tuberculosis, certain eye diseases, and autoimmune diseases, including rheumatoid arthritis. Each year, smoking results in over 8 million premature deaths worldwide, while many others live with serious illnesses caused by smoking.⁹ One challenge in reducing the prevalence of smoking is the influence of the tobacco industry itself. The tobacco industry spends over \$8 billion on advertising its products and provides significant discounts to tobacco sellers to reduce the costs of cigarettes and other products.¹⁰

A more recent worrying trend is the popularity of e-cigarettes among the youth. As of 2021, approximately 4.5% of the adult US population were e-cigarette users. However, the

number of users was much higher (11%) for younger adults aged 18-24.¹¹ While e-cigarette use may be less harmful than the use of combustible cigarettes, e-cigarettes can expose youth to harmful toxicants¹² and may lead to the initiation of more harmful products, such as cigarettes.¹³⁻¹⁸ For example, JUUL, a leading e-cigarette brand with a large market share, contains very high levels of nicotine.¹⁹ One major cause of e-cigarettes' popularity is their manufacturers' aggressive marketing strategies.²⁰⁻²³ E-cigarette advertisements (ads) portray their products as appealing, focusing on flavor and making them appear desirable.^{24,25} They also claim lower health harms (vs. cigarettes), causing youth and young adults to view these ads favorably.²⁶

Quitting smoking can greatly reduce health risks, disease burden, and deaths.⁸ Nicotine is a known addictive substance in tobacco, which makes it hard for people to quit. Repeated quit attempts need to be made to be successful. The U.S. Centers for Disease Control and Prevention (CDC) website has several resources for people interested in quitting. These include counseling, where one could work with doctors, coaches, nurses, and health care professionals to quit. In addition to counseling, people can discuss medical treatment options with their doctors. Of the seven approved medications by the U.S. Food and Drug Administration (FDA), five are based on nicotine and contain nicotine as an active ingredient.⁸ These medicines are nicotine replacement therapies (NRTs), including nicotine gum, lozenges, patches, sprays, and inhalers. These medications can help because NRTs do not contain the cancer-causing chemicals that are present in combustible tobacco. These can reduce the risk of cancer and heart and lung disease. Furthermore, cigarettes are designed to get nicotine to the brain very quickly, while NRTs are safer and less addictive. Af-

ter being treated for a few weeks, NRT can be slowly stopped. Finally, two FDA-approved medications that do not contain nicotine are varenicline and bupropion.²⁷ These are prescription medications that can only be prescribed by a doctor. The CDC website lists resources such as hotlines, text messaging services, and apps to help people quit.

A survey conducted in 2015 to understand smoking cessation behaviors revealed that 68% of adults who smoke wanted to quit.²⁸ In another survey conducted in 2018, about 55% of adults who smoke said they attempted to quit smoking within the past year, but only 7.5% of adults were successful.²⁹ However, the surveys did not identify when they started smoking, what motivated them to start smoking or specific tools they had used while attempting to quit. Further, given that e-cigarette consumption can lead young adults to start using more harmful products, such as cigarettes, it is important to understand how young adults react to aggressive marketing strategies employed by e-cigarette manufacturers, which are like the tactics used by the tobacco industry. Understanding smoking and quitting behaviors, as well as the effects of advertising on young adults, would help promote awareness of resources available for quitting and influence the regulation of cigarette and e-cigarette manufacturers.

The current study aimed to 1) identify when individuals started smoking and understand how they attempted to quit, whether they were successful in quitting, and the tools they utilized to quit, and 2) understand how youth may react to advertising, a primary driver of e-cigarette use, as a means to provide evidence on how it can be regulated so young adults do not progress to cigarette use in the future. This was done using a survey (Part 1) and an in-lab case study utilizing eye-tracking technology (Part 2).

■ Methods

Part 1: Survey:

A questionnaire was created using Google Forms containing 16 questions for the survey. A consent form was attached to the Google Form, and all participants must sign and date the survey before answering it. The survey was sent to over one hundred people who smoked, and data from 82 responses that were received was collected using Google Sheets. Participants had to be over the age of 18; additionally, they were recruited from the US, India, and a few other countries, such as the United Kingdom and the United Arab Emirates. The data were analyzed using spreadsheet tools in Google Sheets. The survey was designed to determine the number of people who smoked who had attempted to quit smoking, how many had succeeded, and what tools they had used to help them quit.

Measures:

The survey included questions on demographics and the participants' smoking and quitting history. Specifically, the questions included: 1) demographic information, 2) smoking history in the last 30 days, 3) number of cigarettes smoked per day, 4) age they started smoking, 5) current smoking status, 6) attempts participants had made to quit smoking, 7) their success in quitting smoking (if they attempted to quit), 8) time

taken to quit smoking, 9) tools participants used to quit smoking, and 10) reasons for why participants do not want to quit.

Part 2: Psychophysiological Study:

Design:

The lead author participated in a study to record perceptions of e-cigarette ads in the laboratory of Professor Elise Stevens, Center for Tobacco Treatment Research and Training, University of Massachusetts Chan Medical School, Worcester, MA.

Three e-cigarette print ads of some of the most popular e-cigarette brands among young adults at the time of the study were viewed in a random order. These brands included Blu, Juul, and MarkTen. The advertisements chosen from each brand contained the following features: 1) brand, 2) descriptor, 3) person, and 4) warning. These were the four areas of interest (AOIs) used for eye tracking (see below). Brands included a clearly identifiable product name or logo. Descriptors included benefits of use (e.g., 'full-on taste' 'vaping made simple') and reasons for use (e.g., 'makes switching easy'). A person included men and women, young adults and older people, and people holding or using the product. These features were chosen because of their popularity in e-cigarette advertising.^{22,30,31} No ad was modified for the study. All ads included a warning as required by the FDA.

An eye-tracking device connected to the computer tracked the author's eye movements, and two sensors on the author's fingers tracked heart rate and skin conductance. Each ad appeared for ten seconds, which falls above the established amount of time needed (6 seconds) to collect heart rate and skin conductance levels for the ad images,³² to take into account baseline levels and time for heart rate and skin conductance to react.³⁴ Between each ad segment, a blank black screen appeared for 50 seconds, then a black screen with the words "get ready" for five seconds, followed by another black screen for five seconds to return heart rate and skin conductance levels to baseline. All methods were consistent with accepted standards of psychophysiological measurement for media studies.³²

Measures:

Visual attention was assessed using an eye tracker connected to the base of the computer screen. For each message, four areas of interest (AOI) were identified: 1) brand, 2) descriptor, 3) person, and 4) warning. All four AOIs were summed for a total number of milliseconds (ms) that the author viewed the AOIs. Time spent on each AOI was determined by dwell time in ms. AOI refers to an area within the ad where dwell time was recorded. For example, by identifying 'brand' or 'warning' as an AOI, helped track whether the dwell time was focused on those regions within the ad. In addition, the greatest amount of revisits (looking away from and then back to a specific AOI) was recorded for each AOI among the features. To analyze data, a heatmap was used to show which AOI had the most dwell time graphically. Red indicates the AOIs with the highest dwell time, and green indicates the AOIs with the lowest dwell time.

■ Results

Part 1: Survey Results:

Demographics:

For survey participants, while there was a broad geographical diversity of responses in the smoking population representing multiple countries, over 85% of the participants lived in the United States (US) and India. The demographic information is summarized in Table 1.

Table 1: Demographic information of survey participants.

Survey participants' country of residence	Number of participants	% of participants
India	53	65
USA	19	23
United Kingdom	5	6
United Arab Emirates	5	6

Smoking History:

Table 2 summarizes the smoking history of the participants. A wide range of responses were observed, from approximately 12% to 88%. 42.7% (35 out of 82 participants) of the participants indicated they had smoked in the past 30 days (i.e., current smokers)³³ while 57.3% (47 out of 82 participants) were ever smokers³⁴ (smokers who have smoked before but not in the past 30 days). Additionally, 87.8% (72 out of 82 participants) of the participants had smoked at least 100 cigarettes in their life (i.e., current or former smokers),³³ while only 12.2% (10 out of 82 participants) of the participants had smoked under 100 cigarettes (i.e., never smokers).³³

Table 2: Smoking history of survey participants.

Survey participants country of residence	Number of participants	% of participants
Current smokers	35	42.7
Ever smokers	47	57.3
Current or former smokers	72	87.8
Never smokers	10	12.2

The following question asked about daily cigarette consumption. The percentage of participants smoking less than 10 cigarettes per day to over 20 cigarettes daily ranged from 11% to approximately 65%. 64.6% of the participants (53 of the 82 participants) smoked less than ten cigarettes per day, 24.4% (20 of the 82 participants) smoked between 11 and 20 cigarettes per day, and the remaining 11% (9 of the 82 participants) smoked more than 20 cigarettes daily.

The next question provided insights into when people started smoking and how long they had been smoking. The majority of the survey participants (58.5% or 48 of the 82 participants) had started smoking before they graduated from college (less than 21 years). In comparison, 41.5% of participants (34 of the 82 participants) started smoking between 21 and 40 years (Figure 1). None of the participants started smoking after 40 years.

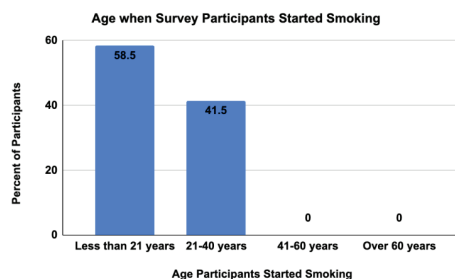


Figure 1: Age when survey participants started smoking. The majority of the survey participants (58.5%) started smoking at less than 21 years of age.

Quit Attempts and Successes:

The following few questions focused on trying to understand the current smoking status of participants, whether they had tried to quit smoking, whether they were successful, and what resources the successful quitters had used to help them quit.

The percentage of participants who responded to the question on their current smoking status ranged from approximately 4% to 62%. 62.2% of the participants (51 of 82) said they had already quit smoking (Figure 2). About 19.5% of the survey participants (16 of the 82 participants) considered quitting, while 3.7% (3 of the 82 participants) had set a quit date. 13.4% (11 of the 82 participants) indicated no intention of quitting.

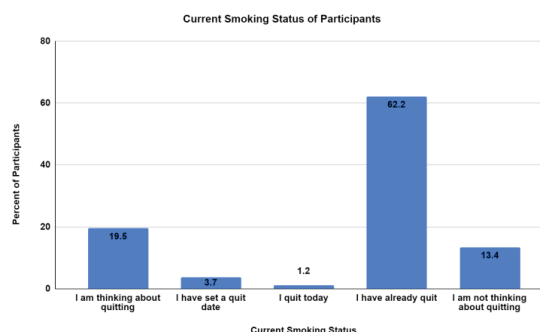


Figure 2: Current smoking status of survey participants. Most participants (62.2%) responded that they had already quit smoking, and another 19.5% were considering quitting. Additionally, 13.4% of the responders indicated they had no intention of resigning.

87.8% of the survey participants (72 of the 82 participants) had attempted to quit, while 12.2% (10 of the 82 participants) responded they had made no attempts to quit. This was consistent with the data shown in Figure 2, where approximately 13% of the participants responded that they were not considering resigning.

When asked how successful participants were in quitting smoking, the percentage of successful participants ranged from approximately 23% to 87%. While 87.8% of participants (72 out of 82 participants) had attempted to quit per the previous question, only 76.8% (63 of the 82 participants) responded that they were successful in quitting, and 23.2% (19 of the 82 participants) were unsuccessful.

Further, when asked if the participants had started to smoke again after quitting, at least 41.5% (34 of the 82 participants) responded that they had relapsed, while 58.5% (48 of the 82 participants) said they had not started again.

52.4% of the participants (43 of the 82 participants) were able to quit smoking in less than six months, 3.7% of participants (3 of the 82 participants) took between 6 months to a year, and 17.1% of the participants (14 of the 82 participants) took over a year to quit (Figure 3).

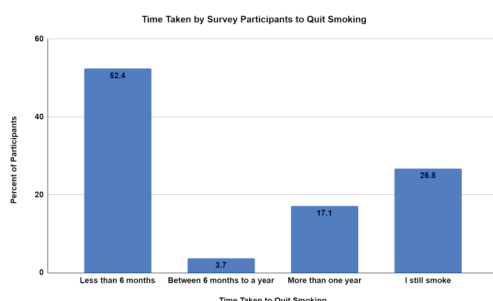


Figure 3: Time taken by survey participants to quit smoking. 52.4% of the survey participants indicated they quit smoking in less than six months, while 17.1% of participants took over a year to quit.

To the question of how long after quitting did the participants start smoking again, the percent of participants ranged from approximately 8% to 58%. 14.6% of the participants (12 of the 82 participants) began smoking within six months, 8.5% of the participants (7 of the 82 participants) within a year, and 18.3% (15 of the 82 participants) started smoking again after a year. 58.5% (48 of the 82 participants) of the participants, like the response to a previous question, stated that they did not restart smoking after quitting.

The final two questions were open-response questions focused on learning about the tools or resources the survey participants had used to quit smoking. A wide range of responses ranging from approximately 2% to 65% was observed. Most participants (64.8% or 53 of the 82 participants) chose to quit without external resources, relying on willpower alone (Figure 4), while smaller proportions used methods like nicotine replacement therapy (11% or 9 of the 82 participants), medications (2.2% or 2 of the 82 participants) or counseling (7.7% or 6 of the 82 participants). 5.5% (5 of the 82 participants) switched to e-cigarettes.

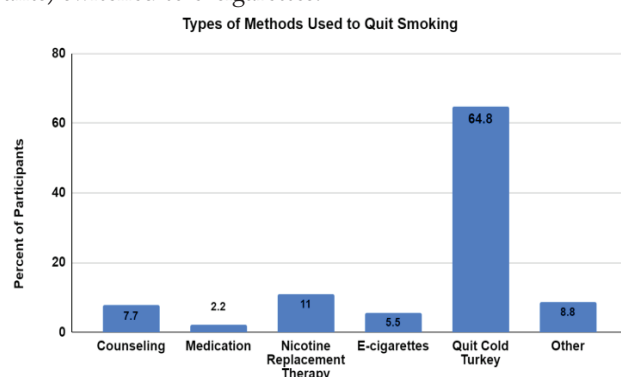


Figure 4: Tools people who smoke use to help them quit smoking. Most participants (64.8%) responded that they quit cold turkey or did so independently through willpower and determination.

The last question was designed to understand the reasons why people who smoked did not want to quit or restart smoking after attempting to quit. Over 50% of the participants said they had stopped after single or multiple attempts, consistent with previous responses. Of the remaining 50% of the participants, about half said they understood the harmful effects of smoking and wanted to quit but could not overcome the addictive effects of smoking. Several suggested that smoking helps them with coping with stress (15.8% or 13 of the 82

participants). A small number of participants (8.5% or 7 of the 82 participants) said they either did not realize the harmful effects of smoking or did not have people who encouraged them. Finally, 10% of the participants (8 out of 82 participants) said they like smoking and accept the risks and thus would not be willing to quit.

Part 2: Psychophysiological Test Results:

Since the survey results (Figure 1) indicated that most people started smoking as young adults, we wanted to study the impact of advertising on youth. Researchers study the perception of ads from e-cigarette makers through psychophysiological studies in the form of heat maps generated by following the visual responses of youth to ads they see on a computer screen.^{34,36}

Figures 5, 6, and 7 compare an ad promoting an e-cigarette product and a heatmap generated from the visualization data for three e-cigarette brands. In all the figures, the picture on the left is the plain ad used by the e-cigarette brand to promote their product. In contrast, the image on the right represents the heat map (generated from the author's visualization data). The color key in the figure describes the various colors in the heat map. The parts of the ads with the darkest color (red) are the areas where the observers pay the most attention.

Figure 5 shows that even though the warning statement was on the top and visible, the areas with the highest levels of attention (red/yellow color in the heatmap) were on the model's face and the ad's promotional text around "This Is Vaping Made Simple." The trend was very similar for the second set of pictures (Figure 6), where heatmap data showed maximum attention to the e-cigarette device, followed by the promotional text from the manufacturer (Juul). The third set of pictures (Figure 7) had the warning in a small text at the bottom of the image. Heat map data showed that the areas of maximum attention were on the model's face and the brand's promotional text at the bottom.



Figure 5: Plain ad and heatmap following visualization. The key shows the color definitions from green (lower attention) to red (high attention). The highest levels of attention were on the model's face and the ad's promotional text.



Figure 6: Plain ad and heatmap following visualization. The key shows the color definitions from green (lower attention) to red (high attention). The highest levels of attention were on the ads' promotional text and the e-cigarette device.

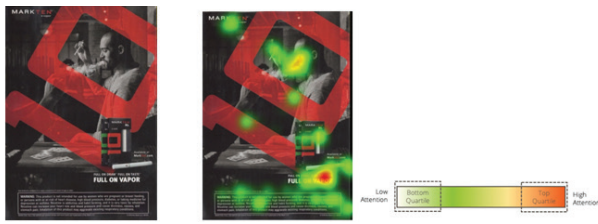


Figure 7: Plain ad and heatmap following visualization. The key shows the color definitions from green (lower attention) to red (high attention). The highest levels of attention were on the ads' promotional text and the model's face.

■ Discussion

Data from the survey (Part 1) suggested that most of the participants had started smoking when they were 21 years old or younger. A possible reason for this is that college (or perhaps even middle school and high school) is where students are likely to 'experiment' with tobacco products. Additionally, the majority of the participants indicated a desire to quit, but only some were successful, which suggests that smoking is addictive and that quitting is hard. This was supported by the fact that at least 40% of the participants responded that they restarted smoking after quitting. Several participants started smoking even after a year since they quit smoking. This indicates that quitting smoking in one attempt is rare, and many people who smoke make several attempts to quit before they are successful. It is also possible that the methods used by the participants to quit may not have been the most effective or that people may not have utilized all the resources available to them to quit. Some participants responded that they were either unaware of the harmful effects of smoking or did not have people to support them in their quitting attempts. Furthermore, less than 10% of the participants had utilized counseling support, suggesting that higher quitting rates could be achieved through heightened awareness of smoking's harmful effects, medication, and counseling.

Psychophysiological studies are beneficial in visually demonstrating the impact of tobacco companies' aggressive marketing strategies.^{34,35} In the case study described in Part 2 of this study, the author's heat maps generated from visual eye-tracking data show clearly that young observers focus on the promotional text messages and the faces of models as opposed to the warning signs on the ad. All e-cigarette brands have ads to promote their products. These ads often are designed to attract young adults by making their products look appealing. While e-cigarette makers must have warnings in their ads on the harmful and addictive properties of the chemicals in their products, these warnings are sometimes not prominent and written in small print (e.g., a warning in Figure 7 is in a small font at the bottom).

Furthermore, the ads have images of young adults vaping, making it more relatable for viewers (the target audience is typically young adults aged 18-26 years) to use their products. This demonstrates how tobacco advertisers use tactics to try to appeal to young adults to get them to use their product. These studies are instrumental in convincing the regulatory agencies that they need to do more to impose stricter regulations on cigarette company ads.^{34,35}

This study had a few limitations. First, since most survey participants were from the US and India, the observed trends may not represent global trends. Further, quitting success rates could be skewed due to a lack of awareness and accessibility to specific tools, such as counseling and medication, in parts of India. Second, the survey participants mostly had a higher socioeconomic status. Future surveys should be more global and target the more vulnerable populations, including racial/ethnic minorities, veterans, and people with lower incomes. Third, it is possible that since this is a self-reported survey, there could be elements of social desirability, and the participants want the survey readers to believe they are sincere in their willingness to quit. Finally, the self-participation of the author in the psychophysiological studies could introduce bias, and future studies should enroll additional young adults to generate more data.

■ Conclusion

Consumption of tobacco products is the leading cause of death and disease worldwide.⁹ This also has an enormous impact on the economy, with billions of dollars spent on healthcare costs.^{36,37} The goals of this research were two-fold: first, a survey was conducted to understand smoking behaviors, including when individuals started smoking, how many times they attempted to quit, and what tools they utilized to do so; and second, a case study was undertaken to understand how advertising plays a role in making e-cigarette products appealing to youth.

Survey results suggested that most of the participants had started smoking as young adults. Additionally, most of the people had attempted to quit, but only some were successful, confirming the addictive impact of smoking and the challenges of quitting. Most of the participants who were successful in quitting did not use any resources such as counseling or medications; instead, they relied on willpower and self-determination. This seems like a huge opportunity, as perhaps more people could have been successful had they either been aware of or had access to resources that could help them quit.

The case study using psychophysiological studies visually demonstrated the impact of aggressive marketing strategies employed by tobacco companies.^{34,35} Heat maps generated from visual eye-tracking data of ads from e-cigarette manufacturers suggest that young adults may focus on branding and imagery over warnings. These advertising features are something the FDA should consider regulating to make ads less appealing to youth and make the warning labels more evident.

A multi-pronged approach is needed to continue to make progress toward reducing smoking/tobacco use. First, policy interventions are required. Governments at local, state, and national levels will need to make collective efforts to bring down tobacco-related diseases and deaths in the United States. Some strategies that have worked include making tobacco products more expensive, introducing more extensive campaigns against tobacco consumption, and stricter marketing regulations for all tobacco products. Further, Australia became the first country to implement plain and standardized packaging for tobacco products.³⁸ Plain packaging laws standardize the appearance of packs by prohibiting all design features (including colors,

shapes, images, logos, and promotional text). Second, more research studies are needed to support evidence-based policy interventions. Studies may also employ psychophysiological methods to work with regulators to provide evidence-based approaches to apply more stringent restrictions on promotional e-cigarette advertising campaigns. Further, recent studies³⁹ have highlighted the use of modern technological tools such as texting and gaming in tobacco cessation. All these efforts can hopefully lead to a continued decline in the consumption of tobacco and e-cigarette products in the future.

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