

Review

Smoking in Video Games: A Systematic Review

Susan R. Forsyth RN, MS, Ruth E. Malone RN, PhD, FAAN

Department of Social and Behavioral Sciences, School of Nursing, University of California, San Francisco, CA

Corresponding Author: Susan R. Forsyth, RN, MS, Department of Social and Behavioral Sciences, School of Nursing, University of California, 3333 California Street, LHts-455, Box 0612, San Francisco, CA 94118, USA. Telephone: 510-512-8290; Fax: 415-476-6552; E-mail: Susan.Forsyth@ucsf.edu

Abstract

Introduction: Video games are played by a majority of adolescents, yet little is known about whether and how video games are associated with smoking behavior and attitudes. This systematic review examines research on the relationship between video games and smoking.

Methods: We searched MEDLINE, psycINFO, and Web of Science through August 20, 2014. Twenty-four studies met inclusion criteria. Studies were synthesized qualitatively in four domains: the prevalence and incidence of smoking imagery in video games ($n = 6$), video game playing and smoking behavior ($n = 11$), video game addiction and tobacco addiction ($n = 5$) and genre-specific game playing and smoking behavior ($n = 3$).

Results: Tobacco content was present in a subset of video games. The literature is inconclusive as to whether exposure to video games as a single construct is associated with smoking behavior. Four of five studies found an association between video game addiction and smoking. For genre-specific game playing, studies suggest that the type of game played affected association with smoking behavior.

Conclusions: Research on how playing video games influences adolescents' perceptions of smoking and smoking behaviors is still in its nascence. Further research is needed to understand how adolescents respond to viewing and manipulating tobacco imagery, and whether engaging in game smoking translates into changes in real-world attitudes or behavior. Smoking imagery in video games may contribute to normalizing adolescent smoking.

Implications: A large body of research has shown that smoking imagery in a variety of media types contributes to adolescent smoking uptake and the normalization of smoking behavior, and almost 90% of adolescents play video games, yet there has never been a published systematic review of the literature on this important topic. This is the first systematic review to examine the research on tobacco and video games. We found that tobacco imagery is indeed present in video games, the relationship between video game playing and smoking remains unclear, there appears to be a correlation between problem gaming and smoking and the genre of games may play a role in adolescent smoking behavior.

Introduction

In the United States, 88% of youth aged 8–18 play video games at least occasionally.¹ The median time spent playing, including all types and genres of video gaming, is 13.2 hours weekly, with boys playing more frequently (16.4 h/wk, $SD = 14.1$) than girls (9.2 h/wk, $SD = 10.2$).^{1,2} Types of video games range from electronic solitaire

to city-building games such as the *Sims* games, open world action-adventure games such as *Grand Theft Auto*, first-person shooters, racing games, maze games, and many others.

About 19.2% of US high school seniors are current smokers,³ and research suggests that exposure to tobacco imagery affects smoking behaviors.⁴ Viewing movies containing smoking imagery

has been linked to youth smoking initiation,⁵⁻¹⁰ providing the basis for a hypothesis that tobacco imagery from other media sources may likewise impact youth smoking. Both cross-sectional^{5,9} and longitudinal studies^{6,7} have suggested that there is a positive dose-response relationship between viewing smoking in movies and the susceptibility to and uptake of smoking, independent of other factors. In 2014, the Surgeon General determined that youth exposed to movie smoking were twice as likely to initiate smoking as those not so exposed.¹⁰ While watching smoking in movies is an uncertain proxy for imagery encountered in video games, it suggests possible avenues of inquiry.

Children are especially susceptible to imagery in games. Children who played with branded items in games were more likely to select that brand when given a choice than those who had played with unbranded items, even when they could not recall the brand.^{11,12} Interacting with branded items in a game increased top-mind awareness, brand image, and behavior intention of participants toward the brand ($P < .05$).¹³ Playing video games and interacting with products and brands during the game created processing fluency,¹⁴ allowing children to later express that brand as a preference. Research has demonstrated that the tobacco industry has been particularly successful appealing to adolescents and that adolescents exposed to tobacco imagery were more likely to become smokers.¹⁵

Engaging in virtual behaviors in video games may modify real-world behavior. A meta-analysis of the effects of violent video games on aggression, empathy, and prosocial behavior¹⁶ found that violent video game exposure was positively associated with and causally related to aggressive behavior, aggression cognition and aggressive affect and causally related to desensitization, lack of empathy, and lack of prosocial behavior. Other work has supported these findings.¹⁷⁻²² Tobacco imagery in video games is thus cause for concern regarding adolescent smoking, particularly given the tobacco industry's history of using movie product placement.²³ No previous reviews have examined the literature on smoking and video gaming. We systematically reviewed published research on the relationship between video games and smoking.

Methods

Study Selection Criteria

We searched for original research articles that addressed the relationship between smoking and video gaming (our search followed PRISMA guidelines). Nonempirical articles, including essays, literature reviews, editorials, opinion pieces, and protocol or instrument development items were excluded, as were non-peer reviewed or non-English language studies. Studies were included if they concerned the relationship between tobacco use and video games or reported on tobacco content found within video games. While smoking initiation is primarily an adolescent and young adult phenomenon,³ we included studies that examined populations other than adolescents so as to fully describe the current state of the science. Articles were excluded if they examined the relationship between various media and smoking, but did not specifically include video games as a unit of analysis. We also excluded studies that investigated the relationship between electronic gambling and smoking, but did not include video gaming, and studies that focused solely on using educational games for smoking cessation.

Data Sources and Searches

MEDLINE, psycINFO, and Web of Science databases were searched for articles published January 1, 1946 (beginning of coverage for MEDLINE) through August 20, 2014. Medical subject heading

(MeSH) terms and free text were used in the searches. The principal search strategy was as follows:

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((“smoking”[MeSH Terms] OR “smoking”[All Fields]) OR
(“tobacco”[MeSH Terms] OR “tobacco”[All Fields] OR “tobacco
products”[MeSH Terms] OR (“tobacco”[All Fields] AND
“products”[All Fields]) OR “tobacco products”[All Fields]))
AND (((“electronics”[MeSH Terms] OR “electronics”[All Fields]
OR “electronic”[All Fields]) AND games[All Fields]) OR (“video
games”[MeSH Terms] OR (“video”[All Fields] AND “games”[All
Fields]) OR “video games”[All Fields])).
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Once relevant articles were identified, their reference lists were searched for additional studies.

Study Selection

Both SRF and REM developed search and inclusion criteria. SRF searched for and screened articles, reviewed abstracts, selected abstracts for full article review and assessed articles for inclusion. REM advised on all phases of the review and synthesis.

Data Collection and Synthesis

Data were collected on these study characteristics: country of origin, date, study design, n , population sampled, sampling strategy, predictor variable/exposure, comparator, and outcome, using an author-generated data collection instrument ([Supplementary Appendix 1](#)). Each study was examined for strengths and possible biases. Because of the heterogeneity of the study designs, populations, predictor variable/exposure, and a lack of standardized measurements, meta-analysis of the data retrieved was not appropriate.

Initially studies were thematically grouped together for descriptive analysis based on the outcome studied: either prevalence and incidence of smoking imagery in video games or smoking status and behavior. Secondly, studies that focused on smoking status and behavior were grouped together based on how each study defined the predictor variable/exposure. Domains were developed and modified inductively as studies were abstracted and added to the database. Synthesis was achieved by examining each domain based on outcome variables, summarizing the studies descriptively and analyzing results narratively.

Results

Study Characteristics

See [Figure 1](#) for article inclusion flowchart.²⁴ Of 24 included studies, 63% ($n = 15$) were cross-sectional surveys of game players, 8% ($n = 2$) were experiments, 13% ($n = 3$) were cohort studies, and 25% ($n = 6$) examined prevalence of tobacco content in video games (n does not add to 24 as one study contained both cross-sectional and cohort components and one was a cross-sectional study on recall of prevalence). All but two studies were published since 2000. See [Supplementary Table 1](#) for study characteristics. No study authors identified conflicts of interest relating to the video game industry or the tobacco industry, although 42% (10/24) of studies contained no conflict of interest statement.

After analysis, four domains emerged: the prevalence and incidence of smoking imagery in video games (studies that examined the prevalence and/or incidence of smoking content in games or participant recall of smoking imagery in games, $n = 6$); video game play and smoking behavior (studies that examined video games as a single construct or together with other media and game play as

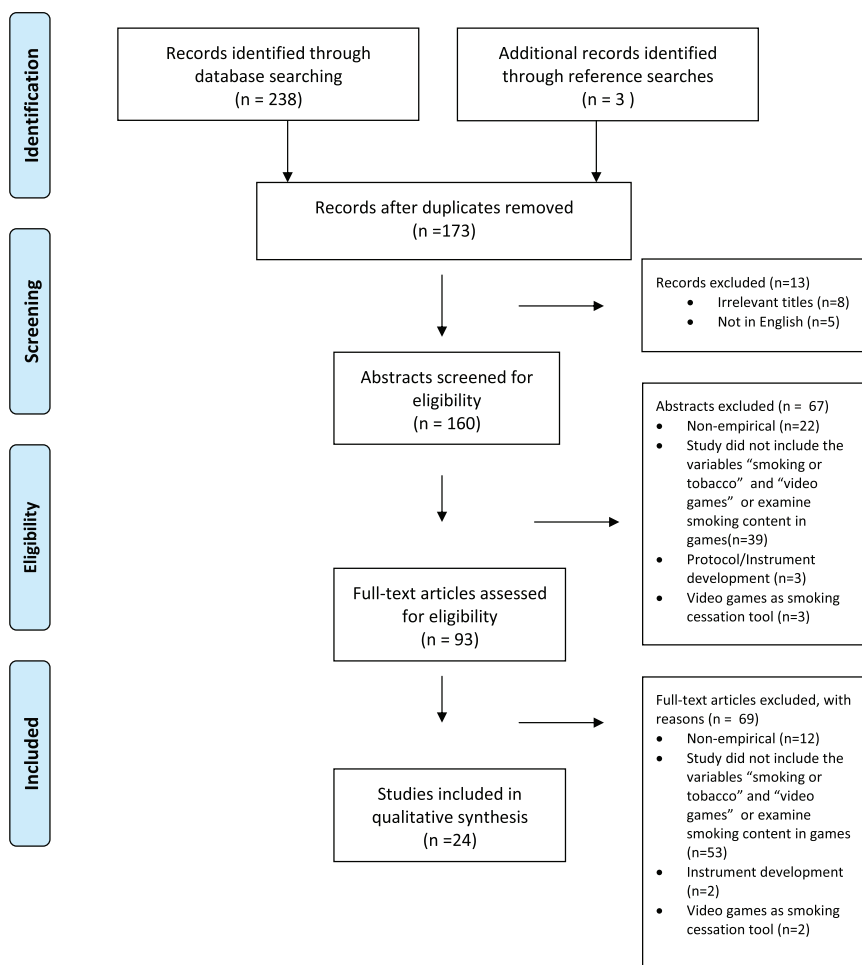


Figure 1. PRISMA 2009 flow diagram.

compared to smoking status, $n = 11$); video game addiction and tobacco addiction (studies that examined the subset of game players who are addicted gamers and compared it to their smoking behavior, $n = 5$), and genre-specific game playing and smoking behavior (studies examining a subset of games or specific imagery within a game and comparing it to smoking behavior, $n = 3$; total > 24 as one study fell into two categories).

Prevalence and Incidence of Smoking Imagery in Gaming

Six studies^{2,25-29} examined whether smoking imagery was present in video games. Four found that a portion of surveyed games featured smoking imagery.^{2,26,27,29} Of the remaining two, one was a cross-sectional study of adolescent recall of smoking imagery in games²⁸ and the other a case study of a specific game.²⁵

Three^{26,27,29} studies took a sample of games and played each game for at least an hour, while recording content. The first of these²⁶ examined games rated "T" for teen, meaning that the content was deemed appropriate for children over age 13 by the Entertainment Software Ratings Board (ESRB), a private ratings board for video games sold in the United States.⁴⁸ Using a random sample drawn from all T rated games ($n = 81$), researchers found that 12 (15%) portrayed substance use, with five (6.3%) games

specifically portraying tobacco use. Of those portraying tobacco use, tobacco imagery was present on average 2.1% of the time (range 0.3%–7.1%); the ESRB had only coded one of those games as portraying substance use. In a second article,²⁷ expanding on the original sample, an additional nine nonrandomly selected T-rated games specifically for the gaming consoles Microsoft Xbox and Nintendo GameCube were examined. Four depicted tobacco use, with tobacco imagery visible an average 2.8% of the time (range 1%–6%). None of these games had received an ESRB content rating for tobacco/substance use.

The third study examined games rated "M" for mature, which are rated by ESRB as appropriate for those aged 17 and older.²⁹ Previous research suggests such restrictive age labeling may make these games even more attractive to all age groups.⁴⁹ For example, most versions of *Grand Theft Auto* are rated M, but the game has reportedly been played by 58% of all teenagers.⁵⁰ In this study, using a randomly selected sample ($n = 36$) of M-rated games, 21 (58%) depicted substance use, with eight (22%) games specifically depicting tobacco-related imagery. However, just one game (3%) had an ESRB content descriptor for substances.²⁹

These studies are now dated. In addition, since each game was only played for an hour, limited content was captured. However, together they indicate that smoking imagery is present in games rated appropriate for teens and in games likely to appeal to teens.

A more recent study examined ESRB ratings to examine whether the prevalence of tobacco content increased over time.² The sample constituted all games rated by the ESRB between September 1, 1994 and July 1, 2011. In games rated “E10+”, meaning appropriate for everyone over age 10, tobacco content ratings increased from 0.8% of games in 2005 to 12.6% in 2011. For games rated T, tobacco content ratings increased from 1.0% in 2005 to 5.7% in 2011, with the highest prevalence in 2009 at 15.6%. Less than 1% of games rated M or adult received a tobacco content descriptor from the ESRB. While this study appears to suggest that tobacco content is raising, only ESRB ratings were examined, not actual game content.

Barrientos-Gutierrez et al.²⁵ conducted a case study of 2010’s top-selling PC military video game, *Starcraft II, Wings of Liberty*, rated T, with one of the package rating descriptors “use of alcohol and tobacco.”⁵¹ Between play episodes, the game features cinematic shorts, which serve to provide cohesion to the game, advance the story and provide rewards.²⁵ Of 18 shorts, 13 included tobacco imagery, including red and white packs resembling Marlboro cigarette packaging. Three of 13 characters within the game were always shown smoking, with no user control over the smoking display. Users playing this game are clearly exposed to smoking imagery. However, it is unknown whether this game is typical in including such imagery and whether this represents paid product placement.

In a random dialing telephone survey of 1000 adolescents, aged 12–24 from New South Wales, Australia, Perez et al.²⁸ explored recall of tobacco imagery in video games. Thirty-three percent of the male sample and 12.8% of females reported exposure to tobacco imagery in games. However, it was unclear how many of the sample actually played video games on a regular basis, as the extent of gaming was not reported.

Together, these studies all indicate that there is tobacco content within many of the video games that adolescents may play. However, they do not give a clear picture of how much tobacco content is found during game play, with ranges from 6% of teen games to 22% of mature games, based on game play, and from less than 1% to 15.7% based on ESRB tobacco content ratings. It is also unclear whether the tobacco content is active (allowing the player’s avatar to smoke) or passive (tobacco use by nonplayable characters), nor do the studies suggest how players perceive and interact with the tobacco content.

Smoking Status and Behavior

Video Game Playing and Smoking Behavior

Eleven studies examined the relationship between playing video games and smoking behavior.^{30–40} Results varied. However, these studies were beset by methodological problems, a lack of specificity and/or a lack of validated tools.

Four studies used video game playing as an independent variable, but collapsed it with other variables such as television or Internet use, making it impossible to tell how much of the effect on smoking behavior was attributable to video game playing alone.^{30,31,36,39} In a cross-sectional survey of adolescent physical activity ($n = 11\,957$)³⁶ published in 2006 from 1994 to 1995 data, adolescents who self-identified as high TV/video game viewers without parental control over content smoked at higher rates than those reporting more physically active lifestyles or whose parents limited their TV viewing (ARR range 0.61–0.82). A cross-sectional telephone survey of 4029 California adolescents aged 12–17 found that the number of weekday hours spent watching TV and playing video games was positively correlated with ever having smoked cigarettes (odds ratio

[OR] = 1.08, $P < .05$) or being a current smoker (OR = 1.11, $P < .05$), after controlling for sociodemographic and behavioral covariates. Conversely, the same researchers found that the number of hours spent watching TV or playing video games on weekends was negatively associated with ever having smoked (OR = 0.91, $P < .001$) or being a current smoker (OR = 0.89, $P < .01$).³⁹ Another self-reported anonymous survey of fourth to fifth graders in Kentucky ($n = 4691$) found that reporting three or more hours a day of television watching and/or video gaming was associated with increased substance use, but when cigarette use was examined separately, results were insignificant.³⁰ This may have been due to the small number of children who had actually tried smoking ($n = 320$). Finally, one recent cross-sectional survey of Brazilian adolescents ($n = 1628$) collapsed video game playing and computer use into one variable. Respondents were asked whether they played video games or used the computer during leisure time and the results were dichotomized into yes and no, and then correlated with smoking status.³⁶ Results were insignificant ($PR = 1.22$; 95% confidence interval [CI] = 0.81% to 1.86%). By collapsing and dichotomizing the independent variable, the researchers were unable to determine possible dose-response effects, or to address possible differences between the effects of computer use and video game playing on smoking rates, making the results uninterpretable.

One cross-sectional study with a longitudinal component of Canadian adolescents ($n = 8215$) used video game playing as an independent variable, but collapsed smoking with seven other risk behaviors ranging from cannabis use to wearing seatbelts as the combined dependent variable.³² While computer use was associated with a 50% increase in risk behaviors, video game playing was not associated with the multiple risk behavior construct. Because smoking was not considered independently, and some video games are played on computers, it is difficult to interpret these results.

Seven studies^{5,33,35,37,38,40,41} used video game playing as one of the independent variables and smoking as one of the dependent variables, without including other types of screen-based media or other substances. While none of these studies focused exclusively on smoking and video game playing, they did consider the relationship between smoking and gaming independently, resulting in findings not confounded by category collapsing.

The earliest such study was longitudinal ($n = 167$) and focused on the relationship between adolescent blood pressure, health habits, stress, and anger. In analysis of covariates, a correlation was found between smoking and hours per week spent playing video games ($r = .38$, $P < .0001$) for high school seniors only.³⁴ However, the sample was drawn from one US high school and the number of self-reported smokers was extremely low. In a repeated cross-sectional survey (1987, $n = 782$; 1999, $n = 2196$), Sweeting and West⁴⁰ found that video gaming and smoking were negatively correlated in both samples (OR = 0.8, $P < .0000$), suggesting that video game playing was protective against smoking as it kept young people occupied.⁴⁰ Primack et al.³⁷ also found no relationship between playing video games and being a current smoker or future smoking susceptibility. In this 2005 cross-sectional survey ($n = 1138$) of students in a large suburban high school, students in the highest third of reported hours per week spent gaming did not smoke at greater rates than those in the lowest third.³⁷

Desai et al.³³ studied the relationship between video gaming and health correlates, including smoking, using a one-time survey administered to Connecticut adolescents aged 14–18 ($n = 4028$). Among those reporting video gaming at least weekly, there was no

correlation between smoking behavior and nonproblematic gaming. However, smoking and problematic gaming were associated, a finding discussed in the next section. Problematic gamers were defined as those who reported having unsuccessfully tried to cut back on their gaming, growing tension only relieved by gaming and irresistible urges to play.³³

Using smoking as a dichotomous variable and playing time as a continuous variable, Raiff et al.³⁸ compared the extent to which smokers and nonsmokers played video games. The anonymous online convenience sample consisted of people over age 18. Smokers spent 8.12 hours ($SD = 7.31$) each week playing, while nonsmokers spent 5.21 hours playing ($SD = 5.85$; $P < .001$). However, of 1239 people consented, only 499 met inclusion criteria and had their data analyzed. 25% of the included subjects were between 18 and 25 years old. The primary reason for exclusion ($n = 522$) was incomplete surveys, defined as skipping at least five questions. Those who were excluded also differed in gender, age, and smoking status from the population who met inclusion criteria.³⁸

Leatherdale and Ahmed³⁵ surveyed a nationally representative sample of Canadian youth from grades 6 through 12 ($n = 51\,922$). 13.7% reported playing video games more than 2 hours daily (mean = 2.1; $SD = 1.1$). Boys (23%) were more likely to report playing more than 2 hours a day, compared to girls (3.4%). Video gaming was highest in seventh, eighth, and ninth grades (13–15 years old), decreasing in older grades. More than 91% of the samples were never-smokers; thus the sample had lower smoking rates than overall Canadian prevalence studies suggest.⁵² Playing video games for more than 2 hours a day was positively associated with current smoking ($OR = 1.23$; 95% CI = 1.10% to 1.37%, $P < .001$).³⁵ This study's large sample size may have been able to detect differences that were less clear in smaller studies. However, age groups were not separately analyzed, likely masking the true association between smoking and game playing, as younger players are less likely to be smokers compared to older players.

Taken together, the results of the seven studies which considered video game playing separately from other media were inconclusive, with three studies finding an association between smoking and video game playing, three not finding an association, and one finding a negative association. The cross-sectional design of these studies precludes causal inference, and none examined gaming content or type of game played as a variable or modifier. For example, playing an online word game for 2 hours may be qualitatively different from playing *Grand Theft Auto*, although these studies would have counted them similarly.

Game Addiction and Tobacco Addiction

Five studies examined the relationship between video game addiction and smoking behavior.^{33,41–44} Four were cross-sectional surveys,^{33,41,43,44} three of which found an association between video game addiction and smoking. The final study was an experiment.⁴²

An early study found that video game addiction was correlated with being a smoker ($r = .39$, $P < .01$).⁴¹ In this convenience sample ($n = 129$), Midwestern US college students filled out an anonymous questionnaire about various addictive behaviors. Addiction was defined using Rozin and Stoess's⁵³ addiction scale, measuring craving, withdrawal, lack of control and tolerance on a seven-point scale (1 = never, 7 = always). However, the tool used to assess video game addiction was not validated, nor was it specifically designed to examine problematic video gaming.

Desai et al.³³ found that among “problematic” gamers, there was a significant correlation between smoking and gaming. Nearly 11% of the sample reported playing video games more than 20 hours a week, but only 4.9% of the sample were considered problematic gamers ($n = 106$). Problematic game players had over twice the risk for being regular smokers than those who did not report problematic gaming ($OR = 2.12$; $P = .007$). However, the three-item tool used to assess whether an adolescent was a problematic game player has never been validated (Personal communication with Desai, R. A, May 11, 2011).

Walther et al.⁴⁴ modified the Video Game Dependency Scale (KFN-CSAS-II), which had been previously validated to assess the difference between video game dependency, risk for video game dependency and other types of gaming. The KFN-CSAS-II was originally adapted from the Internet Addiction Scale (ISS-20) and validated in a population of German ninth grade boys ($n = 7761$; average age 15.3 years, $SD = 0.69$).⁵⁴ Walther et al. surveyed German students aged 12–25 ($n = 2553$) with 20.3% of participants reporting daily smoking, and found no correlation between video game addiction and smoking. However, using the modified KFN-CSAS-II, only 83 participants (3.3%) were identified as “at risk” gamers and 29 participants (1.1%), were identified as addicted gamers, so the small sample size limits conclusive interpretation.⁴⁴

Ream et al.⁴³ also used a validated instrument in their study of concurrent use of substances while playing video games. They surveyed a nationally representative sample of adults ($n = 2885$) using an Internet online survey administered by Knowledge Networks, a survey firm that maintains a large panel of respondents chosen by random digit dialing.⁵⁵ Of the sample, 26% were smokers, somewhat higher than the current US national average of 18% for adults,⁵⁶ with a mean age of 40.4 ($SD = 15.7$). Problem video game playing was positively correlated with tobacco problems ($r = .33$, $P \leq .0001$), defined as experiencing withdrawal, craving, tolerance, and worrying over running out of tobacco. Problem video game playing was assessed using five items from an original nine-item Likert scale used to measure time playing, ability to control the amount of time playing and withdrawal symptoms. The more items endorsed, the more likely a player was to be a smoker. However, the original tool had been validated in a sample of 223 adolescents from Granada and Spain, not in an adult US population,⁵⁷ so its reliability for use with this group is unclear.

The final study in this domain examined the relationship between gaming and smoking by comparing the functional magnetic resonance imaging scans of 16 subjects with comorbid addictions of smoking and gaming with 16 controls.⁴² Each group was shown multiple images of tobacco and gaming while undergoing magnetic resonance imaging scans. Compared to controls, the comorbid group's anterior cingulate and parahippocampus gyrus activated at significantly higher levels when shown the visual cues. It appears that gaming addiction and nicotine dependence may share similar mechanisms of cue-induced reactivity over the fronto-limbic network, particularly for the parahippocampus. However, it is unclear whether sharing similar pathways has bearing on whether seeing tobacco imagery while gaming enhances nicotine craving.

Three of the four cross-sectional surveys found an association between heavy video game playing and smoking. However, all four studies were hampered by the lack of a validated tool or by their use of a tool which had been modified without revalidation. One problem with developing a validated tool with good applicability seems to be the question of whether heavy use of video games should be

considered an addiction and how to define “heavy” use.⁵⁸ Despite considerable debate, video game addiction was not included in the Diagnostic and Statistical Manual (*DSM-5*) from the American Psychiatric Association,⁵⁹ although it was identified as an area needing further research. As more researchers become interested in this topic, tools may emerge that are both valid and applicable.^{1,60-62} In addition, anxiety has been linked to both smoking and video game playing, suggesting that results of the five studies may also be confounded by the relationship between smoking, video games and anxiety disorders, with anxiety as a latent factor.^{63,64} Further research examining these relationships may clarify this issue.

Genre Specific Video Game Playing and Smoking

Three studies examined the relationship between playing genre-specific video games and smoking.⁴⁵⁻⁴⁷ The earliest⁴⁵ investigated whether virtual game-like environments containing smoking cues created greater smoking urges among participants than environments without smoking cues. The convenience sample included 22 adult smokers (average age = 37.3, *SD* = 12.3) who had smoked an average of 19.1 years (*SD* = 12.2). Subjects first navigated through a dynamic virtual environment without smoking cues, then navigated the same environment with embedded smoking cues. In the control setting, the participant navigated through an apartment, down an urban street, past vendors and into a restaurant. In the smoking-cue run, tobacco images were added, including open cigarette packs in the apartment, vendors selling cigarettes on the street, smokers visible on the street, billboards advertising cigarettes and a smoking section and bar in the restaurant. Throughout play, subjects were asked to rate current smoking urges on a 100-point scale (0 = no urge, 100 = strongest urge ever). Navigating through the game embedded with smoking cues increased subjects’ smoking urges by 15.1 points (*SD* = 22.1) as compared to navigating the game without smoking cues ($P < .01$), suggesting that virtual environments with smoking cues may have increased the urge of smokers to smoke, as compared with environments without such cues.

A cross-sectional study of French Canadian adolescents ($n = 1209$; mean age = 16.8) found that adolescents who played video games involving physical movement (exergames) such as dancing or sports simulation were less likely to smoke (*AOR* = 0.5, 95% *CI* = 0.3% to 0.8%) than adolescents who did not engage in active games.⁴⁷ However, exergamers were also more likely to engage in nonactive video games for more than 2 hours a day (*AOR* = 4.0, 95% *CI* = 2.2% to 7.5%) than those who did not exergame. Because of this confounding and the inability to infer causation, it is unclear whether exergaming itself is associated with decreased smoking or whether those who are more physically active simply smoke less.

The third study was longitudinal, examining the relationship between playing mature-rated, risk-glorifying games (MRRG) and behavioral deviance, including smoking.⁴⁶ In a random-digit dialing study ($n = 1350$), with each participant contacted four times over approximately 4 years, participants were asked about amount and type of game playing and ever-, past-month, and lifetime smoking. Participants were considered MRRG players if they played at least one of three popular violent risk-glorifying games and reported that their parents let them play MRRG games at least occasionally. After controlling for age, gender, race parental income, parental education, and parental warmth/responsiveness and demandingness, there was a highly significant main effect of MRRG game play for all measures of cigarette smoking: (1) ever-smoking, $F(1, 2457) = 150.24, P < .001$; (2) lifetime smoking, $F(1, 2377) = 156.34, P < .001$; and (3)

smoking during past month, $F(1, 1936) = 87.32, P < .001$ over all three analyses between participants who played MRRG games and those who played non-MRRG games. There was also a highly significant interaction of MRRG game play and time for each measure of cigarette smoking: (1) ever having smoked, $F(3, 1854) = 9.20, P < .001$; (2) lifetime smoking, $F(3, 1807) = 22.35, P < .001$; and (3) smoking during past month, $F(3, 1766) = 14.74, P < .001$. The results suggest participants who frequently play MRRG games smoke at higher and more rapidly increasing rates as compared to others.

This study was the first to examine the relationship of playing games that are more likely to contain tobacco imagery (violent-risk glorifying games) to smoking prevalence and incidence among adolescents over time. However, results may be subject to recall bias. In addition, only three games were used to determine whether a participant plays a MRRG, resulting in possible misclassification bias.

Taken together, these studies suggest that considering the genre of the game as a variable may provide a more nuanced picture of effects on smoking behavior than examining video games as a single construct.

Conclusions

This systematic review suggests that research on how playing video games influences perceptions of smoking and smoking behaviors is still in its nascence. Tobacco imagery is indeed present in at least a substantial subset of games played by adolescents, although it is unclear how much or how substantial the “dose” may be. For example, *Solid Snake*, the main protagonist in the very popular *Metal Gear* series of video games, is a smoker and can be seen frequently smoking during game play.⁶⁵ In another video game, *Little Big Planet 3*, the tobacco imagery consists of a sticker found in game play featuring a smoking pipe.⁶⁶ Both have tobacco imagery, but the quantity and quality of the imagery are considerably different. Playing a video game, unlike watching a movie, is interactive and may unfold over 20 or more hours, with each player potentially exposed to different imagery depending on how he/she progresses through the game. One avenue for future research would be to focus on the amount and quality of tobacco imagery present in games in order to gain a baseline of possible exposure. However, as discussed below, how that imagery figures in the larger narrative of the game is also likely to be important.

For most of the studies that examined video game playing and smoking behavior, the relationship between smoking and video game playing was not the primary focus and the measures used were heterogeneous, resulting in no definitive conclusions. Because video game playing is rapidly becoming a primary form of entertainment for adolescents,^{1,2} future research focusing on the relationship between video games and smoking uptake, while considering mediating factors such as exposure to tobacco imagery in games, length of time playing and type of games played will provide additional information about the association between game playing and smoking.

Studies comparing gaming addiction to smoking addiction are clearer, suggesting a relationship. However, the mechanism of this relationship is unclear and there are weaknesses in existing studies. There also is considerable debate over definitional issues, complicating how and what to measure and there is a need to consider possible confounding factors. These studies do not parse out whether it is the addiction to video games that makes players more likely to smoke, the tobacco imagery possibly present within the games, or a combination of the two.

The genre studies are beginning to examine video games as having multiple constructs affecting smoking behavior, suggesting that various types of games may have differential relationships with smoking behavior. This is a promising area of study but would benefit from including research on the amount and quality of tobacco content found within popular games in order to parse out the relationship between exposure and outcome.

Research suggests that developing a positive attitude toward smoking is one of the first steps toward eventually becoming a smoker⁴⁶; thus, playing video games with smoking-positive imagery may change attitudes toward smoking or the potential strength of that effect. As video games graphics are increasingly movie-like, tobacco imagery is beginning to look less like white torpedo pixels and is becoming more convincing. For example, in the popular 2007 shooter *Bioshock*, the opening scenes include the protagonist realistically smoking a cigarette from the first-person perspective, with further tobacco imagery present throughout the game and its two sequels, including lifelike smoking of playable characters, and advertisements for fictional brands.⁶⁷ As video games move into 3D technology, the potential exists for players to be able to realistically simulate smoking, immersed in virtual worlds.

Few of the studies were theory-driven; future work in this area would benefit from integrating a theoretical perspective more explicitly. For example, narrative transportation theory⁶⁸ would suggest that active engagement in smoking within the context of game play might have even greater influence on behavior than passively watching smoking behaviors in movies, opening promising possibilities for comparative analyses. According to this body of theory, individuals are “transported” into narrative worlds through cognitive, emotional, and image-based engagement. In turn, this “transportation” into the narrative serves to reduce the effects of counterargument, create connections with characters, and increase emotional involvement.

Further, Bandura’s social cognitive theory argues that people learn by observing others and modeling behaviors that result in rewards.⁶⁹ Research has demonstrated that his theory can be extended to new media,^{70–72} offering further context in which future investigations could be situated. For example, does the type of “narrative world” developed in a game influence the extent to which players are impacted by tobacco imagery?

This systematic review has several limitations. The search, article selection and data collection were carried out by one author. While three databases were systematically searched, there may be other relevant articles in other databases that were not included. In addition, while search terms were carefully selected and trialed, there may be studies that were not identified. Finally, we did not search for or include unpublished data.

However, this review demonstrates that little is known about how adolescents and young adults engage with the narratives and imagery of video games, how they respond to viewing and manipulating game components, and whether their views about smoking in games translate into changes in the way they view or experience the prospect of actual smoking.^{16,73} The results reported suggest that more research is needed to understand how much tobacco imagery is present in games that adolescents play and whether tobacco imagery in video games is serving as a normalizing mechanism for adolescent smoking. Researchers should also consider whether there are differences in player responses depending on the narrative constructions of games. Finally, research should explore

whether tobacco industry product placement is a factor in video game tobacco imagery.

Supplementary Material

Supplementary Appendix 1 and Table 1 can be found online at <http://www.ntr.oxfordjournals.org>

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Declaration of Interests

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