

FROM THE SILVER SCREEN TO TEENS

Describing the Prevalence of Smoking in Movies as Perceived by Teenagers and
Exploring the Underlying Mechanism of the Association between Smoking in Movies
and Adolescent Smoking: A Longitudinal Analysis

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I am very fortunate.

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Dedication

This dissertation is dedicated to my mother, CHEUNG Lin Tai, who had always been my greatest cheerleader, and had encouraged me to study abroad even when she was battling terminal illness.

Abstract

Smoking in movies has been repeatedly shown to be associated with adolescent smoking. However, previous reports on the association were limited to exposure to top-grossing contemporary movies, and did not assess changes in the exposure over time. These reports were also restricted to exposure during early adolescence (ages 9-15), and focused mainly on initiation of smoking. While they have hypothesized mediators that could potentially explained the association, they did not use a longitudinal study design to assess the abilities of these mediators to explain the association.

Using data from the Minnesota Adolescent Community Cohort (n=4735), a prospective observational cohort study with six age cohorts (age cohort 11, 12, 13, 14, 15, and 16), we examined changes in the prevalence of smoking in movies as perceived by teenagers over time. We observed a decline in the perceived prevalence of smoking in movies in all age cohorts, and the decline was steeper in the three older age cohorts than the three younger age cohorts ($p < 0.05$). However, teenagers were still estimated to be exposed to these depictions some of the time at the end of the observation period. We also assessed the effect of changes in the perceived prevalence of smoking in movies on progression of smoking intensity from age 12.5 to 17.9, and found that the perceived prevalence of smoking in movies consistently predicted smoking intensity measured six months later ($p < 0.05$), but only during younger adolescence (exposure from age 13-15.4). In the longitudinal mediation analysis, with data collected when the participants were ages 12-15.9 (n=3112), we found that the perceived prevalence of adult smoking

explained an insignificant portion of the association, while the positive expectancies of smoking did not satisfy the criteria for a mediator.

Although the amount of smoking in movies has declined, teenagers were still exposed to a moderate amount of these images, which could intensify their smoking behavior, particular when exposed as young adolescents. Further studies are needed to examine other potential mediators to guide the development of interventions to alleviate the negative influence of these images on teenagers.

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Chapter 1 Background and Significance

1.1. Adolescent smoking as a public health priority

Adolescent smoking remains an important public health issue around the world. About 10% of 13-15 year-olds in more than 150 countries report currently smoking cigarettes, and another 19% indicate an intention to start smoking during the next twelve months[1]. In the United States, over 3 million children and teenagers are current tobacco users[2]; 50% of high school students have tried smoking, and 20% of them reported smoking at least once a month[3]. Every day, about 3600 children and teenagers smoke their first cigarette, and another 1100 of them become daily smokers[2]. More alarming is that, despite the nation-wide anti-smoking effort (including the endorsement of clean indoor air policies in different parts of the country), prevalence of adolescent smoking has stayed the same since 2005[3].

This situation is particularly worrisome because of the detrimental effects of smoking on adolescent health. Not only does smoking lead to numerous severe long-term health problems as concluded in the Surgeon General Report[4], and is the leading cause of the majority of the preventable death in the United States[5], but it also causes immediate health consequences in adolescents such as frequent shortness of breath, poor physical fitness, poor overall health, and more emotional or psychological complaints[6]. Adolescent smoking also predicts underage alcohol use, including heavy drinking[7-11], and is associated with illicit drug use[2]. Moreover, the younger adolescents start smoking cigarettes, the more likely they will become strongly addicted to nicotine, and continue to smoke in their adulthood[12]. This resonates with the fact that 90% of adult

smokers start smoking at or before the age of 18[13]. Furthermore, smoking has created an overwhelming financial burden to the United States. Each year, smoking costs about \$100 billion in smoking-related health care expenditures, and another \$100 billion in lost productivity[14]. Therefore, understanding the etiology of and preventing adolescent smoking is one of the top priorities in public health.

1.2. Tobacco industry targets adolescents through movies

The tobacco industry is known to target adolescents in promoting its products, and its marketing strategies have been linked to adolescent smoking[15-17]. Although the industry has developed a cigarette advertising code stating that tobacco companies should not advertise their products to teenagers[18], its self-regulatory nature and voluntary endorsement by tobacco companies make it ineffective in restraining tobacco companies from marketing to teenagers. In fact, internal documents from the tobacco companies proved that they have viewed adolescents as their target market, have studied adolescence smoking attitudes and behaviors for decades, and have used media, such as sports magazines and advertising campaigns, to promote tobacco products to teenagers[19]. Movies have been frequently emphasized and highly valued by the industry in marketing tobacco products to young people, since these young audiences are unlikely to be aware of tobacco companies' involvement[20].

Tobacco companies have promoted their products in movies by engaging in product placement activities; in other words, they have provided financial support to filmmakers to have their products or brand logos used or placed in movies. For example, RJ Reynolds had its products featured in *Pennies from Heaven* with Steve Martin, and

Blowout with John Travolta; Philip Morris also paid to feature its products in *Rocky II*, *Die Hard*, and *Superman II*[20]. Because of this sponsorship, tobacco companies could even modify screenplays to ensure their products are portrayed, particularly in a positive way[20]. These product placement activities elicited a series of public hearings at the United States Congress in 1989-1990, and also inquiries by the Federal Trade Commission into various tobacco companies' engagement in these activities in 1990[20]. In response to the public scrutiny, the tobacco industry amended the cigarette advertising and promotion code in 1990 to include the language stating that tobacco companies should not make any payment to have their products or advertisements used in movies[21]. However, the industry did not change the voluntary and self-regulatory nature of the code. In 1998, the Master Settlement Agreement between 49 states and major tobacco companies also restricted the participating tobacco companies from further engagement in product placement activities[22]. Nonetheless, these two events did not seem to reduce brand appearances and smoking depictions in movies (see discussion in section 1.3.).

Tobacco companies have also encouraged key movie industry leaders and actors to smoke, so that smoking would be portrayed in movies. Internal documents showed that tobacco companies have provided free tobacco products to celebrities and movie industry executives on a regular basis to keep them smoking their products[20]. Since the decisions to portray smoking in movies were usually made by actors or famous filmmakers as reported by movie industry workers[23], this approach might have successfully promoted the portrayal of smoking in movies.

1.3. Prevalence of depictions of smoking in movies

Because of the close relationship between the tobacco and movie industries, smoking in movies has become very prevalent. Based on several content analyses on the top money-making movies in the United States from 1988-2003, 75-98% of top movies depicted at least one smoking event[24-27]. Although R-rated movies are more likely to portray smoking and 81-90% of them contain smoking depictions, 64-80% of PG-13 rated movies, and over 50% of PG and G-rated movies also depict smoking[24-27]. Even more shocking is that 56% of G-rated animations released by Disney and other companies from 1937-1997, for which the primary audience is children and teenagers, contain at least one smoking event[28].

Not only is smoking in movies prevalent, it is also prominently featured. Almost half of the annual domestic top ten money-making movies from 1985-1995 have at least one major character who smokes[24]. Another report showed a similar result: after randomly selecting five movies from the top 20 grossing movies each year from 1990-1996 and analyzing their content, investigators found that 57% of major characters smoked[29]. In fact, leading characters in the annual top 25 money-making movies from 1988-1997 were twice as likely as minor characters to smoke[25]. This prevalence of smoking is unrealistically higher than that of similar individuals in the real world[29, 30]. Furthermore, smokers have been portrayed as individuals of upper socioeconomic status[24, 29], while smokers in the real world are usually of lower socioeconomic status[31]. Smoking in movies has also been consistently associated with situations such as agitation, stress, relaxation, happiness, passing time, thinking and socializing[25, 29].

Scholars argue that the prevalence of smoking in movies has been increasing in the last decade despite the tobacco industry having excluded product placement in the cigarette advertising and promotion code in 1990, and the Master Settlement Agreement in 1998 that forbade tobacco companies from participating in product placement (see discussion in section 1.2.). Investigators found that the number of tobacco brand appearances in 400 movies made before Master Settlement Agreement (released from 1996-1999) was not different from that of the 400 movies made after the settlement from 2000-2003[32]. Others analyzing the content of the top grossing movies each year from 1950-2002 also found that the number of smoking depictions in movies had doubled during 1989-2002, from about 5 incidents per hour in the 1980's to about 11 incidents per hour in the early 2000's, and the number of smoking incidents in movies released after 2000 returned to the same amount as those released in 1950s[33]. The content analysis of the top-grossing 50 movies per year from 1991-2001 also showed that the prevalence of smoking in movies also increased in certain genres of movies since 1990, such as action/adventure and drama[26]. The movie rating categories that delivered the most smoking depictions to movies audiences also shifted from R-rated movies to G, PG, and PG-13 rated movies since 2002[27].

Consequently, children and teenagers are exposed to a tremendous amount of smoking in movies. It is estimated that 10-14 year-old teenagers in the United States have seen about 14 billion of smoking depictions delivered by the 532 top domestic box office movies in 1998-2003, which is equivalent to about 665 depictions per teenager [34]. Only 0.2% of teenagers at this age have not seen smoking in movies[35]. These reports may

have underestimated the exposure since they only assessed teenagers' exposure to the top-grossing movies in the United States between 1998 and 2003, and neglected the fact that with the availability of videotapes, VCD and DVD, teenagers might have watched them more than once, and might also have watched older movies. On top of the high teenage exposure to smoking in movies, teenagers are also more likely than adults to recognize and remember these smoking depictions. A cross-sectional survey conducted by Associated Film Promotions[36], an agency established to identify product placement opportunities for the tobacco industry, interviewed audiences from four theaters in metropolitan Los Angeles and found that 100% of respondents under the age of 18 recalled seeing the cigarette brand, Camels, in the movie *Cannonball Run*, while less than 70% of the respondents age 36 or above remembered seeing that brand. This differential recognition of smoking in movies by teenagers implies that they may be more likely to be influenced by these depictions.

1.4. Exposure to smoking in movies and adolescent smoking

Psychologists and communication scholars have studied the effect of media on teenage high-risk behaviors for decades, such as aggressive behaviors, sexual intercourse, cigarette smoking, and alcohol use[37-40]. Research has also shown that exposure to depictions of drinking in movies was associated with adolescent drinking in cross-sectional samples of 10-12 year-old teenagers, both in the United States[41] and Germany[42]. Specific to smoking in movies, scholars have assessed the association between having favorite celebrities who smoke in movies and susceptibility to smoking and smoking initiation, and found that those who named celebrities who smoke in movies

were more susceptible to smoking and more likely to have subsequently initiated smoking[43-45]. Investigators also found that the effect of having favorite celebrities who smoked in movies on susceptibility to smoking was stronger than that of smoking friends and family among never smokers[44]. However, none of these studies assessed the association between exposure to smoking in movies and smoking behaviors among teenagers.

Sargent and colleagues were the first group of investigators to examine the association between exposure to smoking in movies and initiation of smoking among adolescents. They assessed the association in a cross-sectional sample of 9-15 year-old teenagers, and observed those who were exposed to more smoking in movies were more likely to have tried cigarette smoking[46]. They also followed teenagers who had not tried cigarette smoking in the original sample, and confirmed that those who were exposed to more smoking in movies were more likely to start smoking cigarettes during the follow-up period[35]. Findings from another cross-sectional study with a nationally representative sample of 10-14 year-old teenagers also supported the association: those in the highest quartile of exposure to smoking in movies were almost 3 times more likely to have tried smoking than those in the lowest quartile[47]. Findings from studies conducted in Mexico and Germany also supported the association, partly because most of the top-grossing movies in these countries were from the United States[48-50]. Investigators claimed that 46% of smoking initiation among 9-12 year-old teenagers could be said to be caused by excessive exposure to movie smoking, assuming exposure to smoking in movies causes teenagers to experiment smoking[51]. Furthermore, smoking in movies is

also associated with established smoking habits; adolescents who were in the top 5% of the exposure to smoking in movies were two times more likely to have smoked more than 100 cigarettes in a lifetime than those who were in the bottom 5% of the exposure[47].

1.5. Current strategies for reducing the influence of smoking in movies

Scholars have suggested means to modify teenagers' exposure to smoking in movies; however these suggestions do not seem to be promising. Public health scholars[52], have suggested that all movies with smoking depictions should be R-rated. This argument was supported by the findings from several cross-sectional and cohort studies with 10-12 year-old children that parental restriction on R-rated movies was associated with lower likelihood of ever smoking, susceptibility to smoking, and initiation of smoking[53-56]. However, although this method may be effective in young children as they are probably more likely to watch movies with their parents, it may not be effective in teenagers. Because enforcement of the Motion Picture Association of America (MPAA) movie rating system by theatres and movie retailers is completely voluntary[57], teenagers with increasing autonomy will probably be able to watch R-rated movies. This strategy may also raise the concern of censorship, and may possibly interfere with the rights to free speech protected by the First Amendment[58].

Public health advocates have also started campaigns and community organizing activities advocating for "smoke free movies"[59]. Considering the close relationship between the tobacco and the movie industries (see section 1.2.), this approach may not be efficient in alleviating the influence of these depictions on teenagers. An example to support this argument is that after advocating for R-rating movies containing smoking

depictions for more than 5 years, MPAA only agreed to consider smoking when determining movie ratings; its chairman said movies with smoking will not be mandatorily R-rated as it will not provide further information for parents[60]. While it is still important to continue advocating for “smoke-free movies”, new and more efficient strategies at the individual level need to be identified to battle the ongoing influence of smoking in movies on teenagers. Understanding how these smoking depictions influence teenagers to initiate smoking may provide insights to develop new interventions to curb the effect of smoking in movies on adolescent smoking.

1.6. Limitations of current literature

1.6.1. Limitations of the conventional method of measuring the exposure

Most studies pertaining to the association between exposure to smoking in movies and adolescent smoking assessed the exposure by asking the teenagers to recall the movies they saw prior to data collection assisted by a list of contemporary movies[35, 46-49, 51, 61]. These movies were randomly selected from a bigger pool of top-grossing contemporary movies stratified by Motion Picture Association of America (MPAA) rating. Frequency of exposure to smoking in movies was then estimated by counting the number of smoking depictions among those movies which were seen by a teenager.

This method poses several problems. First, the number of movies that can be included to estimate the exposure to smoking in movies is very limited because this method requires extensive efforts to perform content analysis on movies; therefore, previous reports[35, 46-49, 51, 61] only included a certain number of top-grossing movies and failed to include non-top-grossing movies and rental movies. This can lead

to significant underestimation of the exposure since teenagers may watch movies other than top-grossing movies. Videotapes and DVDs also have extended the life cycle of movies and therefore teenagers are likely to be exposed to older movies that have more smoking depictions. Second, the method neglects the fact that teenagers may watch the same movie more than once which would increase their exposure to smoking in movies, particularly with the availability of rental movies. Third, stratifying movies by the MPAA rating may not accurately capture the amount of exposure since teenagers may be more likely to choose movies based on genre rather than MPAA rating, and the prevalence of smoking in movies varies by genre (see section 1.3.). Fourth, the estimated exposure can differ by the method used to sample movies, and how the investigators defined smoking depictions in movies. This is reflected by the mixed findings on the trends in the prevalence of smoking in movies in the literature[26, 29, 33, 62]. In addition to the limitations of the measure of exposure, previous reports did not assess changes in the exposure of smoking in movies over time.

An alternative measure of exposure to smoking in movies is the perceived prevalence of smoking in movies. Although teenagers are not likely to accurately recall how many times they have seen smoking in movies, the perceived prevalence of smoking in movies has advantages over the conventional measure. First, it is not limited by the number of movies that can feasibly be analyzed by investigators, and therefore can capture teenagers' exposure to smoking in all movies. Second, issues of watching the same movie more than once and personal preference of movie are irrelevant, since the more smoking depictions teenagers watch, the more likely they will remember those

depictions. Third, it may also be more predictive of adolescent smoking since it represents exposure to smoking in movies at a cognitive level. However, no studies have explored the factors associated with the perceived prevalence of smoking in movies among teenagers, and only one cross-sectional study has examined its association with adolescent smoking[56].

1.6.2. Limitations of the outcome measures

Despite agreement that uptake of smoking involves a series of stages[63], almost all of the previous studies on the association between exposure to smoking in movies and adolescent smoking have focused on smoking experimentation, in other words, having the first puff of a cigarette[35, 46-49, 51]. Only two studies examined the association between the exposure and having smoked a hundred cigarettes in a lifetime[61, 64]. Both outcomes do not fully describe the progression of smoking intensity, and do not allow teenagers to transition between stages involved in uptake of smoking. A more detailed outcome variable based on the stages of smoking uptake and capturing the smoking intensity of teenagers will be a better outcome to represent the complete continuum of adolescent smoking.

1.6.3. Unknown effect of the exposure on older adolescents

The effect of the exposure to smoking in movies may not be homogeneous throughout adolescence because the interpretations of smoking images in movies by older adolescents may be different from those of younger adolescents. Scholars found that younger adolescents (aged 12-13) were less likely to be aware of the smoking depictions as a commercial strategy in promoting cigarette smoking[65, 66]. They also found that

older adolescents (aged 16-17) reported higher resilience than younger adolescents to depictions of smoking in movies. Younger teenagers, although also reporting resilience to these depictions themselves, were worried that “other teenagers” at their age would be influenced by these depictions. To date, longitudinal studies on the association have only focused on exposure during adolescents aged 9 to 14 with a maximum of two-year follow-up[35, 51, 61, 64], and therefore provided limited understanding of the potential heterogeneity of the effect of smoking in movies on adolescent smoking throughout adolescence.

1.6.4. Lack of empirical evidence on the mechanism underlying the association

Scholars[32, 43, 44, 61] have attempted to explain the association using social learning theory[67], which posits that individuals anticipate outcomes of certain behaviors through observing outcomes of other individuals performing the behaviors. These anticipated benefits are called positive expectancies. Since smoking in movies is often associated with glamour, elegance, stress relief, relaxation, and happiness (see section 1.3), teenagers exposed to smoking in movies may develop positive expectancies of smoking which are consistent with these depictions, and subsequently, be more likely to try smoking cigarettes.

Others[44] also suggested that the normative perception construct in the theory of planned behaviors[68] could possibly mediate the association between exposure to smoking in movies and adolescent smoking. The theory conceptualizes the normative perception as the perceived normality of a behavior, and such perceived normality becomes perceived social pressure on an individual to comply with the perceived norm

by performing that behavior. Since prevalence of adult smoking has been exaggerated in movies (see section 1.3.), teenagers who are exposed to smoking in movies may perceive that smoking is a normal behavior among adults. Hence, teenagers with this perception may start smoking cigarettes, as they are likely to adopt adults' behaviors to demonstrate their maturity.

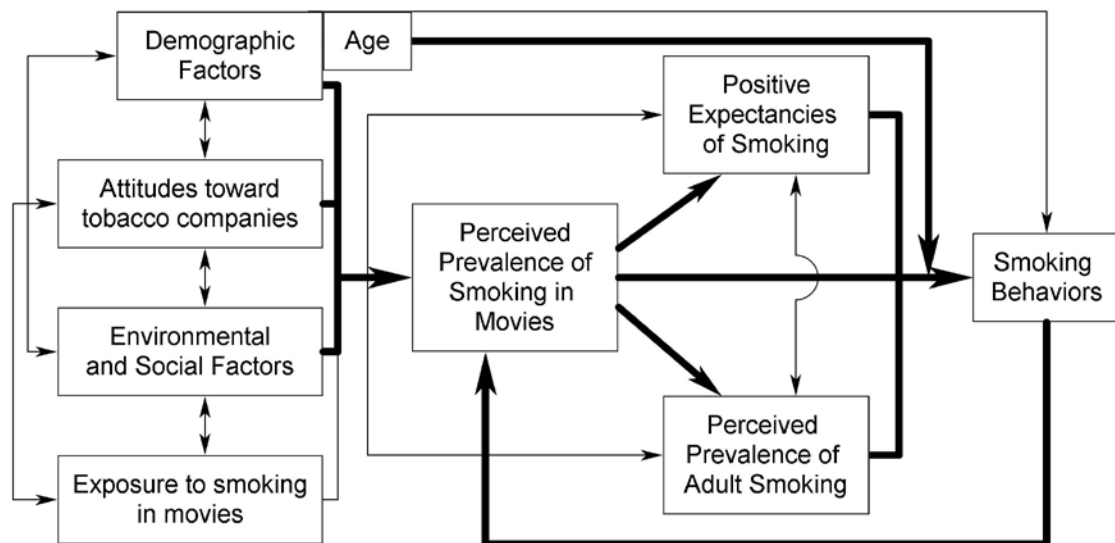
To date, few studies have assessed the ability of these two mediators in explaining the association. One cross-sectional study found that exposure to smoking in movies was associated with positive expectancies of smoking and the normative perception of adult smoking among teenagers[69]. However they did not perform a mediation analysis to test the mediation effects of these two variables. Two other studies have also shown that positive expectancies of smoking significantly mediated the association between exposure to smoking in movies and experimenting with smoking in teenagers[70, 71]; however exposure to smoking in movie and positive expectancies of smoking were measured at the same time in this movie, and therefore the temporal sequence between the exposure and the mediator could not be established. Scholars also performed a mediation analysis using cross-sectional data and found that the normative perception of adult smoking did not significantly mediate the association between exposure to smoking in movies and adolescent smoking [70]. Since there may be lead time between exposure to smoking in movies and development of normative perception of adult smoking, the null finding from the study may not be valid.

1.7. Objectives and theoretical framework

In light of the limitations of the current literature, this dissertation has three objectives. The first objective is to examine the perceived prevalence of smoking in movies among teenagers. Since little is known about this construct, we explored its longitudinal trend, potential cohort and period effects on the trend, and factors associated with the trend. The second objective is to investigate the association between the perceived prevalence of smoking in movies and stages of smoking uptake across the entire adolescence, and assess the potential heterogeneity of the association by age. The third objective is to assess the mediation effects of positive expectancies of smoking and the normative perception of adult smoking on the association between perceived prevalence of smoking in movies and stages of smoking uptake among adolescents.

The following theoretical framework is used to guide the current proposal. It is based on social learning theory[67] and theory of planned behavior[68], and also the existing literature on the topic of movies and smoking.

Figure 1. The conceptual framework on perceived prevalence of smoking in movies and smoking behaviors. This dissertation tested the bolded arrows.



The framework posits that perceived prevalence of smoking in movies among teenagers is influenced by four main groups of factors. The first group includes demographic factors, such as age, gender, and ethnicity. The second group includes attitudes and beliefs towards smoking. The third group includes social and environmental factors, such as parent and sibling smoking status, and number of close friends who smoke. The final group is the actual exposure to smoking in movies. The framework also posits that perceived prevalence of smoking in movies influences adolescent smoking behaviors in three different ways: through positive expectancies of smoking, the normative perception of adult smoking, and unmeasured constructs represented by the direct effect of the perceived prevalence of smoking in movies on smoking behaviors. This framework also hypothesizes that the effect of the perceived prevalence of smoking in movies on adolescent smoking varies by age.

1.8. Significance of the dissertation in preventing adolescent smoking

This dissertation has theoretical contributions to the literature. First, little is known about the perceived prevalence of smoking in movies among teenagers. This dissertation explores this novel construct, both on its longitudinal trend and its predictors. If the construct shows a similar relationship with adolescent smoking as the conventional method of measuring exposure to smoking in movies, future studies on the topic could use a more efficient method of measuring exposure to smoking in movies. Second, this dissertation will be the first study to examine changes in perceived exposure to smoking in movies among adolescents. Findings from this dissertation provide a different perspective on the debate of the longitudinal trends in the prevalence of smoking in

movies. Third, this dissertation examines the heterogeneity of the effect of exposure to smoking in movies and adolescent smoking by age. This may provide insight on how the maturation during adolescence modifies the effect of the exposure. Fourth, the longitudinal mediation analysis on the association between the exposure to smoking in movies and adolescent smoking provides better evidence to determine whether the two proposed mediators in the literature actually explain the association.

This dissertation also has public health implications. First, if the construct of perceived prevalence of smoking in movies show a similar relationship with adolescent smoking as in the conventional method (see section 1.6.), it will provide a more efficient way to evaluate the effectiveness of interventions against the influence of smoking in movies, and allow public health practitioners to adjust the interventions in a timely manner. Second, the findings on the heterogeneity of the association by age will also help public health practitioners to focus their interventions to reduce exposure to smoking in movies on the age group that is more likely to be influenced by these images. Third, understanding the underlying mechanism of the association will shed light on developing interventions to reduce the effects of these depictions on adolescent smoking. Public health practitioners can focus their resources on developing interventions that can change the mediator that significantly explains the association to break the causal chain between exposure to smoking in movies and adolescent smoking.

The findings from this dissertation may also affect other disciplines such as adolescent drinking. Since the association between exposure to drinking in movies and adolescent drinking has been observed (see section 1.4.), results from this dissertation

may also help explain the association, and inform interventions on adolescent drinking. Moreover, since movies produced in the United States are being distributed worldwide, and 64% of their world wide box office in 2007 was from countries other than the United States and Canada[72], adolescents around the world are under the influence of these smoking depictions. Findings from this dissertation may inform interventions to alleviate the negative influence of these depictions globally. For places such as Hong Kong, where the movie rating system is operated and enforced by a government agency, results from this proposal may provide further evidence to support restriction on teenage access to movies containing images of smoking.

Chapter 2 Data Source: Minnesota Adolescent Community Cohort Study

2.1. Overview

We analyzed data from the Minnesota Adolescent Community Cohort (MACC) study to answer our research questions. MACC is a 9-year, multi-level, population-based, observational prospective cohort study funded by the National Cancer Institute. It was designed to examine the effect of state- and local-level tobacco prevention and control programs on youth in Minnesota, and to deepen the understanding of the transitional process from non-smoking to smoking in adolescents. MACC provides several unique strengths to answer the research questions. First, it has a long follow-up period that covers the entire adolescent period, and therefore allows us to explore the differential effects of the perceived prevalence of smoking in movies on smoking throughout adolescence. Second, its longitudinal study design ensures the exposure (the perceived prevalence of smoking in movies) precedes the mediators (positive expectancies of smoking and the normative perception of adult smoking), and also the mediators precede the outcome (adolescent smoking behaviors). This provides a better scientific foundation to infer causal relationships in the study than a cross-sectional study design. Third, the population-based design of the study enables the researchers to include teenagers who were not in school during the study period. This provides a more representative sample of teenagers, and hence, increases the generalizability of the findings from this dissertation.

The study has 5 components: 1) a youth survey pertaining to adolescent tobacco use behaviors, perceived smoking-related social environment, and attitudes and beliefs toward smoking; 2) an assessment of the enforcement of underage tobacco sales

restriction by government agencies; 3) a school survey collecting data about tobacco use prevention curriculum at schools; 4) an annual public record review of local ordinances particularly related to restrictions on youth access to tobacco products and secondhand smoking exposure; 5) an ongoing media review collecting articles from publicly available newspapers in Minnesota covering tobacco-use-related issues. This dissertation only analyzed data from the youth survey.

2.2. Youth survey sampling and recruitment

2.2.1. Stage one: geo-political unit (GPU) sampling

To capture tobacco prevention and control programs happening at various locations at various time, Minnesota was divided into 129 GPUs by the following criteria: 1) every GPU should resemble the existing geographic and political boundaries; 2) they needed to have an adequate number of 12-16 year-old teenagers for sampling; 3) youth tobacco use within the GPUs should be homogeneous; 4) they were potential units to offer local tobacco prevention program (see Appendix I for maps of GPUs). Sixty GPUs were selected through proportion-to-size probability sampling stratified by region (4 non-metropolitan congressional districts, Minneapolis-St. Paul, suburbs of Minneapolis-St. Paul, small cities), level of urbanization, and race and ethnicity. The final sample consists of 28 rural (46%), 21 suburban (35%), 3 small-city (5%), and 8 urban GPUs (14%); these include 3 GPUs with the largest Hispanic population, and all GPUs with Native American reservations in Minnesota.

Four other Midwestern states were selected as comparison states, since they were expected to have minimal tobacco prevention activities during the study period.

Furthermore, they were demographically and geographically similar to Minnesota, which provided high comparability when assessing the effect of state- and local-level tobacco prevention activities. These four states were divided into five GPUs: 1) North Dakota; 2) South Dakota; 3) Upper-Peninsula of Michigan; 4) non-metropolitan area of Kansas; 5) Kansas City and Wichita.

2.2.2. Stage two: individual sampling

After selecting the 60 GPUs in Minnesota and five from comparison states, five age cohorts (ages 12, 13, 14, 15, and 16) were established through a combination of random and quota sampling to ensure an even age distribution in each GPU. In 2000, Clearwater Research, of Boise, Idaho, conducted modified random-digit dialing in each GPU to identify residential households, screen for their eligibility and recruit the eligible households into the study, with the aim of selecting approximately 60 teenagers, 12 in each age cohort, in each GPU. After calling 225,064 phone numbers, they found 6,276 eligible households, and 4,241 of them agreed to participate and completed the baseline interviews, resulting in a 58.5% response rate among eligible households. A similar approach was used to recruit a new 12-year-old cohort with 584 teenagers in 2001, with a 63.6% response rate among eligible households. Table 1 summarizes the response rates in each step of the recruitment process in the initial Minnesota cohort, the comparison cohort, and the new Minnesota cohort.

Since exposure to movies is not likely to vary by state, and also the transitional process from non-smoking to smoking in adolescence would not seem to differ by state, the dissertation pooled the data from all GPUs.

Table 1. Response rates in each MACC cohort.

	Initial Minnesota Cohort		Comparison Cohort		New Minnesota Cohort	
	N	Remained %	N	Remained %	N	Remained %
Total numbers called	200,849		24,215		137,129	
Working phone numbers	177,919		20,685		114,829	
Known and unknown eligible ¹	35,464	100%	4,459	100%	26,836	100%
Known eligible	6,213	17.5%	1,038	23.3%	940	3.5%
Completed interviews	3,636 ²	10.3%	605 ³	13.6%	598 ⁴	2.2%
Response rate (complete interview ÷ known eligible)		58.5%		58.3%		63.6%

¹Unknown eligible included failures in contacting working numbers, and refusals before eligibility was determined. The numbers were obtained by subtracting non-eligible households from working phone numbers, where reason for non-eligibility included no eligible teen, non-private numbers, language barrier, etc.

²203 cases were still followed even though the quota cell was full

³24 cases were still followed even though the quota cell was full; for 1 case, Clearwater Research lost data.

⁴10 cases were still followed even though the quota cell was full; for 13 cases, Clearwater Research lost data, so the final number of complete interviews was 584.

2.3. Baseline and follow-up surveys

Teenagers who completed the baseline survey were contacted every six months from 2001 to 2008 and were asked to complete follow-up surveys (the new Minnesota cohort was contacted from 2002 to 2008 after completing their baseline survey in 2001). In any given year during the study period, the first follow-up survey was completed between April and September, and the second follow-up survey was completed between October and March of the next year. Participants were not contacted during October 2003 to March 2004 (Round 7) due to a gap in study funding.

All surveys, including the baseline survey, were conducted by Clearwater Research through computer-assisted telephone interviews (CATI). Active parental consent and youth assent were obtained for each round of data collection for participants under the age of 18, and active consent was obtained for participants aged 18 or above. The interviews were approximately 10-20 minutes, and assessed participants' tobacco use behaviors, attitudes and beliefs about cigarette smoking, media exposure, social environment, and demographic characteristics. Upon completion of each survey, participants under the age of 18 received \$10 as compensation, while participants aged 18 or above received \$15.

MACC was very successful in retaining participants in the study. The retention rate among the eligible participants from the baseline sample ranges from 96.7% at Round 2 to 80.0% at Round 14 (see Table 2 for round-specific retention rates). The dissertation used data from all 14 rounds of data collection.

Table 2. Round-specific retention rates.

	Number of Participants	Number of Survey Completed ¹	Retention Rate (% of the baseline cohort)
Baseline (Oct 2000 to Mar 2001)	4241	4241	100.0%
Round 2 (Apr 2001 to Sept 2001)	4241	4100	96.7%
Round 3 (Oct 2001 to Mar 2002) ²	4825	4563	94.6%
Round 4 (Apr 2002 to Sept 2002)	4803	4513	94.0%
Round 5 (Oct 2002 to Mar 2003)	4758	4429	93.1%
Round 6 (Apr 2003 to Sept 2003)	4710	4326	91.9%
Round 7 (Oct 2003 to Mar 2004)	Not collected		
Round 8 (Apr 2004 to Sept 2004)	4672	3993	85.5%
Round 9 (Oct 2004 to Mar 2005)	4619	3956	85.7%
Round 10 (Apr 2005 to Sept 2005)	4563	3854	84.5%
Round 11 (Oct 2005 to Mar 2006)	4444	3862	86.9%
Round 12 (Apr 2006 to Sept 2006)	4336	3740	86.3%
Round 13 (Oct 2006 to Mar 2007)	4304	3526	81.9%
Round 14 (Apr 2007 to Sept 2007)	4206	3363	80.0%

¹Participants became ineligible for follow-up because of 1) deceased, 2) permanent refusals, 3) lost to follow-up (unable to be contacted in three consecutive rounds and unable to locate to obtain any further information).

²A new 12-year-old cohort was recruited.

2.4. Specific measures in the dissertation

The MACC youth survey includes over 200 questions about participants' tobacco use behaviors, home and social environment, attitudes and beliefs toward smoking, access to tobacco products, awareness of anti-smoking activities, and more. Table 3 summarizes the measures from the youth survey the investigator used to answer the research questions.

Table 3. Measures used in each manuscript.¹

	Manuscript Proposal 1		Manuscript Proposal 2		Manuscript Proposal 3	
	Baseline	Time-variant	Baseline	Time-variant	Baseline	Time-variant
Demographics						
Age	✓			✓		✓
Gender	✓		✓		✓	
Ethnicity	✓		✓		✓	
Parent education	✓		✓		✓	
Level of urbanization	✓		✓		✓	
Social environment						
Living with Mom	✓					
Living with Dad	✓					
Mom smoking	✓					
Dad smoking	✓					
Sibling smoking	✓					
Number of friends smoke						
Home policy – adults	✓					
Home policy – guests	✓					
Attitudes						
Positive expectancies						
<i>Calm someone down</i>						✓
<i>Good when bored</i>						✓
<i>Feel better when down</i>						✓
Tobacco companies targeting teens						
<i>Get teens smoke</i>	✓					
<i>Too much blame on tobacco companies</i>	✓					
<i>Make too much money from teens</i>	✓					
Normative perception on adult smoking						✓
Exposure						
Perceived prevalence of smoking in movies		✓		✓		✓
Smoking behavior						
Smoking stage				✓		✓

¹Gender and ethnicity were measured at baseline; parent education was measured once later in the study; other variables were measured at each round of data collection.

2.4.1. Demographic factors

Demographic factors include gender, age at each survey, ethnicity, parent education, and level of urbanization. Age at each survey was calculated from a participant's date of birth and date of interview at each round of data collection. Ethnicity was assessed through self-report, with six response categories: African American/Black, American Indian or Native Alaskan, Asian, Hispanic and Latino, White, and others. Parent education level was used as a proxy of socio-economic status. The highest education level obtained by either the father or the mother of a participant, assessed by two separate items (one for the father and one for the mother) with nine options ranging from "Never attended school" to "Graduate or professional degrees holders", was chosen to represent parent education level. The variable was measured once later in the study and assumed to be the same throughout the study period.

We used the Rural Urban Continuum Code 2003[73] developed by the United States Department of Agriculture Economic Development Service to represent the level of urbanization of the participants' residing areas. This continuum code is a 9-class categorization developed to study the economic characteristics of metro and non-metro counties. The code classifies all counties and county units in the United States into metro and non-metro counties according to 2000 census data. Within the metro group, there are 3 sub-classes according to population size of these counties; in the non-metro group, there are 6 sub-classes according to population size and adjacency to metro counties. We used ArcGIS® 9.3[74] to geocode participants' addresses collected at each round to locate the counties where they resided. Based on the county each participant resided in at

each round of data collection, we retrieved a corresponding code for each participant at each round from the Rural Urban Continuum Code 2003 database. Of the 55384 addresses provided by the participants across 15 rounds of data collection, we successfully geocoded 99.7% of them, and were unable to geocode 191 addresses (0.03%) because of missing information on these addresses.

2.4.2. Social and environmental factors

Participants were asked if they were living with their father/stepfather, or mother/stepmother. They were also asked whether their parents or sibling smoke cigarettes. Home smoking policy was also assessed by asking the participants whether adults living with them or adult guests are allowed to smoke inside their homes. To assess the peer social environment, participants were asked for the number of their four closest friends who smoke cigarettes.

2.4.3. Attitudes and beliefs toward smoking

The normative perception of adult smoking by the participants was assessed through participants' perceived prevalence of smoking in the adult population, with five options ranging from "Almost all" to "None". Positive expectancies of smoking were assessed through participants' levels of agreement related to three suggested functions of smoking: calms someone down when angry or nervous, good for when someone is bored, and makes someone feel better when feeling down. Five options, ranging from "Strongly agree" (5 points) to "Strongly disagree" (1 point), were provided for each statement. Attitudes toward tobacco companies targeting teenagers were evaluated through participants' levels of agreement on three other statements: tobacco companies try to get

teenagers smoking, tobacco companies get too much blame for underage smoking, and tobacco companies make too much money from teenagers. Five options were provided in each statement, from “Strongly agree” (5 points) to “Strongly disagree” (1 point). Responses to the second statement (“tobacco companies get too much blame for underage smoking”) were reversed.

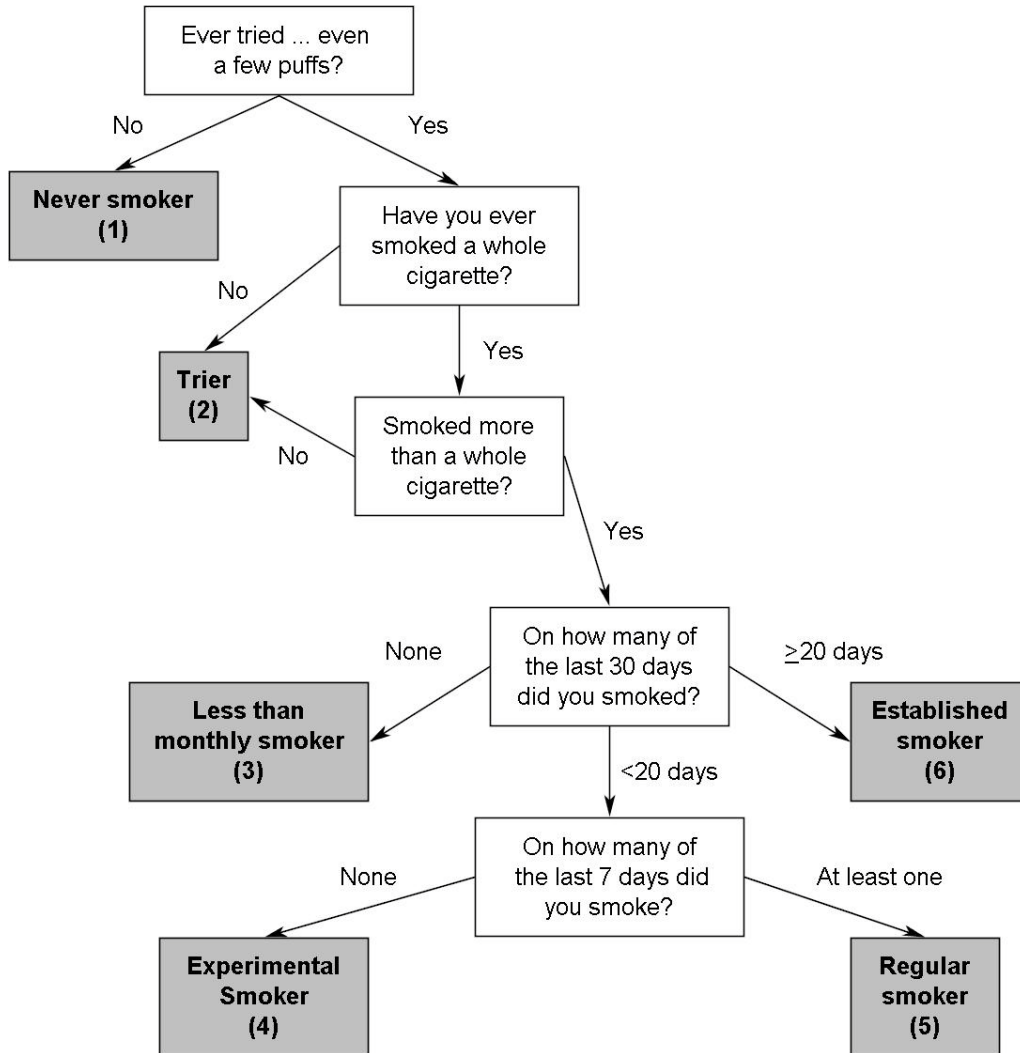
2.4.4. Exposure to smoking in movies

Perceived prevalence of smoking in movies was measured by asking the participants how often they see actors or actresses smoking when they watch movies. Four response categories were “Most of the time”, “Some of the time”, “Hardly ever” and “Never”.

2.4.5. Smoking behaviors

Five items were used to assess smoking behaviors of the participants during the study period: ever experimented with cigarette smoking, ever smoked a whole cigarette, ever smoked more than a whole cigarette, days of smoking in the past 30 days, and days of smoking in the past seven days. An algorithm as shown in Figure 2 was applied to participants’ responses to these questions to classify them into one of the six smoking stages: never smoker, trier, less than monthly smoker, experimental smoker, regular smoker, and established smoker.

Figure 2. Algorithm for classifying smoking stages.



Chapter 3 Manuscript One

Prevalence of smoking in movies as perceived by teenagers: longitudinal trends and predictors

3.1. Introduction

Smoking in movies is prevalent. About 74-98% of the top-grossing movies released during 1985-2003 contained at least some depictions of smoking[24-27, 34]. While the amount of smoking depiction is highest in R-rated movies, 64-80% of the top-grossing PG-13 rated and approximately 50% of the PG/G rated films show images of smoking[25, 27]. Smoking has appeared even in G-rated animations, as 68% of these films released from 1937-1997 portrayed tobacco use by some characters[28]. Teenagers are frequently exposed to these depictions: an estimated 13.9 billion smoking images have been delivered to 10-14 year-olds by the top 100 box-office hits per year alone, which is equivalent to 665 images of smoking per capita[34]. Several studies have demonstrated the association between exposure to these depictions and adolescent smoking[35, 46, 47, 61, 64], leading the National Cancer Institute to conclude a causal relationship between exposure to smoking in movies and initiation of smoking among adolescents[75].

However, findings for changes in prevalence of these depictions in movies over time are mixed. While some reported that smoking in contemporary top-grossing movies increased from the early 1980s to 2000[33], others reported no trend[24, 25], or even a reduction in these depictions[26, 62]. These discrepancies could be due to the use of different coding schemes and sampling frames on movies. Furthermore, these trends do

not necessary represent changes in exposure to smoking in movies among teenagers since they may watch movies other than those analyzed in these reports. Assessing the prevalence of smoking in movies as perceived by teenagers may provide additional insight on this issue. This perception of smoking in movies can be conceptualized as a function of their exposure to these depictions, which does not depend on the movie sampling and coding schemes used by investigators.

We analyzed data from the Minnesota Adolescent Community Cohort (MACC) Study to explore the trajectories of prevalence of smoking in movies as perceived by teenagers. In addition, we assessed the association between these trajectories and demographic, and smoking-related attitudinal and socio-environmental characteristics. Findings from this study provide an alternative view of the changes in prevalence of smoking in movies over time, and identify characteristics of teenagers who are more receptive to these depictions.

3.2. Methods

3.2.1. Study population

The Minnesota Adolescent Community Cohort (MACC) Study was a prospective cohort study designed to examine the effect of state- and local-level tobacco prevention and control programs on youth in Minnesota, and to deepen the understanding of the transitional process from non-smoking to smoking in adolescence. Participants in the MACC Study were selected through cluster random sampling. We divided Minnesota into 129 geo-political units (GPUs) according to existing geographic and/or political boundaries, patterns of local tobacco program activities, and number of adolescents

residing in an area, and selected 60 of these GPUs through stratified random sampling based on regions of the state and race/ethnicity distribution. We chose four other Midwestern states (North and South Dakota, Michigan, and Kansas) as comparison states because of their demographical and geographical similarities to Minnesota, and divided them into five GPUs. Participants were then recruited from the 65 selected GPUs by Clearwater Research, Inc., using modified random digit dialing and a combination of probability and quota sampling methods to obtain an even distribution from ages 12 to 16. Of the 7251 eligible households identified, 3636 participants in Minnesota and 605 participants in comparison states were recruited (a recruitment rate of 58.5% and 58.3% respectively). We recruited an additional cohort of 585 twelve year-olds in Minnesota from the 60 Minnesota GPUs using the same random digit dialing method during 2001-2002 (a recruitment rate of 63.6%), resulting in an overall sample of 4826. Participants were surveyed every six months since recruitment except in 2004 due to a gap in funding. We analyzed data collected from participants who completed at least two surveys before the age of 18 (n=4735).

The University of Minnesota Institutional Review Board approved this study. Parents provided active informed consent for the participants to be part of the study. We obtained active informed consent from the participants after they reached the age of consent.

3.2.2. Measures

The prevalence of smoking in movies as perceived by the participants, was assessed by asking them at each survey, “When you watch movies, how often do you see

actors and actresses smoking?” Four options were provided: most of the time (4), some of the time (3), hardly ever (2), and never (1).

Participants were asked to report their gender (0=female, 1=male), and ethnicity (0=white, 1=non-white). They were also asked to report the highest education level achieved by their fathers and mothers, and the highest education level of the two parents in a household was used to represent parent education level and categorized into high school or less (1), some college (2), college graduate (3), some graduate school or above (4). We also used participants’ addresses collected in each survey to determine their residing counties, and retrieved the corresponding rural urban continuum codes (1-9)[73] to represent levels of urbanization of the areas in which they resided. We reversed the order of the code so that a higher value represented a higher level of urbanization.

We measured the participants’ awareness of tobacco companies marketing toward teenagers at each survey by assessing their levels of agreement (1=strongly disagree, 5=strongly agree) on three statements: tobacco companies try to get teenagers smoking, tobacco companies make too much money from teenagers, and tobacco companies get too much blame for underage smoking. We reversed the order of the responses to the last item so that it was in the same direction with the other two items.

We asked the participants at each survey if they lived with their parents and if their parents smoked. Those who lived with at least one parent who smoked were classified as “yes (1)” for parent smoking status, and those who did not live with parents who smoked were classified as “no (0)”. Sibling smoking status was assessed at each survey by asking the participants if they lived with a sibling who smokes or not (1=yes,

0=no). Participants were also asked at each survey if adults living in their homes were allowed to smoke inside their homes (1=yes, 0=no), and if adult guests were allowed to smoke in their homes (1=yes, 0=no). We added up the responses from these two items to form a three-level home smoking policy score: smoking not allowed (0), adults/guests allowed to smoke (1), and adults and guests allowed to smoke (2). Participants were also asked to reported the number of close friends who smoked (0-4) at each survey.

3.2.3. Analysis

We stratified the analysis by age cohort, defined by participants' ages in 2000. Those recruited in 2000-2001 were stratified into age cohorts 12, 13, 14, 15, and 16, and those recruited in 2001-2002 were classified as age cohort 11. Depending on the age and year entering the study, the maximum number of surveys completed before age 18 varied from 4 surveys (age cohort 16) to 11 surveys (age cohorts 11 and 12).

We used latent variable growth curve models[76] to estimate the trajectory of the perceived prevalence of smoking in movies over time in each age cohort. This type of model allows us to estimate longitudinal trajectories of a variable without eliminating subjects who have missing data on the variable during the observation period. It also allows us to explore different shapes of the trajectory to best describe changes in a variable over time. To best describe the longitudinal changes in the perceived prevalence of smoking in movies in each age cohort, we tested the intercept-only (no growth), linear, quadratic, and cubic growth models, and chose the best model based on model fit, parsimony, and statistical significance of parameter estimates. We compared the slopes of trajectories between age cohorts to examine cohort effect. We then obtained the predicted

estimates of the perceived prevalence of smoking in movies at each age in each age cohort (and the standard errors) from the best model, and compared the estimates for the same age across age cohorts to examine period effect.

We also examined the effects of the baseline values of the predictors and changes in these predictors over time on the longitudinal trend of the perceived prevalence of smoking in movies in each age cohort. To determine whether a predictor changed significantly over time, we examined the difference between its baseline measurement and its last measurement in each age cohort that was measured at the same time of the year as the baseline. For example, in age cohort 16, this was the difference between baseline and the third surveys which were both measured in the winter. If the difference between these two measurements of a predictor is statistically significantly different from zero ($p < 0.05$), we would compute an average change per year of observation by dividing the difference by the number of years of observation, to represent changes of the predictor over time.

We examined the crude association between each predictor with the longitudinal trend of the perceived prevalence of smoking in movies in each age cohort, by first regressing the intercept (i.e. the average perceived prevalence of smoking in movies at baseline) and the slope (i.e. the average change in the perceived prevalence of smoking in movies over time) of the longitudinal trend in each age cohort on the baseline value of a predictor, and then on the baseline value and changes of a predictor if the predictor demonstrated significant changes over time. If the association between a predictor (either baseline value or changes over time) and the longitudinal trend (either the intercept or the

slope) was significant using a liberal criterion of $p < 0.1$, the predictor would enter the multivariate analysis. Predictors were entered into the multivariate models in two blocks in each age cohort: the first model included only significant demographics (gender, race/ethnicity, parent education level, and/or level of urbanization), and second model added all other predictors that were significant in the bivariate analysis. Regression coefficients were standardized. The standardized regression coefficient of the association between a predictor and the intercept of the longitudinal trend of the perceived prevalence of smoking in movies can be interpreted as the standard deviation change in the average perceived prevalence of smoking in movies at baseline associated with one standard deviation increase in the predictor. The standardized regression coefficient on the association between a predictor and the slope can be interpreted as standard deviation change in the average change in the perceived prevalence of smoking in movies over time associated with one standard deviation increase in the predictor.

All models were estimated using Mplus® v5.21[77]. All variables were modeled as continuous, and the standard errors of all estimates were obtained through the sandwich estimator option to handle the clustering by GPU.

3.3. Results

Among the 4735 participants, about half of them were male (49.1%), and the majority of them were white (85.1%). Slightly over one-third (34.9%) of them had a parent who graduated from college. About half of the participants (47.1%) lived in counties in metropolitan areas of one million people or more at baseline. Half (50.3%) of

the participants reported seeing actors and actresses smoking in movies “some of the time”, and another 35.5% of them reported “most of the time” at baseline.

We estimated a number of unconditional latent variable growth curve parameters in different models to characterize the nature of changes in the perceived prevalence of smoking in movies over time, and results are shown in Table 4. The linear models had the best model fit (smallest log likelihood and BIC) among other models within age cohort 11, 14, 15, and 16. The quadratic models had the best model fit within age cohort 12 and 13, but the quadratic slope parameters were not significantly different from zero ($p>0.05$). Therefore we chose the linear model to represent the trajectories of perceived frequency of smoking in movies in all age cohorts.

We estimated the perceived frequency of smoking in movies at each age from the linear latent variable growth models and plotted them by age cohorts against age (Figure 3). The plot shows that the amount of smoking in movies as perceived by the participants declined as they aged in all age cohorts, and the decline was significantly more rapid in age cohorts 14-16 than 11-13 in pair-wise comparisons ($p\leq 0.01$). When plotting the predicted values by age against year (Figure 4), the amount of smoking as perceived by teenagers also demonstrated a downward trend from 2001-2006, and the last predicted value at each age was significantly lower than that of the baseline ($p<0.005$), except in age 12.

Table 5 presents the mean values (or proportions) of the time-varying predictors at baseline and follow-up, and the p-values of the differences between the two measurements in each age cohort. Four variables demonstrated significant changes over

time in at least four age cohorts: attitudes on whether tobacco companies get too much blame for teen smoking, the number of smoking close friends, living with parent who smoked, and restriction on home smoking (all $p < 0.05$). Over time, participants in all age cohorts increasingly disagreed that tobacco companies are getting too much blame for underage smoking. They also had increasing number of smoking close friends as they aged, except in age cohort 16. Significantly fewer participants lived with smoking parents except in age cohort 14 and 16, and smoking became less acceptable at home over time in all age cohorts.

Table 6 shows the crude associations between the baseline values of the predictors and the intercept of the longitudinal trend in the perceived prevalence of smoking in movies in each age cohort. Only the number of smoking close friends at baseline was consistently associated with the intercept, i.e. the average perceived prevalence of smoking in movies at baseline in all age cohorts. Table 7 shows the crude associations between the baseline values of and the changes in the predictors and the slope of the longitudinal trend in the perceived prevalence of smoking in movies in each age cohort. None of the predictors consistently predicted the slope i.e. the average change in the perceived prevalence of smoking in movies over time in all age cohorts.

In the multivariate analysis, only the number of smoking close friends at baseline was consistently associated with the intercepts of the longitudinal trends in the perceived prevalence of smoking in movies in all age cohorts (Table 8, $p < 0.01$). With one standard deviation increase in the number of smoking close friends at baseline, the average perceived prevalence of smoking in movies at baseline increased by 0.12 standard

deviation in age cohort 16 to 0.22 standard deviation in age cohort 11.. None of the associations between the predictors and the slopes of the longitudinal trends in the perceived prevalence of smoking in movies consistently reached statistical significance across age cohorts (Table 9).

3.4. Discussion

We observed that over 85% of the 12-16 year-olds recalled seeing actors and actresses smoking in movies for at least some of the time at baseline. This finding not only agrees with other studies that depictions of smoking are ubiquitous in movies[24-27, 34], but also extends these findings by showing how these images are being perceived by teenagers and encoded for later recall. Communication scholars suggested that as these depictions are encoded, stored, and retrieved upon prompting, they are connected with other memories[78]. Therefore, they could serve as the basis of individuals' knowledge and attitudes toward smoking, and may subsequently affect their smoking behaviors.

The amount of smoking in movies as perceived by teenagers was significantly reduced in all age cohorts as they aged, particularly in the 14-16 year-old cohorts; it was also reduced significantly from 2001-2006 within all ages, except in age 12. The finding supports the downward trend of smoking in movies as observed by other scholars[26, 27, 62] that not only the amount of smoking in top-grossing movies was reduced, but also teenagers' exposure to these images. The observed reduction could be the result of the reduction in tobacco use by major characters in movies released during 1999-2004[30]. As fewer major characters smoke in movies, the total number of depictions of smoking by actors and actresses may also be reduced, subsequently leading to a lower perceived

prevalence of smoking in movies by teenagers. The reduction in number of R-rated movies released during 2001-2003[27] may also explain the differential reduction between the older and younger age cohorts. As older adolescents are more likely to watch R-rated movies[34] and R-rated movies contain more depictions of tobacco use[25, 27, 34], a reduction in availability of R-rated movies would have had a stronger effect on the older than the younger age cohorts. However, teenagers were still estimated to see these depictions some of the time at the end of the observation period given the decline (the last data point in Figure 4). This amount of exposure could still have a significant impact on adolescent smoking.

We also observed that adolescents who reported socializing with close friends who smoke were consistently more likely to report a higher perception of the amount of smoking in movies. This elevated perceived prevalence of smoking in movies could be due to an increase in exposure to smoking in movies. As sensation seeking is a personal trait associated with adolescent smoking[35], teenagers who socialize with smoking teenagers may be influenced by their smoking friends to watch movies with high sensation seeking values, for example, drama or action adventure, which have more depictions of smoking than other genres of movies[25]. This heighten perceived amount of smoking could also be due to the encoding process of these teenagers. Teenagers with smoking close friends remember these depictions since they are relevant to their social environment in reality. These depictions may then serve as reinforcement of their reality, and may therefore influence them to smoke.

The validity of our measure, perceived prevalence of smoking in movies, as a true reflection of exposure to smoking in movies may be questioned. Despite lack of validation, we found it to vary in agreement with the change of prevalence of smoking by major characters in movies. Since the study follow-up period is relatively long (two to six years), loss-to-follow-up and missing data may have introduced bias. However, latent growth modeling handles missing values without deleting any subjects in the analysis. Additional analysis using only those who completed all the surveys during the follow-up period also yielded similar results (data not shown). It is possible that the perceived amount of smoking in movies is associated with factors that we did not measure, such as health classes at school and conversations with other teenagers about smoking. Further research is needed to determine the influences of these variables on the trends of the amount of smoking in movies as perceived by teenagers.

To our knowledge, this is the first study examining the trends in prevalence of smoking in movies as perceived by teenagers. Our findings suggest that the amount of smoking as perceived by teenagers declined over time. However, teenagers were still exposed to these images some of the time given the decline. Future studies will need to validate the measure of the perceived prevalence of smoking in movies, and explore the role of having smoking close friends on the exposure to smoking in movies.

Table 4. Parameter estimates and fit statistics of the latent variable growth models of the longitudinal trends of the perceived prevalence of smoking in movies.

Age Cohort	Model	Parameter Estimates				Fit Statistics	
		Intercept	Slope	Quadratic	Cubic	Log Likelihood	BIC
11	Intercept-only	3.04*				-4044.83	8172.22
	Linear	3.10*	-0.02*			-3942.31	7986.23
	Quadratic	3.09*	-0.01	0.00		-3930.18	7987.37
12	Intercept-only	3.12*				-6103.14	12293.53
	Linear	3.15*	-0.01*			-5956.67	12020.73
	Quadratic	3.17*	-0.03*	0.00		-5912.91	11960.05
13	Intercept-only	3.11*				-5197.16	10468.57
	Linear	3.16*	-0.03*			-5085.83	10266.18
	Quadratic	3.17*	-0.05*	0.00		-5049.00	10219.51
	Cubic	3.18*	-0.06	0.01	0.00	-5035.79	10226.85
14	Intercept-only	3.13*				-3917.09	7894.65
	Linear	3.21*	-0.05*			-3867.11	7814.85
	Quadratic	3.23*	-0.09*	0.01		-3855.39	7818.31
15	Intercept-only	3.16*				-3468.51	6990.84
	Linear	3.25*	-0.08*			-3398.57	6871.15
	Quadratic	3.25*	-0.09*	0.00		-3396.47	6893.87
16	Intercept-only	3.18*				-2309.09	4658.43
	Linear	3.28*	-0.14*			-2268.78	4597.94

[†]Estimates for quadratic and cubic models are not available in some age cohorts as these models did not converge.

*p<0.05.

Table 5. Comparisons between the means of the baseline and follow-up measurements of the predictors. ¹

Predictors		Age cohort					
		11	12	13	14	15	16
Level of urbanization	Baseline	7.13	6.78	6.75	6.82	6.74	6.82
	Follow-up	7.15	6.81	6.78	6.79	6.77	6.82
	p-value	0.54	0.26	0.27	0.26	0.05	0.92
Attitudes toward tobacco companies Get too much blame (reversed)	Baseline	3.18	3.20	3.34	3.38	3.40	3.16
	Follow-up	3.75	3.76	3.73	3.69	3.62	3.28
	p-value	<.01	<.01	<.01	<.01	<.01	0.03
Make too much money from teens	Baseline	4.29	4.36	4.29	4.36	4.37	4.28
	Follow-up	4.23	4.22	4.37	4.44	4.41	4.31
	p-value	0.34	0.01	0.08	0.04	0.21	0.38
Get teens smoking	Baseline	4.45	4.29	4.39	4.44	4.35	4.27
	Follow-up	4.33	4.25	4.32	4.42	4.40	4.27
	p-value	0.04	0.39	0.12	0.52	0.19	0.84
Social environment Number of smoking close friends	Baseline	0.19	0.21	0.41	0.69	0.94	1.40
	Follow-up	0.81	0.94	1.01	1.00	1.17	1.40
	p-value	<.01	<.01	<.01	<.01	<.01	0.95
Living with smoking siblings	Baseline	6%	9%	9%	13%	14%	13%
	Follow-up	8%	9%	9%	12%	11%	13%
	p-value	0.17	0.67	0.91	0.32	0.04	1.00
Living with smoking parents	Baseline	30%	32%	30%	31%	34%	31%
	Follow-up	26%	29%	27%	30%	30%	31%
	p-value	<.01	0.03	0.03	0.56	<.01	0.61
Home smoking restriction score	Baseline	0.46	0.59	0.53	0.57	0.59	0.69
	Follow-up	0.27	0.35	0.35	0.45	0.48	0.57
	p-value	<.01	<.01	<.01	<.01	<.01	<.01

¹Mean values at baseline and follow-up. Estimates are based on participants provided data in both baseline and follow-up surveys. Follow-up survey differs by age cohort: age cohort 11=survey 13, age cohort 12=survey 11, age cohort 13=survey 9, age cohort 14=survey 5, age cohort 15=survey 5, age cohort 16=survey 3. Bolded estimates demonstrated significant difference between baseline and follow-up ($p<0.05$). Ranges of the predictors: level of urbanization (1-9, a higher score means more urban), attitudes toward tobacco companies (1-5, a high score means more negative attitudes toward tobacco companies), number of smoking close friends (0-4), home smoking restriction score (0-2, a higher score means less restriction).

Table 6. Bivariate associations between baseline values of predictors and intercept of the longitudinal trend in the perceived prevalence of smoking in movies in each age cohort.¹

Predictors	Age cohort					
	11	12	13	14	15	16
Demographics						
Male (vs. female)	-0.03	-0.02	-0.03	0.03	-0.05	-0.10*
Non-white (vs. white)	0.13*	0.04	0.09*	0.15*	0.04	0.07
Parent education	-0.14*	-0.15*	-0.17*	-0.11*	-0.12*	-0.13*
Level of urbanization	-0.07	-0.02	-0.02*	-0.06	-0.07	-0.05
Attitudes toward tobacco companies						
Get too much blame (reversed)	-0.02	-0.09*	-0.01	0.03	-0.05	0.03
Make too much money from teens	0.13*	0.01	0.09*	0.13*	0.13*	0.21*
Get teens smoking	0.12*	0.03	0.13*	0.06*	0.07	0.14*
Social environment						
Number of smoking close friends	0.29*	0.16*	0.21*	0.22*	0.29*	0.12*
Living with smoking siblings	0.18*	0.09	0.19*	0.12*	0.16*	0.05
Living with smoking parents	0.15*	0.07*	0.16*	0.08*	0.15*	0.04
Home smoking restriction score	0.21*	0.05	0.11*	0.07*	0.08*	0.08*

¹Standardized regression coefficients presented.

*p<0.10.

Table 7. Bivariate associations between baseline values and changes of predictors and slope of longitudinal trend in the perceived prevalence of smoking in movies in each age cohort.¹

Predictors	Age cohort					
	11	12	13	14	15	16
Demographics						
Male (vs. female)	0.03	-0.02	-0.02	-0.13*	0.04	-0.02
Non-white (vs. white)	-0.02	0.06	0.05	0.08	0.07	0.08
Parent education	0.06	0.03	0.15*	-0.01	0.10	0.00
Level of urbanization	0.05	0.01	0.00	0.07	-0.03	0.11
Attitudes toward tobacco companies						
Get too much blame (reversed)	0.00	-0.01	0.00	-0.08	0.01	0.01
Change in agreeing “get too much blame (reversed)”	-0.06	-0.02	0.00	0.08	0.15*	0.17
Make too much money from teens	-0.12*	-0.05	-0.11*	-0.12*	-0.06	-0.15*
Change in agreeing “make too much money from teens”		0.05		0.21*		
Get teens smoking	-0.09	-0.07	-0.09*	0.00	-0.01	0.03
Change in agreeing “get teens smoking”	0.08					
Social environment						
Number of smoking close friends	-0.19*	-0.07	0.02	-0.07	-0.21*	0.00
Change in number of smoking close friends	-0.05	0.03	-0.02	-0.03	0.03	
Living with smoking siblings	-0.16*	-0.05	-0.18*	-0.10	-0.10*	-0.08
Change in living with smoking siblings					-0.11	
Living with smoking parents	-0.10	0.01	-0.13*	0.03	-0.13*	0.08
Change in living with smoking parents	0.00	0.04	0.07		-0.20*	
Home smoking restriction score	-0.09	0.00	0.07	0.04	-0.07	0.09
Change in home smoking restriction score	-0.07	0.05	0.00	-0.02	-0.06	0.08

¹Standardized regression coefficients presented. No estimates on effects of changes in predictors if the predictors did not change significantly over time ($p < 0.05$).

* $p < 0.10$.

Table 8. Multivariate associations between baseline values of predictors and intercept of the longitudinal trend in the perceived prevalence of smoking in movies in each age cohort.¹

Predictors	Age cohort					
	11	12	13	14	15	16
Demographics						
Male (vs. female)				0.04		-0.09
Non-white (vs. white)	0.11		0.08	0.14*		
Parent education	-0.12	-0.15*	-0.17*	-0.11	-0.12*	-0.12
Level of urbanization			-0.06		-0.07	
Attitudes toward tobacco companies						
Get too much blame (reversed)		-0.07			-0.05	
Make too much money from teens	0.09		0.06	0.14	0.12*	0.18*
Get teens smoking	0.12*		0.13*	0.09		0.08
Social environment						
Number of smoking close friends	0.22*	0.14*	0.14*	0.18*	0.25*	0.12*
Living with smoking siblings	0.13*		0.13*	0.06	0.09	
Living with smoking parents	0.04	0.01*	0.08	0.02	0.12	
Home smoking restriction score	0.13*		-0.04	-0.02	-0.05	0.04

¹Standardized regression coefficients presented. Predictors not significantly associated with either intercepts or slopes in bivariate analysis ($p \geq .10$) were not included in the models. Demographic predictors were adjusted for each other; other variables were adjusted for all variables with significant bivariate associations with either the intercept or the slope.

* $p < 0.01$.

Table 9. Multivariate associations between baseline values and changes of predictors and slope of longitudinal trend in the perceived prevalence of smoking in movies in each age cohort.¹

Predictors	Age cohort					
	11	12	13	14	15	16
Demographics						
Male (vs. female)				-0.13		-0.02
Non-white (vs. white)	-0.01		0.06	-0.08		
Parent education	0.06	0.03	0.14*	0.00	0.10	0.00
Level of urbanization			0.04			
Attitudes toward tobacco companies						
Get too much blame (reversed)		-0.02			0.07	
Change in agreeing "get too much blame (reversed)"					0.14	
Make too much money from teens	0.09		-0.08	0.02	-0.06	-0.18
Change in agreeing "make too much money from teens"				0.21*		
Get teens smoking	-0.08		-0.07	-0.05		0.09
Social environment						
Number of smoking close friends	-0.16	-0.07	0.09	-0.06	-0.16*	0.00
Living with smoking siblings	-0.13		-0.17*	-0.09	-0.05	
Living with smoking parents	-0.05	0.03	-0.12	0.02	-0.13	
Change in living with smoking parents					-0.20*	
Home smoking restriction score	0.03		0.04	0.06	0.07	0.09

¹Standardized regression coefficients presented. Predictors not significantly associated with either intercepts or slopes in bivariate analysis ($p \geq .10$) were not included in the models. Demographic predictors were adjusted for each other; other variables were adjusted for all variables with significant bivariate associations with either the intercept or the slope.

* $p < 0.01$.

Figure 3. Prevalence of smoking in movies as perceived by adolescents in different age cohorts.

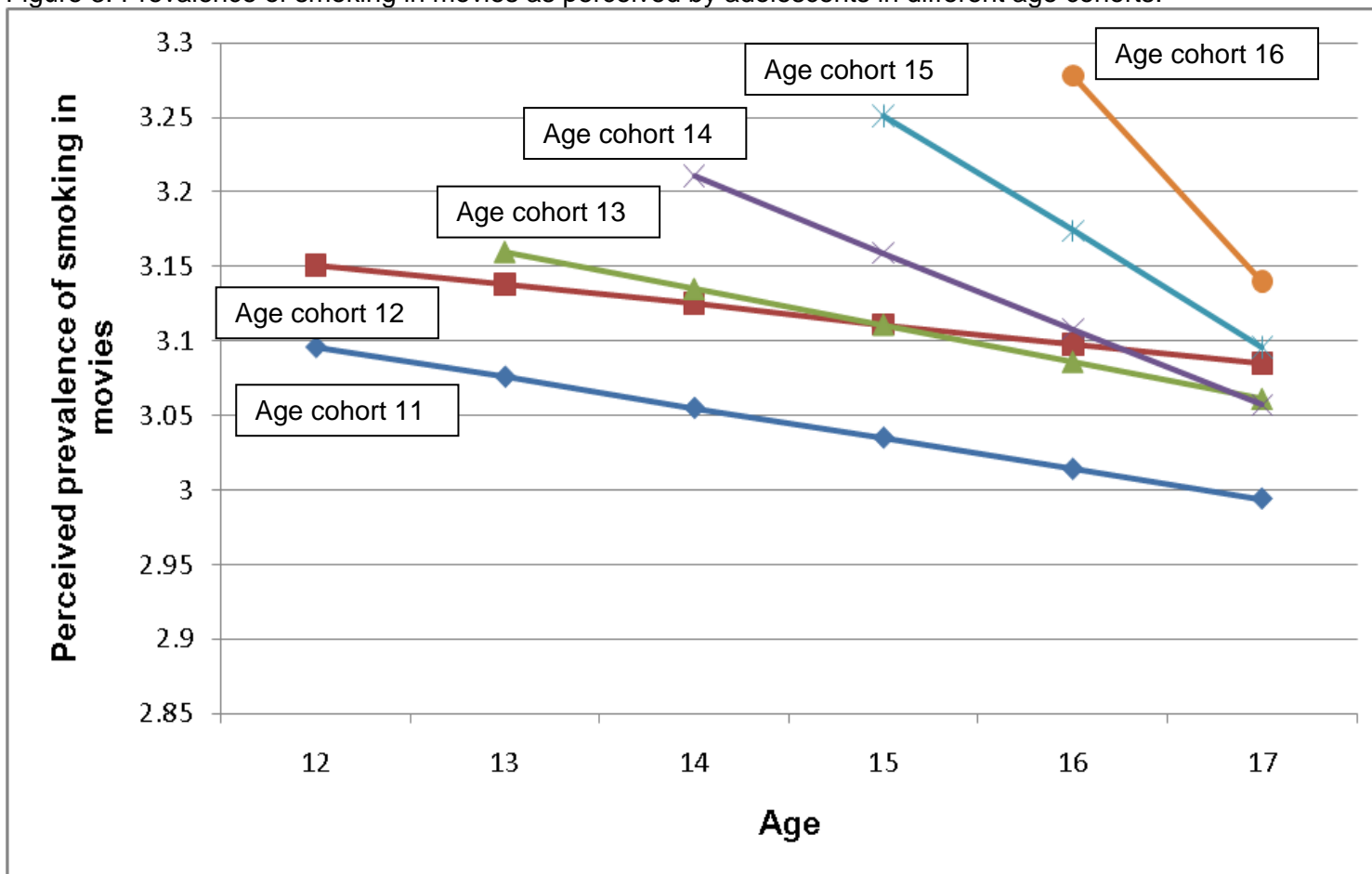
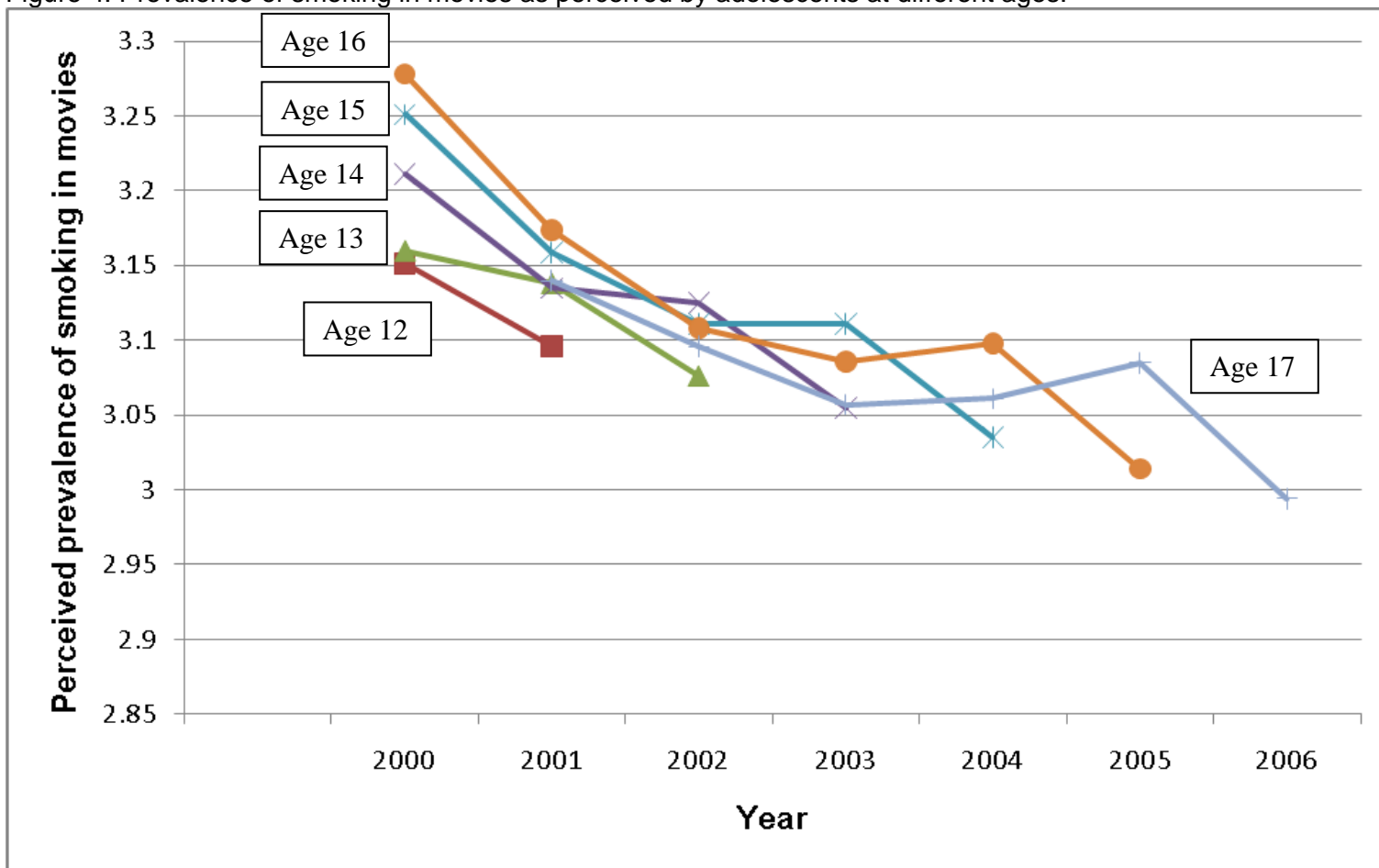


Figure 4. Prevalence of smoking in movies as perceived by adolescents at different ages.



Chapter 4 Manuscript Two

Prevalence of smoking in movies as perceived by adolescents and smoking behavior:
their prospective relationships and variation by age

4.1. Introduction

Exposure to smoking depictions in movies at a young age has been found to be a predictor of adolescent smoking. Findings from both cross-sectional[46, 47] and cohort studies of regional and US samples have demonstrated that high exposure to smoking in movies increases the likelihood of both experimenting with cigarette smoking[35, 51] and smoking >100 cigarettes in a lifetime [61, 64]. These findings, in part, led the National Cancer Institute to conclude a causal relationship between adolescent exposure to smoking in movies and adolescent smoking initiation[75]. The World Health Organization also released a report to urge member countries to take action to reduce the influences of these images on adolescent smoking[79].

To date, studies on this relationship have been limited to young children (9-15 years old) [35, 46, 47, 51, 61, 64]. The effect of exposure to smoking in movies among older adolescents is unknown. Furthermore, since most of these studies only measured exposure to smoking in movies at baseline, they were unable to address how changes in exposure to smoking in movies may affect the adolescent smoking behaviors. Previous studies were also unable to examine how exposure to images of smoking in movies influences progression of adolescent smoking because they only used one of the stages involved in the development of adolescent smoking [63] as an outcome.

We assessed the effect of exposure to smoking in movies on subsequent stage of smoking using data from the Minnesota Adolescent Community Cohort Study, where both exposure to smoking images in movies and development stages of smoking were measured repeatedly throughout adolescence. We also investigated the reverse, namely, whether smoking stage prospectively affect the perception of smoking in movies to examine if teenagers' smoking intensity predicts their subsequent exposure to these smoking images. Variations of these associations throughout adolescence were also explored. Findings from this study provided insights on the relationship between exposure to smoking depictions in movies and progression of smoking from early to late adolescence.

4.2. Methods

4.2.1. Study population

The Minnesota Adolescent Community Cohort (MACC) Study was a prospective cohort study designed to examine the effect of state- and local-level tobacco prevention and control programs on youth in Minnesota, and to deepen the understanding of the transitional process from non-smoking to smoking in adolescence. Participants in the MACC Study were selected through cluster random sampling. We divided Minnesota into 129 geo-political units (GPUs) according to existing geographic and/or political boundaries, patterns of local tobacco program activities, and number of adolescents residing in an area, and selected 60 of these GPUs through stratified random sampling based on regions of the state and race/ethnicity distribution. We chose four other Midwestern states (North and South Dakota, Michigan, and Kansas) as comparison states

because of their demographical and geographical similarities to Minnesota, and divided them into five GPUs. Participants were then recruited from the 65 selected GPUs by Clearwater Research, Inc., using modified random digit dialing and a combination of probability and quota sampling methods to obtain an even distribution from ages 12 to 16. Of the 7251 eligible households identified, 3636 participants in Minnesota and 605 participants in comparison states were recruited (a recruitment rate of 58.5% and 58.3% respectively). We recruited an additional cohort of 585 twelve year-olds in Minnesota from the 60 Minnesota GPUs using the same random digit dialing method during 2001-2002 (a recruitment rate of 63.6%), resulting in an overall sample of 4826. Participants were surveyed every six months since recruitment except in 2004 due to a gap in funding. We restricted our analysis to data collected from participants who completed at least two surveys before the age of 18 (n=4760).

The University of Minnesota Institutional Review Board approved this study. Parents provided active informed consent for the participants to be part of the study. We obtained active informed consent from the participants after they reached the age of consent.

4.2.2. Measures

We assessed the perceived exposure to smoking in movies and smoking stage in each round of data collection. We asked the participants to report how often they saw actors and actresses smoking when they watched movies, with four responding options: most of the time (4), some of the time (3), hardly ever (2), and never (1). We also asked them five questions pertained to their smoking behaviors in each survey, including ever

experimented with cigarette smoking, ever smoked a whole cigarette, ever smoked more than one cigarette, number of days smoked in the past 30 days and in the past 7 days. Participants were classified into one of the six smoking stages which represented their smoking intensity, ranging from never smoker (1) to established smoker (6), based on the algorithm illustrated in Figure 2 (see Chapter 2, page 28). We used these two measures to create age-specific perceived prevalence of smoking in movies and age-specific smoking stages for each participant, in six-month increments from age 12 to 17.9.

We included gender, race/ethnicity, parent education, level of urbanization and age cohort in the analysis. We collapsed the original six-category race/ethnicity item into two categories, non-white (1) and white (0), because of the small number of participants in race/ethnicity categories other than whites. Participants were asked to report the highest education level achieved by their fathers and mothers, and the highest education level of the two parents in a household was used to represent parent education. Responses were categorized into high school graduate or less (1), some college (2), college graduate (3), some graduate school or above (4). We used participants' addresses collected in each survey to determine their residing counties, and retrieved the corresponding rural urban continuum codes (ranging from 1-9)[73] to represent levels of urbanization of the areas in which they resided. We reversed the order of the code so that a higher value represented a higher level of urbanization. Age cohort was defined as age in 2000. Participants recruited in 2000-2001 were stratified into 12-, 13-, 14-, 15, and 16-year-old cohorts, while participants recruited in 2001-2002 were classified as age cohort 11. This

information was used to control for cohort effect shown in our previous analysis (see Chapter 3).

4.2.3 Analysis

4.2.3.1. Centering by age

Since participants in different age cohorts reached the same ages in different chronological time, we centered the data on exposure to smoking in movies and smoking stages by age, i.e., pooling data from participants at the same ages across different rounds of data collection. For example, perceived prevalence of smoking in movies assessed when the participants were age 13, regardless of the year that variable was assessed, was pooled to form the variable perceived prevalence of smoking in movies at age 13. Centering by age allowed us to examine the potential heterogeneity of the mediating effect by age, and also to pool multiple age cohorts in the study to increase statistical power. Since only a few participants provided data when they were at the ages of 12-12.4, we were unable to include this age range in our analysis, reducing our sample size to 4745.

4.2.3.2. Assessing the associations between the exposure and the outcome

We assessed the prospective associations between the perceived prevalence of smoking in movies and smoking stage using autoregressive crosslagged models[80, 81]. This type of model allows us to capture the longitudinal changes within factors and assess the prospective predictions between factors. It is particularly appropriate for our analysis because the exposure to smoking in movies changed over time, as shown in our previous analysis (see Chapter 3). Figure 5 illustrates all the regressions and correlations we

simultaneously estimated between the perceived prevalence of smoking in movies and smoking stage from age 12.5 to 14.4 in the model. The full model extended the analysis to age 17.9. To capture the longitudinal changes within a factor, we simultaneously estimated the effect of each of its age-specific measurements on its measurements assessed six months later by regression (illustrated by the single-headed arrows, for example, from $PPSM_{Age\ 12.5-12.9}$ to $PPSM_{Age\ 13-13.4}$). To control for seasonal variations, we also estimated the effect of each age-specific measurements of a factor on its measurements assessed a year later (illustrated by the curved single-headed arrows, for example, from $PPSM_{Age\ 12.5-12.9}$ to $PPSM_{Age\ 13.5-13.9}$). We applied these two sets of regressions to both factors in the model.

To assess how the two factors prospectively predicted each other, we estimated the effect of each age-specific measurement of one factor on the age-specific measurement of the other factor assessed six months later (illustrated by the solid single-headed arrows, for example, from $PPSM_{Age\ 12.5-12.9}$ to $SS_{Age\ 13-13.4}$, and from $SS_{Age\ 12.5-12.9}$ to $PPSM_{Age\ 13-13.4}$). We delineated the cross-sectional association between the two factors by also simultaneously estimating the correlations between age-specific measurements of the two factors assessed at the same ages (illustrated by the double-headed arrows, for example, $PPSM_{Age\ 12.5-12.9}$ with $SS_{Age\ 12.5-12.9}$). We also adjusted for gender, race/ethnicity, parent education, level of urbanization, and age cohort by estimating their effects on the baseline measures of each factors.

Analysis was performed using Mplus® version 5.21[77]. All variables were modeled as continuous variables. Because of model complexity, we were unable to

control for the clustering effect of the variables by GPU. Since the intra-class correlations in the exposure and outcome variables were small (<0.02), the standard errors of our estimates should not be significantly biased by this limitation.

4.3. Results

Of the 4745 participants, the majority of them were white, and had parents who had graduated from college (Table 10). At baseline, about half of the participants reported seeing smoking in movies some of the time, and another 30-40% reported this experience most of the time. The proportion of participants who were never smokers in each age cohort varied between about 87% (age cohort 11 and 12) and about 45% (age cohort 16).

Overall, the perceived prevalence of smoking in movies was consistently predictive of smoking stage measured six months later. In the crude model, seven out of the ten estimated prospective associations showed that an increase in perceived prevalence of smoking in movies was associated with a subsequent increase in smoking stage (Table 11). Adjusting for covariates did not change the magnitude and statistical significance of these estimates. It also appeared that the association was very consistent among younger ages (perceived prevalence of smoking in movies measured from ages 13-15.4), but less consistent in the older ages (perceived prevalence of smoking in movies measured from ages 15.5-17.4).

Smoking stage did not consistently predict the perceived prevalence of smoking in movies. Three of the ten estimated associations were statistically significant in the crude model (Table 12), but only one of them remained significant after adjusting for

covariates. The variation in the magnitude of this association did not seem to show an age-related pattern.

4.4. Discussion

Existing research on exposure to smoking in movies and adolescent smoking has focused on exposure during younger adolescence[35, 46, 47, 51, 61, 64]. We expanded the current literature by examining the effect of the exposure throughout the entire adolescent period on smoking, and also used a more detailed measure of smoking intensity. We found that exposure to depictions of smoking in movies consistently influenced smoking intensity during younger adolescence (exposed under the age of 15.5), but such influence was inconsistent during older adolescence (exposed after the age of 15.5). If this is true, intervention to reduce exposure to these depictions is more warranted in younger than older adolescents.

The observed age-related pattern could be explained by the differential interpretation of these smoking images in movies between younger and older adolescents. Previous qualitative research found that older teenagers interpreted smoking images in movies as a means to promote cigarettes[66]. They reported resilience to these images, and therefore would be less likely to be influenced by these images. However, younger teenagers were found to interpret these images as accurate reflections of reality[65], which may make them more receptive to these images, and more vulnerable to their influence on adolescent smoking. In addition, movies may be important references for social norms of smoking for younger teenagers but not for older teenagers. A previous report demonstrated that young children (ages 9-15) with high exposure to smoking in movies

were more likely to perceive a high prevalence of adult smoking[69]. This may not be true among older teenagers. As teenagers age, they have more friends who smoke (see Chapter 3, Table 5), and that may become a more salient reference for social norms of smoking.

Our findings also add a different dimension to the known relationship between exposure to smoking in movies and adolescent smoking. Previous studies show *high* exposure to these depictions is associated with experimenting with cigarette smoking[35, 46, 47] and becoming a 100-cigarette smoker[61, 64]. Because we were able to adjust for previous measurements of exposure to smoking in movies and smoking intensity, we showed that an *increase* of exposure to these depictions is associated with the *progression* in smoking stage; in other words, an *increase* in exposure to smoking in movies *intensifies* adolescence smoking behavior. This provides stronger evidence on the temporality between exposure to smoking in movies and adolescent smoking because a change in the exposure is followed by a subsequent change in the outcome.

According to the effect size recommendations provided by Cohen[82], the effect we observed is small while the effects observed by previous studies are between small and moderate. The discrepancy could be because we used a different, but more detailed 6-level smoking stage variable as an outcome instead of dichotomous variables used in previous research that only describe one of the developmental stages involved in smoking uptake. Our research question also differs from those of previous studies: we assessed the effect of *changes* in exposure to smoking in movies on adolescent smoking, instead of the effect of *high* exposure as in previous reports. We also measured the exposure by asking

the participants to estimate the amount of smoking they saw in movies, instead of conducting a content analysis on movies they recall watching. Therefore our measure may be subject to inaccurate recall that could lead to underestimation of the exposure and bias the result toward the null. Furthermore, the small effect size may be due to the low sensitivity of a four-level measure to capture the variation of the exposure to smoking in movies. Nonetheless, given these depictions are prevalent in movies[25, 27, 29, 30] and movies are ubiquitously available to adolescents, this small effect can have significant impact on adolescent smoking at a population level.

We did not find a consistent association between progression of smoking intensity and subsequent exposure to smoking in movies. It may imply that as teenagers smoke more, they did not choose to watch more movies that contain more depictions of smoking, such as drama and adventure [25, 26], than those with less depictions of smoking. It may also imply that they did not increasingly identify themselves with the smoking actors and actresses in movies and therefore did not differentially remember those depictions better than teenagers who smoke less.

A limitation of our analysis was that we could not control for cluster sampling because of model complexity. However, we were able to control for cluster sampling in our crude model and the estimates were comparable with the results shown in this report. As in all prospective studies, missing data due to loss to follow up may bias the results. Since we used maximum likelihood models which can handle missing data without removing participants that are loss to follow up, we were able to include over 99% of the original cohort in our analysis. The accuracy of self-report exposure to smoking in

movies may also be a concern. However, it is the only way to assess the exposure to smoking in movies at a cognitive level, as depictions that participants remembered may have stronger influence on their smoking behaviors than those they did not remember.

In conclusion, we found that an increase of exposure to smoking in movies was associated with a subsequent increase in smoking intensity among adolescents, and the association was more consistent among younger than older adolescents. Further research is needed to confirm our findings.

Table 10. Baseline characteristics of participants in each age cohort.

Characteristics	Age cohort [n(%)]					
	11	12	13	14	15	16
Gender						
Male	274 (47.8%)	390 (47.4%)	450 (52.6%)	417 (50.3%)	408 (48.8%)	387 (47.2%)
Female	299 (52.2%)	432 (52.6%)	405 (47.4%)	412 (49.7%)	428 (51.2%)	433 (52.8%)
Race/ethnicity						
White	466 (83.4%)	667 (81.2%)	729 (85.4%)	709 (85.5%)	732 (87.6%)	712 (86.6%)
Non-white	93 (16.6%)	154 (18.8%)	125 (14.6%)	120 (14.5%)	104 (12.4%)	108 (13.2%)
Parent education						
High school or less	103 (22.1%)	157 (22.7%)	138 (19.7%)	130 (19.9%)	125 (19.9%)	132 (22.0%)
Some college	73 (15.7%)	139 (20.1%)	168 (24.0%)	177 (27.1%)	163 (26.0%)	144 (24.0%)
College graduate	213 (45.7%)	272 (39.3%)	246 (35.1%)	206 (31.5%)	176 (28.1%)	190 (31.7%)
Graduate school	77 (16.5%)	124 (17.9%)	148 (21.1%)	141 (21.6%)	163 (26.0%)	133 (22.2%)
Level of urbanization ¹	7.0 ± 2.5	6.8 ± 2.6	6.8 ± 2.6	6.8 ± 2.6	6.7 ± 2.6	6.8 ± 2.5
Perceived prevalence of smoking in movies						
Never	5 (0.9%)	9 (1.1%)	11 (1.3%)	5 (0.6%)	6 (0.7%)	4 (0.5%)
Hardly ever	121 (21.2%)	124 (15.2%)	121 (14.2%)	94 (11.4%)	83 (10.0%)	85 (10.4%)
Some of the time	270 (47.3%)	418 (51.2%)	431 (50.6%)	414 (50.4%)	436 (52.4%)	400 (49.0%)
Most of the time	175 (30.6%)	265 (32.5%)	289 (33.9%)	309 (37.6%)	307 (36.9%)	327 (40.1%)
Smoking stage						
Never	503 (86.3%)	735 (87.9%)	683 (79.1%)	555 (66.1%)	494 (58.1%)	375 (44.5%)
Trier	66 (11.3%)	82 (9.8%)	134 (15.5%)	182 (21.7%)	197 (23.2%)	194 (23.0%)
Less than monthly	6 (1.0%)	9 (1.1%)	16 (1.9%)	36 (4.3%)	52 (6.1%)	101 (12.0%)
Experimental smoker	3 (0.5%)	4 (0.5%)	15 (1.8%)	18 (2.1%)	33 (3.9%)	35 (4.2%)
Regular smoker	4 (0.7%)	5 (0.6%)	9 (1.0%)	22 (2.6%)	34 (4.0%)	46 (5.5%)
Established smoker	1 (0.2%)	1 (0.1%)	6 (0.7%)	27 (3.2%)	40 (4.7%)	91 (10.8%)

¹Means and standard deviations.

Table 11. Prospective effect of the perceived prevalence of smoking in movies on smoking stage.¹

Effect of the perceived prevalence of smoking in movies measured at...	On smoking stage measured six months later	
	Crude estimate (95% CI)	Adjusted estimate (95% CI) ²
Age 12.5-12.9	0.03 (0.00, 0.06)	0.03 (0.00, 0.05)
Age 13.0-13.4	0.05 (0.02, 0.07)	0.05 (0.02, 0.07)
Age 13.5-13.9	0.03 (0.01, 0.04)	0.02 (0.00, 0.04)
Age 14.0-14.4	0.03 (0.00, 0.05)	0.02 (0.00, 0.04)
Age 14.5-14.9	0.04 (0.01, 0.06)	0.04 (0.00, 0.05)
Age 15.0-15.4	0.02 (0.01, 0.03)	0.02 (0.00, 0.04)
Age 15.5-15.9	0.01 (-0.01, 0.03)	0.01 (-0.01, 0.02)
Age 16.0-16.4	0.00 (-0.01, 0.01)	0.00 (-0.01, 0.02)
Age 16.5-16.9	0.03 (0.01, 0.04)	0.03 (0.01, 0.04)
Age 17.0-17.4	0.01 (0.00, 0.03)	0.01 (0.00, 0.03)

¹Standardized regression coefficients presented. Adjusted for the perceived prevalence of smoking in movies and smoking stage measured six and twelve months prior (if available), and also correlations between the two variables measured at the same ages. Bolded estimates (and 95% confidence intervals) are statistically significant ($p < 0.05$).

²Also adjusted for gender, race/ethnicity, parent education, level of urbanization, and age cohort.

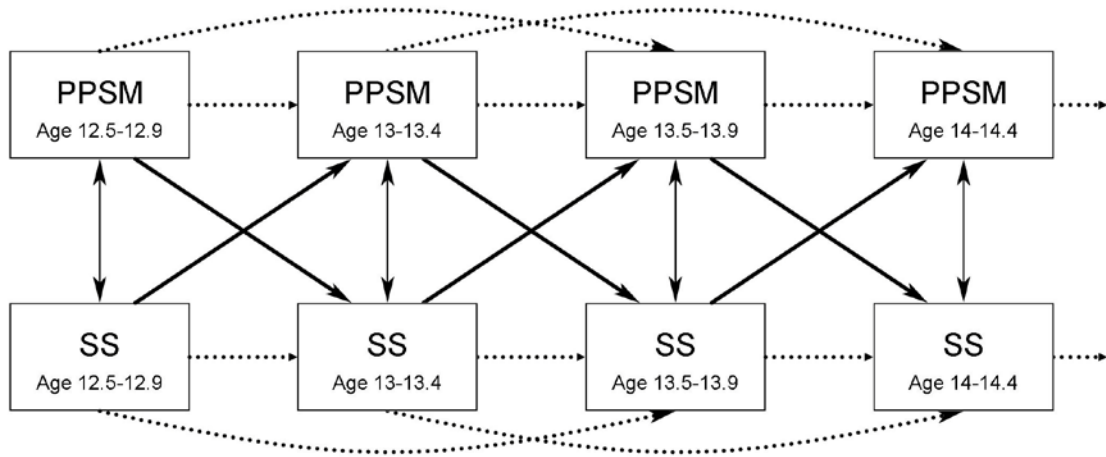
Table 12. Prospective effect of smoking stage on the perceived prevalence of smoking in movies.¹

Effect of smoking stage measured at...	On the perceived prevalence of smoking in movies measured six months later	
	Crude estimate (95% CI)	Adjusted estimate (95% CI) ²
Age 12.5-12.9	0.04 (0.00, 0.08)	0.03 (-0.01, 0.08)
Age 13.0-13.4	0.02 (-0.03, 0.07)	0.01 (-0.04, 0.05)
Age 13.5-13.9	0.01 (-0.04, 0.05)	-0.01 (-0.04, 0.03)
Age 14.0-14.4	0.03 (-0.01, 0.07)	0.02 (-0.02, 0.06)
Age 14.5-14.9	0.03 (-0.01, 0.07)	0.02 (-0.02, 0.05)
Age 15.0-15.4	0.04 (0.00, 0.07)	0.03 (-0.01, 0.06)
Age 15.5-15.9	0.04 (0.01, 0.06)	0.03 (0.00, 0.05)
Age 16.0-16.4	0.02 (-0.01, 0.05)	0.01 (-0.01, 0.04)
Age 16.5-16.9	0.03 (0.00, 0.06)	0.03 (0.01, 0.06)
Age 17.0-17.4	0.00 (-0.03, 0.03)	0.00 (-0.03, 0.03)

¹ Standardized regression coefficients presented. Adjusted for smoking stage and the perceived prevalence of smoking in movies measured six and twelve months prior (if available), and also correlations between the two variables measured at the same ages. Bolded estimates (and 95% confidence intervals) are statistically significant ($p < 0.05$).

² Also adjusted for gender, race/ethnicity, parent education, level of urbanization, and age cohort.

Figure 5. Autoregressive crosslagged model between the perceived prevalence of smoking in movies (PPSM) and smoking stage (SS) (truncated). Single-headed arrows represent regressions and double headed arrows represent correlations.



Chapter 5 Manuscript Three

How smoking in movies affects adolescent smoking: a longitudinal mediation analysis

5.1. Introduction

The association between high exposure to smoking imagery in movies and smoking initiation during adolescence has been consistently demonstrated in studies conducted in the United States[35, 46, 47, 51] and in other countries[48-50]. Given the detrimental effects of smoking, interventions to reduce the influence of these depictions on teenagers are warranted. Public health scholars have advocated for “smoke free movies”[59] through working with the movie industry, and have also urged the Motion Picture Association of America to rate all movies that depict smoking as R-rated[52]. However, these strategies may not be effective since the tobacco industry and the movie industry have had a close relationship[20]; others noted that these strategies may raise concerns about censorship and compromising the freedom of speech protected by the First Amendment[58].

In addition to these policy-level strategies to reduce teenagers’ exposure to smoking in movies, interventions at the individual level may provide another opportunity to curb the influence of these images on adolescent smoking. Understanding the underlying mechanism of how exposure to smoking in movies affects adolescent smoking may provide important information to inform these individual-level interventions. Some scholars[44] have hypothesized that this association operates through the construct of normative perception as posited in the Theory of Planned Behavior[68]. It suggests that because the prevalence of smoking by movie characters is much higher

than that of adults in the real world[30], teenagers who frequently see portrayals of smoking in movies would assume that smoking is a normal behavior among adults, and would subsequently initiate smoking. Scholars[32, 43, 44, 61] have also suggested that the association may be mediated through the construct of positive expectancies according to the Social Learning Theory[67]. Since smoking is often portrayed as a means of stress relief, relaxation, and happiness[25], teenagers may, after seeing these portrayals, expect themselves to receive these benefits if they smoke, and subsequently initiate smoking. A few reports using cross-sectional data have provided preliminary evidence supporting these hypotheses[69-71]. However, little is known about whether these two constructs also explain how the exposure to smoking in movies influences the progression of smoking intensity during adolescence.

In this paper, we examine whether the normative perception of adult smoking and positive expectancies of smoking mediate the association between exposure to smoking in movies and progression of smoking intensity. In other words, we assessed if the exposure to smoking in movies influences subsequent normative perception of adult smoking and positive expectancies of smoking (the mediators), and if these two mediators influence subsequent progression in smoking intensity using prospective data from the Minnesota Adolescent Community Cohort Study. The study had repeated measures available for exposure to smoking in movies, the perceived prevalence of adult smoking, positive expectancies of smoking, and smoking intensity through adolescence, and provided certainty of the time sequence between the exposure, the mediators, and the

outcome. Our findings may provide insight to alternative interventions that can alleviate the negative influence of smoking in movies on teenagers.

5.2. Methods

5.2.1. Study population

The Minnesota Adolescent Community Cohort (MACC) Study was a prospective cohort study designed to examine the effect of state- and local-level tobacco prevention and control programs on youth in Minnesota, and to deepen the understanding of the transitional process from non-smoking to smoking in adolescence. Participants in the MACC Study were selected through cluster random sampling. We divided Minnesota into 129 geo-political units (GPUs) according to existing geographic and/or political boundaries, patterns of local tobacco program activities, and number of adolescents residing in an area, and selected 60 of these GPUs through stratified random sampling based on regions of the state and race/ethnicity distribution. We chose four other Midwestern states (North and South Dakota, Michigan, and Kansas) as comparison states because of their demographical and geographical similarities to Minnesota, and divided them into five GPUs. Participants were then recruited from the 65 selected GPUs by Clearwater Research, Inc., using modified random digit dialing and a combination of probability and quota sampling methods to obtain an even distribution from ages 12 to 16. Of the 7251 eligible households identified, 3636 participants in Minnesota and 605 participants in comparison states were recruited (a recruitment rate of 58.5% and 58.3% respectively). We recruited an additional cohort of 585 twelve year-olds in Minnesota

from the 60 Minnesota GPUs using the same random digit dialing method during 2001-2002 (a recruitment rate of 63.6%), resulting in an overall sample of 4826.

A unique design feature of the MACC Study is its high survey intensity during the follow-up period. Participants were surveyed every six months since recruitment except in 2004 due to a gap in funding. Since our previous analysis showed consistent influence of smoking in movies on smoking behavior only in the under 16 population, we restricted our analysis to data collected from participants who completed at least two surveys before the age of 16; in other words, those under the age of 15 at baseline (n=3127).

The University of Minnesota Institutional Review Board approved this study. Parents provided active informed consent for the participants to be part of the study. We obtained active informed consent from the participants after they reached the age of consent.

5.2.2. Measures

We assessed the perceived exposure to smoking in movies in each survey by asking the participants to report how often they saw actors and actresses smoking when they watched movies, with four responding options: most of the time (4), some of the time (3), hardly ever (2), and never (1).

We also collected information on the mediators in each round of data collection. We assessed participants' perceived prevalence of adult smoking by asking them to estimate how many adults smoke cigarettes, with five options ranging from none (1) to almost all (5). Participants were also asked to rate their levels of agreement, ranging from strongly disagree (1) to strongly agree (5), on three statements related to the perceived

function of smoking: cigarettes can calm someone down when angry or nervous, cigarettes are good for when someone is bored, and cigarettes make a person feel better when feeling down. We used the average score of these three items to represent participants' positive expectancies of smoking. The Cronbach alpha coefficient for these three items was 0.73.

Smoking intensity at each round of data collection was assessed by asking the participants five questions pertaining to their smoking behaviors, including ever experimented with cigarette smoking, ever smoked a whole cigarette, ever smoked more than one cigarette, number of days smoked in the past 30 days and in the past 7 days. Participants were classified into one of the six smoking stages which represented their smoking intensity, ranging from never smoker (1) to established smoker (6), based on the algorithm illustrated in Figure 2 (see Chapter 2, page 28). We used these four measures to create age-specific perceived prevalence of smoking in movies, the perceived prevalence of adult smoking, positive expectancies of smoking, and smoking stage for each participant, in six-month increments from age 12 to 15.9.

We included gender, race/ethnicity, parent education, level of urbanization and age cohort in the analysis. We collapsed the original six-category race/ethnicity item into two categories, Non-white (1) and Whites (0), because of the small number of participants in race/ethnicity categories other than Whites. Participants were asked to report the highest education level achieved by their fathers and mothers, and the highest education level of the two parents of a participant was used to represent parent education. Responses were categorized into high school graduate or less (1), some college (2),

college graduate (3), some graduate school or above (4). We used participants' addresses collected in each survey to determine their residing counties, and retrieved the corresponding rural urban continuum codes (ranging from 1-9)[73] to represent levels of urbanization of the areas in which they resided. We reversed the order of the code so that a higher value represented a higher level of urbanization. Age cohort was defined as age in 2000. Participants recruited in 2000-2001 were stratified into 12-, 13-, and 14-year-old cohorts, and those recruited in 2001-2002 were classified as age cohort 11. This information was used to control for cohort effect on the exposure shown in our previous analysis (see Chapter 3).

5.2.3. Analysis

5.2.3.1. Centering by age

Since participants in different age cohorts reached the same ages in different chronological time, we centered the data on the exposure, the mediators, and the outcome by age, i.e., pooling data from participants at the same ages across different rounds of data collection. For example, perceived amount of smoking in movies assessed when the participants were age 13, regardless of the year that variable was assessed, was pooled to form the variable perceived amount of smoking in movies at age 13. Centering by age allowed us to examine the potential heterogeneity of the mediating effect by age, and also to pool multiple age cohorts in the study to increase statistical power. Since only a few participants provided data when they were at the ages of 12-12.4, we were unable to include this age range in our analysis, reducing our sample size to 3112.

5.2.3.2. Assessing the association between the exposure, the mediators, and the outcome

We assessed the prospective associations between the perceived prevalence of smoking in movies and the two potential mediators (the perceived prevalence of adults smoking and positive expectancies of smoking) separately using autoregressive crosslagged models[80, 81]. This type of model allows us to capture the longitudinal changes within factors and assess the prospective predictions between factors. It is particularly appropriate for our analysis because the perceived prevalence of smoking in movies changed over time, as shown in our previous analysis (see Chapter 3). Figure 6 illustrates all the regressions and correlations we simultaneously estimated between the perceived prevalence of smoking in movies and the perceived prevalence of adult smoking from age 12.5 to 14.4 in the model. The full model extended the analysis to age 15.9. To capture the longitudinal changes within a factor, we simultaneously estimated the effect of each of its age-specific measurements on its measurements assessed six months later by regression (illustrated by the single-headed arrows, for example, from $PPSM_{Age12.5-12.9}$ to $PPSM_{Age13-13.4}$). To control for seasonal variations, we also estimated the effect of each age-specific measurements of a factor on its measurements assessed a year later (illustrated by the curved single-headed arrows, for example, from $PPSM_{Age12.5-12.9}$ to $PPSM_{Age13.5-13.9}$). We applied these two sets of regressions to both factors in the model.

To assess how the two factors prospectively predicted each other, we estimated the effect of each age-specific measurement of one factor on the age-specific measurement of the other factor assessed six months later (illustrated by the solid single-headed arrows, for example, from $PPSM_{Age12.5-12.9}$ to $PPAS_{Age13-13.4}$, and from $PPAS_{Age$

$_{12.5-12.9}$ to $PPSM_{Age\ 13-13.4}$). We delineated the cross-sectional association between the two factors by simultaneously estimating the correlations between age-specific measurements of the two factors assessed at the same ages (illustrated by the double-headed arrows, for example, $PPSM_{Age\ 12.5-12.9}$ with $PPAS_{Age\ 12.5-12.9}$). We also adjusted for gender, race/ethnicity, parent education, level of urbanization and age cohort by estimating their effects on the baseline measures of each factors.

We applied this modeling strategy to assess the separate associations between the perceived prevalence of smoking in movies and the two potential mediators (the perceived prevalence of adult smoking and positive expectancies of smoking). We also assessed the association of the mediators that were predicted by the exposure with smoking stage using the same modeling strategy. Only mediators that were shown to be predicted by the exposure and predicted the outcome were used to estimate the mediating effects.

5.2.3.3. Estimating the mediating effects

Estimating mediating effects can be conceptualized as deconstructing the total effect of an exposure on an outcome into the portion that is explained by the mediators and the portion not explained by the mediators. To ensure the exposure preceded the mediator, and the mediator preceded the outcome, we estimated the mediation effects of five prospective effects of the perceived prevalence of smoking in movies on smoking stage: age 12.5-12.9 on 13.5-13.9, age 13-13.4 on 14-14.4, age 13.5-13.9 on 14.5-14.9, age 14-14.4 on 15-15.4, and age 14.5-14.9 on 15.5-15.9. The one-year time lag was because data were collected every six months. Figure 7 illustrates a longitudinal

mediation model using the perceived prevalence of adult smoking as an example of a mediator, covering ages 12.5 to 14.4. The actual model covered up to age 15.9. This type of model has the advantages of capturing changes within the factors over time, and preserving temporal sequence between the exposure, the mediator, and the outcome, and therefore was preferred to answer our research question. Similar to the autoregressive crosslagged model, we modeled the changes within the exposure, the mediator, and the outcome by estimating the effects of each of age-specific measurements in each factor on age-specific measurements assessed six months and a year later (illustrated by the single-headed arrows, for example, $PPSM_{Age\ 12.5-12.9}$ to $PPSM_{Age\ 13-13.4}$, and $PPSM_{Age\ 12.5-12.9}$ to $PPSM_{Age\ 13.5-13.9}$, respectively.)

To estimate the prospective predictions, we modeled the prospective associations between the exposure and the mediators measured six months apart (for example, the single-headed arrows from $PPSM_{Age\ 12.5-12.9}$ to $PPAS_{Age\ 13-13.4}$, from $PPAS_{Age\ 12.5-12.9}$ to $PPSM_{Age\ 13-13.4}$), and between the mediator and the outcome measured six months apart (for example, the single-headed arrows from $PPAS_{Age\ 12.5-12.9}$ to $SS_{Age\ 13-13.4}$, from $SS_{Age\ 12.5-12.9}$ to $PPAS_{Age\ 13-13.4}$). We also modeled the effects of the exposure on the outcome measured six months and a year later (for example, single-headed arrows from $PPSM_{Age\ 12.5-12.9}$ to $SS_{Age\ 13-13.4}$, and $PPSM_{Age\ 12.5-12.9}$ to $SS_{Age\ 13.5-13.9}$). Cross-sectional correlations between the three factors assessed at the same ages were modeled to prevent inflation of the estimates on the prospective associations. We then adjusted for covariates by estimating their effects on the baseline values of the exposure, the mediator, and the outcome.

The exposure could assert its effect on the outcome measured a year later through four pathways. Using the effect of the exposure at age 12.5-12.9 on smoking stage at age 13.5-13.9 as an example, there was one mediated pathway through the perceived prevalence of adult smoking (from $PPSM_{Age\ 12.5-12.9}$ to $PPAS_{Age\ 13-13.4}$ to $SS_{Age\ 13.5-13.9}$), and three unmediated pathways not going through the mediator (from $PPSM_{Age\ 12.5-12.9}$ to $PPSM_{Age\ 13-13.4}$ to $SS_{Age\ 13.5-13.9}$, from $PPSM_{Age\ 12.5-12.9}$ to $SS_{Age\ 13-13.4}$ to $SS_{Age\ 13.5-13.9}$, and from $PPSM_{Age\ 12.5-12.9}$ to $SS_{Age\ 13.5-13.9}$ directly). These pathways are bolded in Figure 7.

The effect of the mediated pathway was estimated by the following equation:

$$\text{Mediated effect } (M) = \alpha \times \beta$$

where α is the regression coefficient of the exposure measured at age 12.5-12.9 on the mediator measured at age 13-13.4, and β is the regression coefficient of the mediator measured at age 13-13.4 on the outcome measured at age 13.5-13.9.

The effect of the unmediated pathways was estimated by the following equation:

$$\text{Unmediated effect } (U) = (\tau'_1 \times \lambda) + \tau'_2 + (\theta \times \tau'_3)$$

where λ is the regression coefficient of the exposure measured at age 12.5-12.9 on the exposure measured at age 13-13.4, θ is the regression coefficient of the outcome measured at age 13-13.4 on the outcome measured at age 13.5-13.9, and τ_1 , τ_2 , and τ_3 are regression coefficient of the exposure measured at age 12.5-12.9 on the outcome measured at age 13-13.4, on outcome measured at age 13.5-13.9, and the exposure measured at age 13-13.4 on the outcome measured at age 13.5-13.9, respectively. The total prospective effect (T) was the sum of the mediated and unmediated effects, and the

percent explained by the mediator was estimated by the following equation:

$$\text{Percent explained by the mediator} = \frac{M}{T} \times 100\%$$

Analysis was performed using Mplus® version 5.21[77]. Because of model complexity, we were unable to control for the clustering effect of the variables by GPU. Since the intra-class correlations in the exposure and outcome variables were small (<.02), the standard errors of our estimates should not be significantly biased by this limitation.

5.3. Results

Of the 3112 participants, 83.9% were White, and 56.8% had parents with some college education or above. About 80% of the participants reported seeing smoking in movies at least some of the time, and about 36% of them believed that at least most of the adults smoke at baseline (Table 13). Their average expectancies of smoking score was about 2, which meant they generally did not agree that smoking has positive functions. Proportion of participants who were non-smokers ranged between 86-88% in age cohort 11 and 12 and about 66% age cohort 14.

We found that an increase in the perceived prevalence of smoking in movies consistently predicted a subsequent increase in the perceived prevalence of adult smoking measured six months later (Table 14). In contrast, the perceived prevalence of smoking in movies did not significantly predict subsequent positive expectancies of smoking (Table 14).

Since the positive expectancies of smoking were not predicted by the exposure, it was dropped from the subsequent analysis. On the association between the perceived

prevalence of adult smoking and the outcome, we found that an increase in the perceived prevalence of adult smoking consistently predicted a subsequent increase in smoking stage assessed six months later (Table 15). The perceived prevalence of adult smoking therefore fulfilled the criteria to be a mediator on the association between the exposure and the outcome, and was entered into the longitudinal mediation model.

Results from the longitudinal mediation analysis showed a consistent total prospective effect of the perceived prevalence of smoking in movies on smoking stage, independent of the covariates (Table 16). However, the mediation effects by the perceived prevalence of adult smoking were not significant ($p > 0.05$). Only 3-5% of the association between the exposure and the outcome was explained by this mediator during the age of 12.5 to 15.9.

On the association between the perceived prevalence of adult smoking and the perceived prevalence of smoking in movies, we observed an interesting finding that an increase in the perceived prevalence of adult smoking also consistently predicted a subsequent increase in the perceived prevalence of smoking in movies (Table 17).

5.4. Discussion

The objective of this study was to examine the ability of two potential mediators, the perceived prevalence of adult smoking and positive expectancies of smoking to explain the effect of changes in exposure to smoking movies on progression in smoking intensity during adolescence. Baron and Kenny[83] suggested that a mediator should be an intermediate step on the causal pathway that is caused or influenced by the exposure, and causes or influences the outcome.

We found that the perceived prevalence of adult smoking fulfilled this set of criteria: an increase in exposure to smoking in movies prospectively predicted a subsequent increase in the perceived prevalence of adult smoking, and an increase in the perceived prevalence of adult smoking also predicted a subsequent increase in smoking intensity. In contrast, we did not find the positive expectancies of smoking to be a mediator of the association between exposure to smoking in movies and progression in smoking intensity. Both findings contradict previous mediation analyses on the association between exposure to smoking in movies and adolescent smoking, which found that the positive expectancies of smoking, instead of the perceived prevalence of adult smoking, was a mediator[70, 71].

Several differences between our study and previous studies may explain the disagreements. First, previous reports either measured the exposure and the mediators at the same time[70], or measured the mediators and the outcome at the same time[71]. The associations found between these variables were therefore cross-sectional, and it is uncertain if the mediators and the outcome are the results of the exposure, or vice versa. Our study has the strength of using longitudinal data to preserve the temporal sequence between the exposure, the mediators, and the outcome, and therefore is in a better position to conclude that the perceived prevalence of adult smoking is a mediator of the association, while the positive expectancies of smoking is not. Second, our measure of exposure is different from that of the previous reports. We measured the exposure to smoking in movies by asking the participants to estimate how often they saw actor and actresses smoking, while previous mediation analysis performed content analysis on

movies that were seen by the participant using a random list of top grossing movies.

Third, we used a more detailed, six-level measure of smoking intensity as the outcome, while previous reports only used ever smoked[71] as the outcome, or did not differentiate those who smoked more than 100 cigarettes in a lifetime[70]. Finally, our research question was also different from those of the previous reports. We examined the ability of the *changes* in the mediators in explaining the *changes* in exposure of smoking in movies and *changes* in smoking intensity, while previous reports assessed whether a *high level* of exposure to smoking in movies was associated with *high levels* in the mediators, and a *high level* of smoking.

It is not surprising that the mediated effects are not statistically significant, given that the total effects were small, according to Cohen's definition of effect sizes[82]. It is more informative to know that only 3-5% of the association between the changes in exposure to smoking in movies and progression of smoking intensity was explained by the changes in perceived prevalence of adult smoking. This suggests that while the perceived prevalence of adult smoking fulfilled the criteria of being a mediator, it did not explain a significant portion of the association. Therefore intervening on this construct will only eliminate a small portion of the effect of the exposure on progression of smoking during adolescence.

The remaining unmediated effects may be explained by other mediators. Role modeling may be a potential way to explain the association. Since celebrities are silent role models for teenagers, those whose favorite celebrities smoke in movies may simply mimic the behavior and initiate smoking, or those who already started smoking will

smoke more frequently. A previous mediation analysis provided empirical support to this hypothesis by demonstrating that smoking by teenagers' favorite movie stars mediated the association between exposure to smoking in movies and adolescent smoking[70]. Viewing portrayals of smoking in movies may also enhance sensation seeking personality, a personal trait that has been shown to be associated with adolescent smoking[35], and subsequently leads to progression of smoking intensity. Evidence from the alcohol use literature supports this hypothesis as scholars found that exposure to R-rated movies, which were more likely to depict drinking, increased subsequent sensation seeking personality and alcohol initiation[84]. Another potential explanation of the association is priming[85]. These depictions may act as a reminder for non-smoking teenagers that smoking is a behavioral option for them, particularly in the situations depicted in movies. For smoking teenagers, these depictions may serve as cues for smoking and create an urge to smoke. This is supported by findings from an experiment on college young adults that found those who saw smoking images were more likely than those who did not see smoking images to smoke immediately after the movie[86]. The more often they saw these depictions, the more they were reminded to smoke, subsequently leading to progression of smoking intensity. Further study is needed to evaluate these hypotheses and to identify the mediators that explain a major portion of the association between exposure to smoking in movies and adolescence smoking to inform individual-level interventions to curb the negative effects of this exposure.

We observed that teenagers who had an increased perception of smoking as a normal adult behavior had subsequently reported increased perceived prevalence of

smoking in movies. Since we also found significant relationships in the reverse of this association, these findings together imply that there is a reciprocal relationship between the perceived prevalence of smoking in movies and the perceived prevalence of adult smoking. It is possible that teenagers have high exposure to smoking in movies because they are interested in certain genres of movies with high smoking content, e.g. drama and adventure[25, 26], and upon watching these movies, they develop a higher perceived prevalence of adults smoking, and also a deeper interest in these genres that leads to higher exposure to smoking in movies. An alternative explanation may be that teenagers who developed a higher perceived prevalence of adults may be more likely to encode these depictions due to their aspiration to adult behaviors.

One concern of our study was the participants' ability to accurately recall their exposure to smoking in movies and their smoking behaviors. It is likely that participants could not remember all the portrayals of smoking in movies they had seen. However, this underestimation is likely to be non-differential misclassification and therefore would result in underestimation of the association. The four-level measure of exposure to smoking in movie also may not be very sensitive in capturing the variations of exposure to smoking images in movies. Another concern is the accuracy of self-reported smoking behaviors. A previous meta-analysis concluded that this measure is valid in most cases[87]. We were unable to control for clustering by GPU in our final model due to model complexity. We were able to control for clustering in the crude model and found similar results as presented in this paper. Missing data because of loss to follow-up always raises concern in prospective studies. Because we used maximum likelihood

models in our analysis, we were able to retain most of the participants in our analysis, without excluding participants due to missing data.

In conclusion, this is the first study that used completely prospective data to examine the ability of two constructs, the perceived prevalence of adult smoking and positive expectancies of smoking, in explaining the effect of changes in exposure to smoking in movies and progression in smoking. Our results showed that the perceived prevalence of adult smoking explained only an insignificant portion of the association, while the positive expectancies of smoking did not fulfill the criteria to be a mediator. Future studies should examine other potential mediating processes to shed light on interventions to alleviate the negative influence of smoking in movies on adolescents.

Table 13. Baseline characteristics of the sample for the mediation analysis.

Characteristics	Age cohort [n(%)]			
	11	12	13	14
Perceived prevalence of smoking in movies				
Never	5 (0.9%)	9 (1.1%)	11 (1.2%)	5 (0.6%)
Hardly ever	123 (21.1%)	127 (15.3%)	122 (14.2%)	96 (11.5%)
Some of the time	274 (47.1%)	424 (51.1%)	434 (50.5%)	419 (50.0%)
Most of the time	180 (30.9%)	270 (32.5%)	293 (34.1%)	317 (37.9%)
Perceived prevalence of adult smoking				
None	0 (0.0%)	3 (0.4%)	1 (0.1%)	2 (0.2%)
A few	70 (12.1%)	88 (10.6%)	94 (11.0%)	84 (10.0%)
Some	286 (49.6%)	409 (49.5%)	458 (53.4%)	443 (52.8%)
Most	192 (33.3%)	280 (33.9%)	269 (31.4%)	276 (32.9%)
Almost all	29 (5.0%)	47 (5.6%)	35 (4.1%)	34 (4.1%)
Positive expectancies of smoking¹				
	1.9 ± 0.9	1.9 ± 0.9	1.9 ± 0.9	2.0 ± 0.9
Smoking stage				
Never smoker	503 (86.3%)	735 (87.9%)	683 (79.1%)	555 (66.1%)
Trier	66 (11.3%)	82 (9.8%)	134 (15.5%)	182 (21.7%)
<Monthly smoker	6 (1.0%)	9 (1.1%)	16 (1.9%)	36 (4.3%)
Experimental smoker	3 (0.5%)	4 (0.5%)	15 (1.8%)	18 (2.1%)
Regular smoker	4 (0.7%)	5 (0.6%)	9 (1.0%)	22 (2.6%)
Established smoker	1 (0.2%)	1 (0.1%)	6 (0.7%)	27 (3.2%)

¹Means and standard deviations present for the continuous variable.

Table 14. Prospective effect of the perceived prevalence of smoking in movies on the potential mediators.

Effect of the perceived prevalence of smoking in movies measured at...	On potential mediators measured six months later ¹	
	The perceived prevalence of adult smoking	Positive expectancies of smoking
Age 12.5-12.9	0.07 (0.02, 0.11)	0.00 (-0.04, 0.05)
Age 13.0-13.4	0.07 (0.02, 0.11)	-0.01 (-0.05, 0.02)
Age 13.5-13.9	0.09 (0.05, 0.13)	-0.02 (-0.05, 0.01)
Age 14.0-14.4	0.10 (0.06, 0.14)	0.01 (-0.03, 0.04)
Age 14.5-14.9	0.06 (0.02, 0.10)	0.01 (-0.02, 0.04)
Age 15.0-15.4	0.08 (0.04, 0.11)	0.01 (-0.02, 0.04)

¹Standardized regression coefficients presented. Adjusted for the perceived prevalence of smoking in movies and the mediators measured six and twelve months prior (if available), and also correlations between the perceived prevalence of smoking in movies and the mediators measured at the same ages. Also adjusted for gender, race/ethnicity, parent education, level of urbanization, and age cohort. 95% confidence intervals are provided in parentheses. Bolded estimates and 95% confidence intervals are statistically significant ($p < .05$).

Table 15. Prospective effect of the perceived prevalence of adult smoking on subsequent smoking stage.¹

Effect of the perceived prevalence of adult smoking measured at...	On smoking stage measured six months later
Age 12.5-12.9	0.05 (0.01, 0.08)
Age 13.0-13.4	0.04 (0.01, 0.06)
Age 13.5-13.9	0.03 (0.01, 0.06)
Age 14.0-14.4	0.04 (0.02, 0.06)
Age 14.5-14.9	0.03 (0.01, 0.05)
Age 15.0-15.4	0.03 (0.01, 0.05)

¹Standardized regression coefficients presented. Adjusted for the perceived prevalence of adult smoking and smoking stage measured six and twelve months prior (if available), and also correlations between the two variables measured at the same ages. Also adjusted for gender, race/ethnicity, parent education, level of urbanization, and age cohort. 95% confidence intervals are provided in parentheses. Bolded estimates and 95% confidence intervals are statistically significant ($p < .05$).

Table 16. Longitudinal mediation analysis of the effect of the perceived prevalence of smoking in movies and smoking stage through the perceived prevalence of adult smoking.¹

Effect of the perceived prevalence of smoking in movies measured at...	On smoking stage measured a year later		
	Mediated through the perceived prevalence of adult smoking	Total prospective effect	Percent Mediated
Age 12.5-12.9	0.002 (0.000, 0.004)	0.036 (0.000, 0.074)	5.6%
Age 13.0-13.4	0.002 (0.000, 0.004)	0.049 (0.015, 0.085)	4.1%
Age 13.5-13.9	0.002 (-0.004, 0.008)	0.035 (0.001, 0.067)	5.7%
Age 14.0-14.4	0.002 (0.000, 0.004)	0.034 (0.002, 0.068)	5.9%
Age 14.5-14.9	0.001 (-0.001, 0.003)	0.036 (0.009, 0.063)	2.8%

¹Standardized regression coefficients presented. Adjusted for the perceived prevalence of smoking in movies, the perceived prevalence of adult smoking, and smoking stage measured six and twelve months prior (if available), and also correlations between the three variables measured at the same ages. Also adjusted gender, race/ethnicity, parent education, level of urbanization and age cohort. 95% confidence intervals are provided in parentheses. Bolded estimates and 95% confidence intervals are statistically significant ($p < .05$).

Table 17. Prospective effect of the perceived prevalence of adult smoking on subsequent perceived prevalence of smoking in movies. ¹

Effect of the perceived prevalence of adult smoking measured at...	On the perceived prevalence of smoking in movies measured six months later
Age 12.5-12.9	0.07 (0.02, 0.12)
Age 13.0-13.4	0.05 (0.01, 0.10)
Age 13.5-13.9	0.08 (0.04, 0.12)
Age 14.0-14.4	0.10 (0.06, 0.14)
Age 14.5-14.9	0.06 (0.02, 0.10)
Age 15.0-15.4	0.08 (0.05, 0.12)

¹Standardized regression coefficients presented. Adjusted for the perceived prevalence of adult smoking and the perceived prevalence of smoking in movies measured six and twelve months prior (if available), and also correlations between the two variables measured at the same ages. Also adjusted for gender, race/ethnicity, parent education, level of urbanization, and age cohort. 95% confidence intervals are provided in parentheses. Bolded estimates and 95% confidence intervals are statistically significant ($p < .05$).

Figure 6. Autoregressive crosslagged model between the perceived prevalence of smoking in movies (PPSM) and the perceived prevalence of adult smoking (PPAS) (truncated). Single-headed arrows represent regressions and double headed arrows represent correlations.

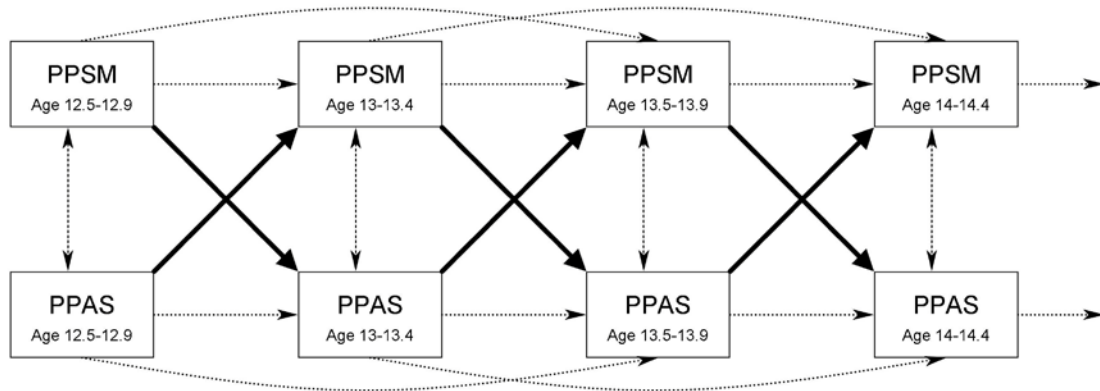
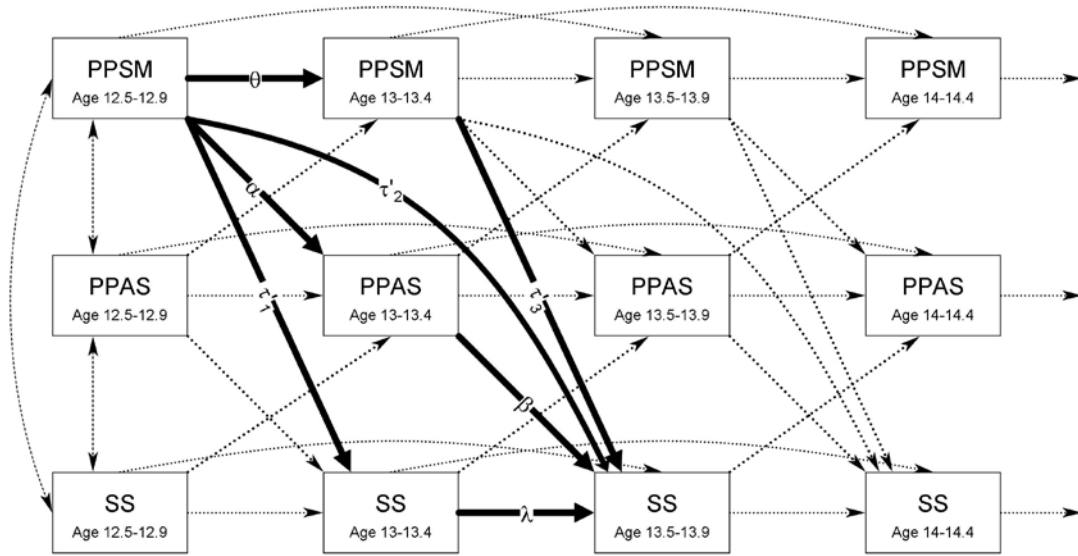


Figure 7. Longitudinal mediation model of the effect of the perceived prevalence of smoking in movies (PPSM) and smoking stage (SS) through the perceived prevalence of adult smoking (PPAS). All single-headed arrows represent regressions and double-headed arrows represent correlation. Correlations between variables measured at age 13-13.4, measured at age 13.5-13.9, and measured at age 14.0-14.4 were omitted for presentation.



Chapter 6 Conclusions and implications

6.1. Overview

Adolescent smoking remains an important public health issue in the United States and worldwide[1, 2]. The National Cancer Institute, after reviewing previous studies demonstrating exposure to depictions of smoking in movies as young children (ages 9-14) is associated with adolescent smoking[35, 46, 47, 51, 61, 64], concluded that watching portrayals of smoking in movies causes adolescents to initiate smoking[75]. Because of the high prevalence of smoking depictions in movies produced in the United States[25-27] and the global distribution of these movies[72], these depictions have also been shown to have negative influence on adolescent smoking around the world[48-50].

However, several questions on this topic have not been answered in the literature. First, findings on the longitudinal trends of depiction of smoking in movies are mixed. Depending on how movies were selected into a study and how smoking depiction is defined, previous reports have either claimed an increase[29, 33] or a decrease[26, 30, 62] in the prevalence of smoking in movies. Previous studies also did not examine changes of exposure to these depictions during adolescence. Second, previous studies have mostly examined the effect of seeing these portrayals in early adolescence on smoking initiation[35, 46, 47, 51]. The effect of this exposure during older adolescence (age 15-17), and its effect on progression of smoking intensity during adolescence is unknown. Third, the underlying mechanisms that explain the effect of seeing depictions of smoking in movies on adolescent smoking have not been thoroughly explored. Previous reports only examined the mechanism for smoking initiation[71] or smoking

intensity up to smoking 100 cigarettes in a lifetime, using study designs that lack the ability to conclude that the exposure actually influences the subsequent mediators, and the mediators influences the subsequent outcome. This study was proposed to answer these three research questions.

6.2. Conclusions from Manuscript One

We examined the longitudinal trends of the exposure to smoking in movies during adolescence (ages 12-18) by modeling the repeated measurements on the perceived prevalence of smoking in movies from 2000-2006, and explored the factors that predict these longitudinal trends. We found that the amount of smoking in movies as perceived by adolescents decreased during that period of time while holding age constant. We also found that the exposure declined as adolescents aged, and the reduction was steeper in the older age cohorts (14, 15, and 16) than the younger age cohorts (11, 12, and 13). The number of smoking close friends consistently predicted the baseline level of perceived prevalence of smoking in movies across age cohorts. However, we did not find any factors that consistently predicted changes in the perceived prevalence of smoking over the period of observation. Our findings suggest that the amount of smoking in movies that teenagers are exposed to declined over time, which agree with previous reports of a decline in the overall number of portrayals of smoking in movies.

6.3. Conclusions from Manuscript Two

We examined the prospective effects of changes in the perceived prevalence of smoking in movies on progression of smoking intensity during adolescence, and assessed if these effects varied by age. We also explored whether progression of smoking intensity

predicts subsequent changes in the perceived prevalence of smoking. We observed that an increase in the perceived prevalence of smoking in movies predicted subsequent progression of smoking intensity, and the effect was consistent when the exposure was at younger ages (13 to 15.4). In contrast, we did not observe a consistent effect of the progression of smoking intensity on the subsequent perceived prevalence of smoking in movies. Our findings showed that portrayals of smoking in movies influence progression of smoking intensity during younger adolescence.

6.4. Conclusions from Manuscript Three

We assessed the ability of two mediators, the perceived prevalence of adult smoking and positive expectancies of smoking, in explaining the effect of changes in the perceived prevalence of smoking in movies on progression of smoking intensity during younger adolescence (ages 12.5 to 15.9). We found that the perceived prevalence of adult smoking fulfilled the criteria of being a mediator, which was predicted by the exposure and subsequently predicted the outcome; however it explained only an insignificant portion of the association between changes in the perceived prevalence of smoking in movies and progression of smoking intensity. Positive expectancies of smoking did not fulfill the criteria for being a mediator. These findings suggest existence of other mechanisms that explain the association between the exposure to smoking in movies and adolescent smoking.

6.5. Contributions to the current literature

6.5.1. Novel use of the construct of the perceived prevalence of smoking in movies

Exposure to smoking in movies is conventionally measured by performing content analysis on the movies that teenagers reported they have watched[46]. Investigators generate a list of movies randomly selected from top-grossing films stratified by rating, and ask the participants to recall those they have watched, and then researchers count the number of scenes that depict smoking in those movies to estimate the exposure. This approach has several critical limitations that reduce its ability to fully capture the exposure. First, because of the large number of movies available to teenagers, this approach is limited to top-grossing contemporary movies, and is unable to fully capture teenagers' exposure to smoking depictions in all movies. Second, stratification by rating may not be appropriate since teenagers are likely to choose movies by genre instead of rating. Third, this approach also excludes exposure to movies available by rental and on television movie channels. Fourth, it does not accommodate the possibility that teenagers may watch a movie more than once. Fifth, previous studies that examine the exposure to smoking in movies among teenagers also did not examine changes in exposure over time.

The perceived prevalence of smoking in movies provides a different perspective on the exposure to smoking in movies. It may represent a more comprehensive estimation of the exposure since it is not limited to any movie sampling methods, and can be conceptualized as a function of teenagers' exposure to smoking portrayals in movies, regardless of the ratings, genres, and release year of the movies. To our knowledge, this is the first study that examined this variable with longitudinal data, and explored predictors of its changes over time. Our finding showed that the perceived exposure to

smoking in movies decreased during the period of observation, which adds additional insight to the current debate of the trends in smoking in movies in the literature.

6.5.2. Assessing the effect of exposure to smoking in movies on progression of smoking intensity

To date, studies on smoking in movies and adolescent smoking have been mostly focused on smoking initiation[35, 46, 47, 51], and therefore have been unable to assess how the exposure affects the progression of smoking. We are the first to explore the association between changes in the exposure on progression and smoking intensity, and found that an increase of exposure to smoking in movies led to a subsequent increase in smoking intensity. Although the effect was small, it is still meaningful on a population basis given the ubiquity of the exposure. This also provides additional information on the association: while the previous reports have found that *high levels* of exposure to smoking in movies led to *smoking initiation*, we found that an *increase* in the exposure led to *progression of smoking intensity*, from non-smokers through established smokers. This adds a new dimension to the temporality of the association between exposure to smoking in movies and adolescent smoking, and provides additional evidence to uphold the causal association between them as concluded by the National Cancer Institute[75].

6.5.3. Assessing the effect of the exposure on smoking thorough adolescence

Previous studies also were restricted to exposure to smoking in movies in young adolescents (ages 9-14), and have not examined the effect of the exposure among older adolescents. We expanded the current literature by assessing the association between the exposure and smoking intensity throughout adolescence (ages 12.5 to 17.9). Through this

analysis, we discovered a novel finding that exposure to depictions of smoking in movies consistently influenced progression of smoking intensity during younger adolescence (exposure during ages 13 to 15.4), but inconsistently during older adolescence (exposure during ages 15.5 to 17.4). This finding suggests that interventions to reduce the effect of these depictions on younger adolescents may be more important than in older adolescents.

6.5.4. Using longitudinal data to perform mediation analysis on the association

Although scholars have hypothesized explanations on the association between exposure to smoking in movies and adolescent smoking[35, 43, 44, 61], there have been only a few attempts in the literature to provide empirical support for these hypotheses[70, 71]. These attempts were also limited to using data from studies that the temporal sequence between the exposure, the explanatory variables (the mediators), and the outcome was not certain. We filled this knowledge gap by using longitudinal data, where the temporal sequence between the exposure, the mediators and the outcome was preserved, to examine two of these hypotheses: mediation through the perceived prevalence of adult smoking and positive expectancies of smoking. Through this longitudinal mediation analysis, we clarified the previous literature that the perceived prevalence of adult smoking mediated only a small portion of the association, while positive expectancies of smoking was not a mediator of the association.

6.6. Limitations

Although the Minnesota Adolescent Community Cohort (MACC) Study sampled participants from comparison states to form a comparison cohort, the majority of the

participants (87.5%) were sampled from Minnesota. Therefore, the results from this dissertation may not be generalizable to adolescents in other states or regions of the United States. However, the availability of movies does not seem to greatly vary across states, and there is no evidence that the developmental process of adolescent smoking differs by state, so the limitation on the generalizability of our findings should be minor.

As in all prospective studies, loss to follow up poses a threat to the internal validity. The MACC Study has a high retention rate (about 80% at Round 14) which reduces the bias caused by loss to follow up. We also used analytical methods (maximum likelihood models) that can handle missing data without excluding participants that are lost to follow up. Nonetheless, our estimates on changes in time-variant covariates are affected by loss to follow up, since we could not compute a difference if there was no follow-up measure. However, given the high retention rate, the magnitude of this problem should be small.

The measure of exposure, the perceived prevalence of smoking in movies, is not a validated measure. Although we observed similar findings using this measure compared to previous studies that based their exposure on content analysis, we are uncertain if our measure of exposure accurately captures the true exposure to smoking in movies. The four-level exposure measure also may not be sensitive enough to capture the variation in exposure to smoking in movies, which may lead to the small effects we observed in this dissertation.

The differential follow-up time in each age cohort before the participants turned age 18 also limited our analysis. The relatively smaller amount of data available at the

younger ages (age 12-13) hindered us from estimating an overall trend in the perceived prevalence of smoking in movies among all participants throughout adolescence. It also hampered us from examining the effect of the perceived prevalence of smoking in movies on progression of smoking intensity during younger adolescence (age 12-12.5).

Because of the study design, we can only examine the longitudinal mediation process occurring over a year, as data collection occurred every six months. It is possible that exposure to smoking in movies has stronger short terms effects on the mediators (the perceived prevalence of adult smoking and positive expectancies of smoking), or the mediators have stronger short term effects on smoking intensity that would not be captured by our analysis.

Although we examined predictors of the baseline and changes in the perceived exposure to smoking in movies, we did not examine if the strength of the association between the exposure and adolescent smoking differs by the level of these predictors. It is possible that given the same amount of exposure to smoking images in movies, teenagers with certain characteristics are more susceptible than others without these characteristics to the influence of the exposure. For example, exposure to R-rated movies, which have the most smoking depictions comparing to other ratings, was found to predict smoking initiation in White adolescents, but not in Black adolescents[88]. Nonetheless, we did adjust for these predictors in our analyses.

This dissertation also only focuses one potential avenue of intervention by identifying mediators on the association between the perceived exposure to smoking in movies and adolescence smoking, with the rationale that intervening on a significant

mediator will interrupt the effect of these smoking images on adolescent. Another possible avenue of intervention is to identify significant mutable moderators on the association. For example, the association may be moderated by the awareness of cigarette marketing tactic; in other words, these images may be less influential among teenagers who are aware that tobacco companies use smoking portrayals in movies to promote cigarette smoking than in those who are not aware. We only explored the effect of an immutable moderator (age) on the association between the perceived exposure to smoking in movies and adolescent smoking.

6.7. Implications

Integrating our findings into the current literature, we see the following implications for interventions:

1. Interventions to reduce exposure to smoking in movies among adolescents are needed. Taking the findings from our study and previous reports, we know that exposure to smoking images in movies is associated with subsequent smoking initiation and progression in smoking intensity. Although we found that exposure to these depictions was declining, on average teenagers still reported seeing these images some of the time, and therefore, are still under the influence of these images. In addition, because of the increasing adoption of clean indoor air policy nationwide, smoking has become invisible in most places. Therefore, portrayals of smoking in movies may become an increasingly prominent source to visualize the behavior, and a constant reminder to teenagers that smoking is a behavior option for them. Thus, interventions to reduce the exposure of these depictions on adolescents are still

needed to protect them from the detrimental effect of smoking. We should continue with our current approach of working with the movie industry to remove the exposure from teenagers[52, 59]; however, since we cannot expect these approaches to have immediate effects, we also need to identify new strategies to reduce the influence of these images on adolescent smoking.

2. Interventions on reducing influence of smoking in movies should focus on younger adolescents. Our findings have strengthened those of the previous reports that exposure to smoking images in movies are more detrimental during younger adolescence than in older adolescence. Therefore, we should focus our effort in developing effective interventions to reduce the influence of these images on younger teenagers.
3. Different avenues of intervention to reduce the influence of smoking in movies on teenagers are necessary. While classifying movies with smoking images with an adult rating may be a reasonable intervention, it may not be efficient in reducing the exposure and influence of these images on younger teenagers since the movie rating system is voluntarily enforced by the theaters and movie retailers in the United States. We examined two factors have been proposed to explain the association between the exposure and adolescent smoking, and found neither of them explains a significant portion of the association. Further research is needed to explore other potential explanatory factors on this association so that interventions can be developed to reduce the influence of these images on adolescent smoking.

For example, scholars observed that viewing smoking scenes in movies

immediately increased ninth graders' intent to smoke[89], and aroused an urge to immediate smoking in college young adults[86]. If we confirm that this explains a significant portion of the association between exposure to smoking in movies and smoking intensity among adolescents, we will have a strong rationale to develop interventions that counter this immediate urge to smoke. A potential intervention will be to show anti-smoking advertisements to the audience before showing movies that depict smoking, as scholars have found that anti-smoking advertisements curbed the intent to smoke due to the smoking scenes among ninth graders[89]. If this intervention is effective, public health practitioners can advocate for a policy to require showing of these anti-smoking advertisements in the theaters and include them in rental movies.

Another avenue of intervention is to identify significant modifiable moderators on the association between exposure to smoking in movies and adolescent smoking. For example, if future research shows that teenagers' awareness of tobacco marketing tactics is a significant moderator of the association, we can then develop interventions to effectively increase teenagers' awareness of this smoking-promotion tactic. These interventions can be at the individual level, such as disseminating the information in health classes, or at the community level, such as media campaigns.

6.8. Future research directions

Validation of the measure of exposure, the perceived prevalence of smoking in movies, is needed. Future research needs to demonstrate the ability of this measure to capture the true exposure to smoking in movies. Validating the measure has public health

implications because if we can demonstrate that the perceived exposure to smoking in movies is a good proxy for the true exposure, public health practitioners can use this measure to evaluate the effects of interventions aiming at reducing the exposure to or the influence of smoking in movies on adolescents. This would allow a more rapid evaluation of these interventions as there is no need to perform labor-intensive content analysis to measure the exposure.

Future research should also explore the short term effect of the exposure to smoking in movies on the mediators we examined. Upon examining the six-month prospective effects, we found that the perceived exposure to smoking images in movies had a small effect on the perceived prevalence of adult smoking and had no effect on positive expectancies of smoking. However, our findings cannot conclude that the exposure has no short term effects on these mediators. Future experimental studies that assess these two mediators after exposing teenagers to depictions of smoking in movies may provide evidence on the short-term effect of the exposure on teenagers.

Identifying alternative mediators that explain the major portion of the association between exposure to smoking in movies and progression of smoking intensity is also necessary. We hypothesized that the association may be explained by role modeling, deepening of the sensation seeking trait after viewing these movies with depictions of smoking, and priming. Further studies are needed to provide empirical evidence to support these hypotheses. Once a significant mediator is found, public health researchers can start developing interventions to modify this mediator to curb the negative influence of smoking imagery in movies on adolescents.

Performing subgroup analysis to identify sub-populations that are more susceptible to the influence of smoking images in movies may also be important. To date, scholars have only examined how the association differs by race/ethnicity. If future research can further segment the sub-populations that are highly receptive to these images, tailored interventions can be developed to effectively curb the effect of these depictions on adolescents in these sub-populations.

Exploring significant modifiable moderators on the association between exposure to smoking in movies and adolescent smoking may also provide a different avenue of intervention. Future studies should identify these moderators and assess their abilities to modify the association. Once significant moderators are identified, research can focus on developing strategies to change these moderators, and assess their effectiveness in reducing the influence of smoking in movies on adolescence.

Replicating our study in countries or places that have a government-enforced movie rating system may shed new lights on public health interventions to reduce adolescent exposure to smoking in movies. Although the movie rating system is a self-regulatory voluntary system in the United States, it is enforced by government agencies in other places like Hong Kong. If the replication of our study shows that teenage exposure to smoking in movies is associated with adolescent smoking in these places, it may be easier to enact a public policy to give these movies an adult rating. With the enforcement by a government agency, we will be able to evaluate the effect of giving movies with smoking images an adult rating on exposure to smoking in movies and adolescent smoking.

6.9. Overall conclusion

This dissertation examined the changes in the exposure to smoking in movies as perceived by adolescents, its influence on progression of smoking intensity throughout adolescence, and explored two potential explanatory variables that were proposed to explain the association between exposure to smoking in movies and adolescent smoking. It showed that the exposure to smoking in movies was slightly declining, and it influenced progression of smoking intensity during younger adolescence. However the two proposed explanatory variables did not explain a significant portion of the association. Further research is needed to validate the measure of the perceived prevalence of smoking in movies, explore the short term effects of the exposure on the two mediators we examined, and identify other explanatory variables so that interventions can be designed to curb the negative influence of these images on teenagers.

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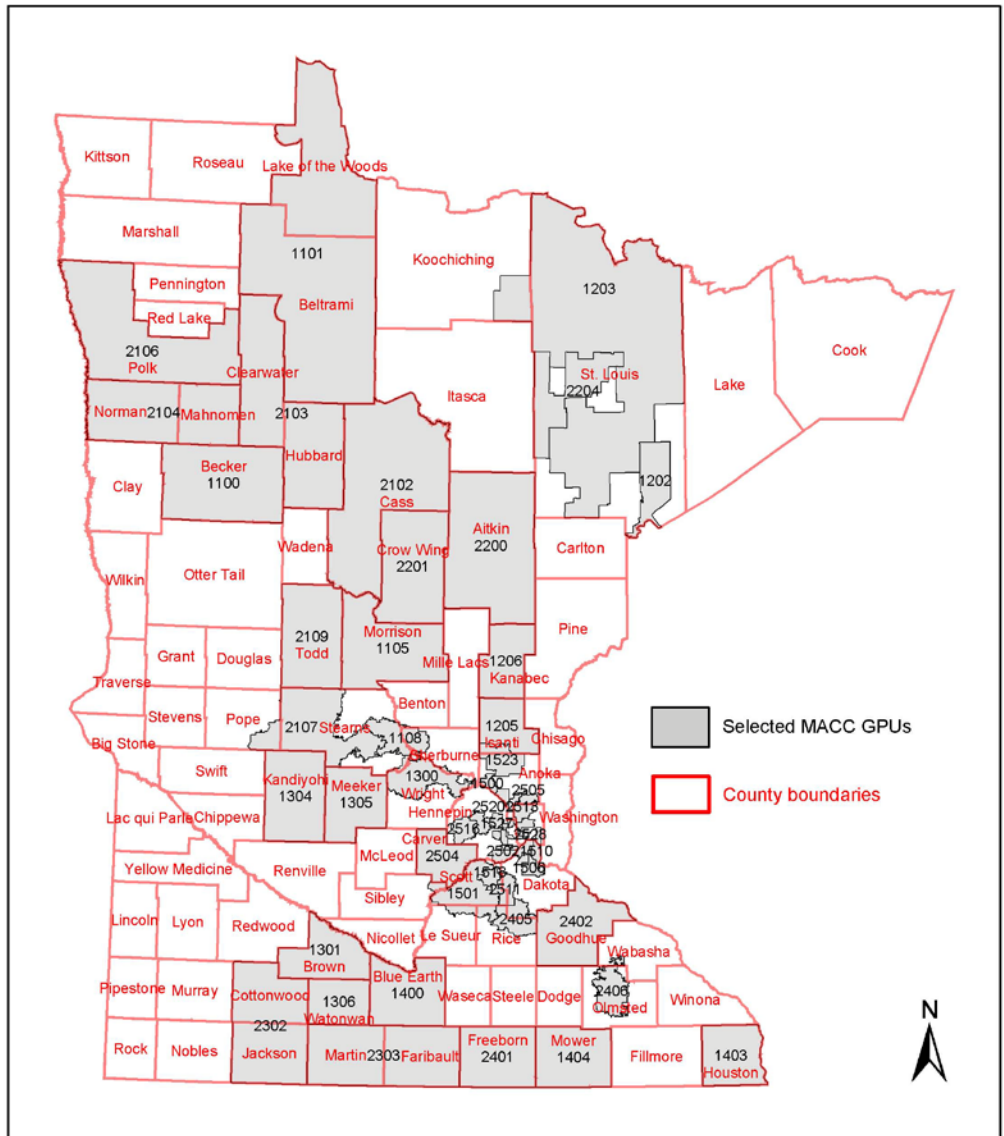
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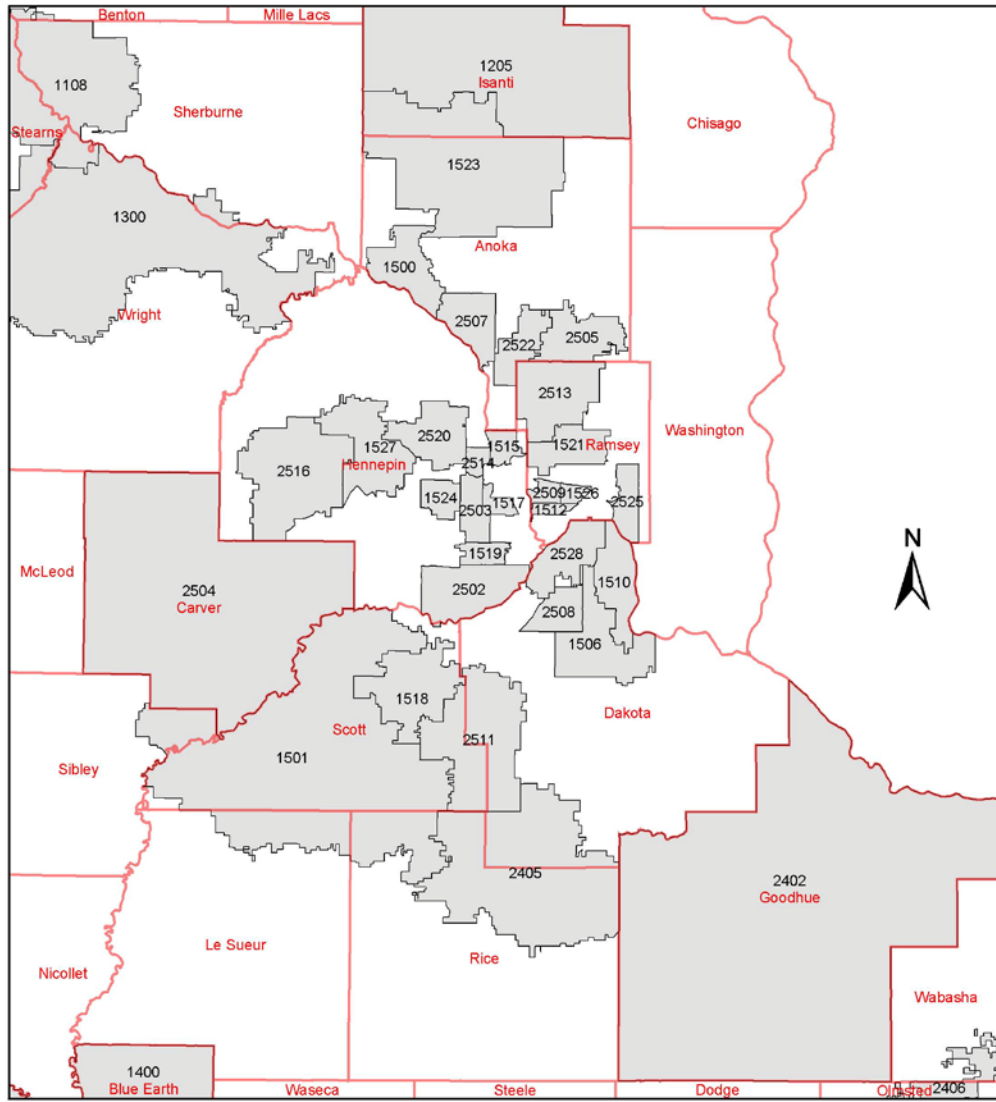
Appendix I: Geo-political units map

Minnesota counties and Minnesota Adolescent Community Cohort (MACC) Geo-Political Units (GPUs)



26 August 2006
 Division of Epidemiology and Community Health
 PI : Jean L. Forster, PhD, MPH
 Map produced by: Rachel Widome, PhD

Minnesota metro counties and Minnesota Adolescent Community Cohort (MACC) Geo-Political Units (GPUs)



26 August 2006
 Division of Epidemiology and Community Health
 PI : Jean L. Forster, PhD, MPH
 Map produced by: Rachel Widome, PhD

- Selected MACC GPUs
- County boundaries

Appendix II: Minnesota Adolescent Community Cohort Study baseline

youth survey.

HELLO

Hello, my name is _____, and I'm calling for the University of Minnesota from Clearwater Research.

Q0010

My first few questions are about your use of the Internet.

On average, how many hours per day do you use the Internet?

1. NEVER (Skip to Q0040)
 2. UP TO ONE-HALF HOUR
 3. MORE THAN ONE-HALF HOUR, UP TO ONE HOUR
 4. MORE THAN ONE HOUR, UP TO TWO HOURS
 5. MORE THAN TWO HOURS
 8. DON'T KNOW
 9. REFUSED
-

Q0020

Have you ever seen tobacco advertising on the Internet?

1. YES
 5. NO (Skip to Q0040)
 8. DON'T KNOW (Skip to Q0040)
 9. REFUSED (Skip to Q0040)
-

Q0030

About how often do you see tobacco advertising when you are on the Internet? Would you say most times, occasionally, or only once in awhile?

1. MOST TIMES
3. OCCASIONALLY
5. ONLY ONCE IN AWHILE
8. DON'T KNOW
9. REFUSED

Q0040

Have you ever smoked a whole cigarette?

1. YES (Skip to Q0060)
 5. NO
 8. DON'T KNOW (Skip to Q0090)
 9. REFUSED (Skip to Q0090)
-

Q0050

Have you ever tried or experimented with cigarette smoking, even one or two puffs?

1. YES (Skip to Q0130)
 5. NO (Skip to Q0090)
 8. DON'T KNOW (Skip to Q0090)
 9. REFUSED (Skip to Q0090)
-

Q0060

How old were you when you smoked a whole cigarette the first time?

ENTER NUMBER OF YEARS

98. DON'T KNOW (Skip to Q0080)
 99. REFUSED (Skip to Q0080)
-

Q0070

How long ago was that? Would you say A) less than one month ago, B) in the past six months, or C) more than six months ago? You can just give me the letter.

1. A) LESS THAN ONE MONTH AGO
3. B) IN THE PAST SIX MONTHS
5. C) MORE THAN SIX MONTHS AGO
8. DON'T KNOW
9. REFUSED

Q0080

Have you smoked more than one whole cigarette?

1. YES
5. NO
8. DON'T KNOW
9. REFUSED

(Skip to Q0130)

Q0090

Do you think you will try a cigarette soon?

1. YES
 5. NO
 8. DON'T KNOW
 9. REFUSED
-

Q0100

If one of your best friends were to offer you a cigarette, would you smoke it?

1. YES
 5. NO
 8. DON'T KNOW
 9. REFUSED
-

Q0110

Do you think you will be smoking cigarettes one year from now?

1. YES
5. NO
8. DON'T KNOW
9. REFUSED

Q0120

Would it bother your parents if you smoked? Would you say it would bother them A) a lot, B) a little, or C) not at all? You can just give me the letter.

1. A) A LOT
3. B) A LITTLE
5. C) NOT AT ALL
8. DON'T KNOW
9. REFUSED

(Skip to Q0430)

Q0130

Thinking about the last seven days, on how many of those days did you smoke a cigarette, even one or two puffs?

ENTER NUMBER OF DAYS

0. ZERO
8. DON'T KNOW
9. REFUSED

Q0140

Now thinking about the last 30 days, on how many of those days did you smoke a cigarette, even one or two puffs?

ENTER NUMBER OF DAYS

0. ZERO (Skip to Q0160)
98. DON'T KNOW
99. REFUSED

Q0150

When was the last time you smoked a cigarette, even one or two puffs? Was it A) sometime today, B) sometime in the past week, or C) longer ago than that?

1. A) SOMETIME TODAY (Skip to Q0170)
 3. B) SOMETIME IN THE PAST WEEK (Skip to Q0170)
 5. C) LONGER AGO THAN THAT
 8. DON'T KNOW (Skip to Q0170)
 9. REFUSED (Skip to Q0170)
-

Q0160

Would you say you last smoked A) within the past month, B) within the past six months, C) within the past year, or D) more than a year ago?

INTERVIEWER: VERIFY RESPONSE

1. A) WITHIN PAST MONTH
 2. B) WITHIN PAST SIX MONTHS (Skip to Q0430)
 3. C) WITHIN PAST YEAR (Skip to Q0430)
 4. D) MORE THAN A YEAR AGO (Skip to Q0430)
 8. DON'T KNOW
 9. REFUSED
-

Q0170

On a scale from 1 to 5, where 1 is "not at all hard" and 5 is "extremely hard", how hard is it for you to avoid smoking in places where it's not allowed, for example in a movie theater, at home, or at school?

1. NOT AT ALL HARD
- 2.
- 3.
- 4.
5. EXTREMELY HARD
8. DON'T KNOW
9. REFUSED

INTERVIEWER:

IF RESPONDENT ANSWERS 1 OR 2, CONFIRM BY SAYING:

So you would say it's not very hard for you to avoid smoking?

IF RESPONDENT ANSWERS 4 OR 5, CONFIRM BY SAYING:

So you would say it's quite hard for you to avoid smoking?

Q0180

On a scale from 1 to 5, where 1 is "not addicted at all" and 5 is "very addicted", how addicted are you to cigarettes?

1. NOT AT ALL ADDICTED
- 2.
- 3.
- 4.
5. VERY ADDICTED
8. DON'T KNOW
9. REFUSED

INTERVIEWER:

IF RESPONDENT ANSWERS 1 OR 2, CONFIRM BY SAYING:

So you would say you are not very addicted to cigarettes?

IF RESPONDENT ANSWERS 4 OR 5, CONFIRM BY SAYING:

So you would say you are quite addicted to cigarettes?

Q0190

On a scale from 1 to 5 where 1 is "not at all sure", and 5 is "very sure", how sure are you that you can quit smoking totally and for good if you wanted to?

1. NOT AT ALL SURE
- 2.
- 3.
- 4.
5. VERY SURE
8. DON'T KNOW
9. REFUSED

INTERVIEWER:

IF RESPONDENT ANSWERS 1 OR 2, CONFIRM BY SAYING:

So you would say you're not very sure you can quit?

IF RESPONDENT ANSWERS 4 OR 5, CONFIRM BY SAYING:

So you would say you're quite sure you can quit?

Q0200

Do you want to stop smoking in the next year or so?

1. YES
 5. NO (Skip to Q0220)
 8. DON'T KNOW (Skip to Q0220)
 9. REFUSED (Skip to Q0220)
-

Q0210

When do you think you will stop totally and for good? Would you say A) within the next month, B) within the next six months, or C) in more than six months?

1. A) WITHIN THE NEXT MONTH
 3. B) WITHIN THE NEXT SIX MONTHS
 5. C) IN MORE THAN SIX MONTHS
 8. DON'T KNOW
 9. REFUSED
-

Q0220

How many times, if any, have you tried to quit smoking?

INTERVIEWER: READ CHOICES IF NECESSARY

1. NEVER (Skip to Q0250)
 3. ONE TIME
 5. MORE THAN ONE TIME
 8. DON'T KNOW
 9. REFUSED
-

Q0230

The last time you tried to quit smoking, did you stay off cigarettes for more than a month?

1. YES (Skip to Q0250)
5. NO
8. DON'T KNOW (Skip to Q0250)
9. REFUSED (Skip to Q0250)

Q0240

About how many days did you stay off cigarettes?

ENTER THE NUMBER OF DAYS

- 0. ZERO
- 98. DON'T KNOW
- 99. REFUSED

Q0250

Do your parents know that you have smoked?

- 1. YES
- 5. NO (Skip to Q0270)
- 8. DON'T KNOW (Skip to Q0280)
- 9. REFUSED (Skip to Q0280)

Q0260

Would you say that it bothers them A) a lot, B) a little, or C)not at all?

- 1. A) A LOT
- 3. B) A LITTLE
- 5. C) NOT AT ALL
- 9. REFUSED

(Skip to Q0280)

Q0270

If they knew that you smoked, would it bother them A) a lot, B) a little, or C) not at all?

- 1. A) A LOT
- 3. B) A LITTLE
- 5. C) NOT AT ALL
- 9. REFUSED

Q0280

During the past 30 days, about how many times, if any, have you gotten cigarettes by having a friend or relative buy them for you?

ENTER NUMBER OF TIMES

- 0. ZERO
- 98. DON'T KNOW
- 99. REFUSED

Q0290

And in the past 30 days, about how many times, if any, have you bought cigarettes, on your own from vending machines?

ENTER NUMBER OF TIMES

- 0. ZERO
- 98. DON'T KNOW
- 99. REFUSED

Q0300

How about over the Internet?

CLARIFY IF NECESSARY:
During the past 30 days, if any, about how many times have you bought cigarettes?

ENTER NUMBER OF TIMES

- 0. ZERO
- 98. DON'T KNOW
- 99. REFUSED

Q0310

In a store where you pick up the cigarettes and bring them to the checkout counter?

CLARIFY IF NECESSARY:

During the past 30 days, if any, about
how many times have you bought cigarettes?

ENTER NUMBER OF TIMES

- 0. ZERO
- 98. DON'T KNOW
- 99. REFUSED

Q0320

In a store where the clerk has to hand you the cigarettes?

CLARIFY IF NECESSARY:

During the past 30 days, if any, about
how many times have you bought cigarettes?

ENTER NUMBER OF TIMES

- 0. ZERO
- 98. DON'T KNOW
- 99. REFUSED

(If answer to either Q0310 or Q0320 is more than zero, skip to Q0350)

Q0340

In the past 30 days, did you try to buy cigarettes in a store?

- 1. YES
- 5. NO (Skip to Q0370)
- 8. DON'T KNOW (Skip to Q0370)
- 9. REFUSED (Skip to Q0370)

Q0350

During the past 30 days, when you tried to buy cigarettes, were you asked to show proof of age?

1. YES
 5. NO (Skip to Q0370)
 8. DON'T KNOW (Skip to Q0370)
 9. REFUSED (Skip to Q0370)
-

Q0360

Did anyone refuse to sell you cigarettes because of your age?

1. YES
 5. NO
 8. DON'T KNOW
 9. REFUSED
-

Q0370

Were you on school property at any time during the past 30 days?

1. YES
 5. NO (Skip to Q0390)
 8. DON'T KNOW (Skip to Q0390)
 9. REFUSED (Skip to Q0390)
-

Q0380

During the past 30 days, on how many days did you smoke cigarettes on school property?

ENTER NUMBER OF DAYS

0. ZERO
98. DON'T KNOW
99. REFUSED

Q0390

How did you get the last cigarette you smoked? A) Did someone give it to you, B) did you buy it, or C) did you just take it?

1. A) GOT IT FROM SOMEONE
3. B) BOUGHT IT (Skip to Q0410)
5. C) TOOK IT (Skip to Q0420)
8. DON'T KNOW (Skip to Q0490)
9. REFUSED (Skip to Q0490)

Q0400

Did you get it from A) another teenager, or B) from an adult who let you have it?

- 1 A) ANOTHER TEENAGER
- 5 B) AN ADULT
- 8 DON'T REMEMBER
- 9 REFUSED

(Skip to Q0490)

Q0410

Did you buy it A) from a store, B) from a vending machine, or C) by paying another person for it?

- 1 A) A STORE
- 3 B) A VENDING MACHINE
- 5 C) ANOTHER PERSON
- 8 DON'T REMEMBER
- 9 REFUSED

(Skip to Q0490)

Q0420

Did you take it from A) another person, or B) from a business?

- 1 A) ANOTHER PERSON
- 5 B) A BUSINESS
- 8 DON'T REMEMBER
- 9 REFUSED

(Skip to Q0490)

Q0430

During the past 30 days, have you bought cigarettes?

- 1. YES
- 5. NO (Skip to Q0490)
- 8. DON'T KNOW (Skip to Q0490)
- 9. REFUSED (Skip to Q0490)

Q0440

During the past 30 days, about how many times, if any, have you gotten cigarettes by having a friend or relative buy them for you?

TIMES

- 0. ZERO
- 98. DON'T KNOW
- 99. REFUSED

Q0450

And in the past 30 days, about how many times, if any, have you bought cigarettes, on your own from vending machines?

TIMES

- 0. ZERO
- 98. DON'T KNOW
- 99. REFUSED

Q0460

How about over the Internet?

CLARIFY IF NECESSARY:

During the past 30 days, if any, about
how many times have you bought cigarettes?

TIMES

- 0. ZERO
- 98. DON'T KNOW
- 99. REFUSED

Q0470

In a store where you pick up the cigarettes and bring them to the checkout counter?

CLARIFY IF NECESSARY:

During the past 30 days, if any, about
how many times have you bought cigarettes?

TIMES

- 0. ZERO
- 98. DON'T KNOW
- 99. REFUSED

Q0480

In a store where the clerk has to hand you the cigarettes?

CLARIFY IF NECESSARY:

During the past 30 days, if any, about
how many times have you bought cigarettes?

TIMES

- 0. ZERO
- 98. DON'T KNOW
- 99. REFUSED

Q0490

Have you ever used any of the following tobacco products?

Smokeless tobacco, such as chewing tobacco, snuff, or dip?

1. YES
 5. NO (Skip to Q0520)
 8. DON'T KNOW (Skip to Q0520)
 9. REFUSED (Skip to Q0520)
-

Q0500

How old were you the first time you used smokeless tobacco?

YEARS

0. ZERO
 98. DON'T KNOW
 99. REFUSED
-

Q0510

During the past 30 days, on how many days have you used smokeless tobacco?

DAYS

0. ZERO
 98. DON'T KNOW
 99. REFUSED
-

Q0520

How about cigars, cigarillos, or little cigars?

1. YES
5. NO (Skip to Q0550)
8. DON'T KNOW (Skip to Q0550)
9. REFUSED (Skip to Q0550)

Q0530

How old were you the first time you used
cigars, cigarillos, or little cigars?

YEARS

- 98. DON'T KNOW
- 99. REFUSED

Q0540

During the past 30 days, on how many days have you used cigars, cigarillos, or little cigars?

DAYS

- 0. ZERO
- 98. DON'T KNOW
- 99. REFUSED

Q0550

Have you ever used a pipe to smoke tobacco?

- 1. YES
- 5. NO (Skip to Q0580)
- 8. DON'T KNOW (Skip to Q0580)
- 9. REFUSED (Skip to Q0580)

Q0560

How old were you the first time you used a pipe to smoke tobacco?

YEARS

- 98. DON'T KNOW
- 99. REFUSED

Q0570

During the past 30 days, on how many days
have you used a pipe to smoke tobacco?

DAYS

- 0. ZERO
 - 98. DON'T KNOW
 - 99. REFUSED
-

Q0580

How about bidis or kreteks or clove cigarettes?

- 1. YES
 - 5. NO (Skip to Q0610)
 - 8. DON'T KNOW (Skip to Q0610)
 - 9. REFUSED (Skip to Q0610)
-

Q0590

How old were you the first time you used bidis or kreteks or clove cigarettes?

YEARS

- 98. DON'T KNOW
 - 99. REFUSED
-

Q0600

During the past 30 days, on how many days have you used bidis or kreteks or clove cigarettes?

DAYS

- 0. ZERO
- 98. DON'T KNOW
- 99. REFUSED

Q0610

Now, I have a few questions about people who may smoke.

How many of your four closest friends smoke cigarettes?

FRIENDS

- 0. ZERO
- 9. REFUSED

Q0620

Does your mother or stepmother live in the same household with you?

- 1. YES
- 5. NO (Skip to Q0640)
- 8. DON'T KNOW (Skip to Q0640)
- 9. REFUSED (Skip to Q0640)

Q0630

Does she smoke cigarettes?

- 1. YES
- 5. NO
- 8. DON'T KNOW
- 9. REFUSED

Q0640

Does your father or stepfather live in the same household with you?

- 1. YES
- 5. NO (Skip to Q0660)
- 8. DON'T KNOW (Skip to Q0660)
- 9. REFUSED (Skip to Q0660)

Q0650

Does he smoke cigarettes?

1. YES
 5. NO
 8. DON'T KNOW
 9. REFUSED
-

Q0660

Do you live with a brother or sister who smokes cigarettes?

1. YES
 5. NO
 7. DOESN'T HAVE BROTHERS OR SISTERS
 8. DON'T KNOW
 9. REFUSED
-

Q0670

Does anyone else you live with smoke cigarettes?

1. YES
 5. NO
 7. DOES NOT LIVE WITH ANYONE ELSE
 8. DON'T KNOW
 9. REFUSED
-

Q0680

When you watch movies, how often do you see actors or actresses smoking cigarettes? Would you say ...

1. Most of the time,
3. Some of the time,
5. Hardly ever, or
7. Never?
8. DON'T KNOW
9. REFUSED

Q0690

In your opinion, how many adults smoke cigarettes? Would you say...

1. Almost all of them,
2. Most,
3. Some,
4. A few, or
5. None?
8. DON'T KNOW
9. REFUSED

Q0700

How many teenagers your age smoke cigarettes? Would you say ...

1. Almost all of them,
2. Most,
3. Some,
4. A few, or
5. None?
8. DON'T KNOW
9. REFUSED

Q0710

Are adults who live with you allowed to smoke inside your home?

1. YES
5. NO
8. DON'T KNOW
9. REFUSED

Q0720

Are adult guests allowed to smoke inside your home?

1. YES
5. NO
8. DON'T KNOW
9. REFUSED

Q0730

On a scale from 1 to 5, where 1 is not at all hard and 5 is extremely hard, how hard would it be for a teenager, under age 18, to smoke in the following places?

How about on school property?

1. NOT AT ALL HARD
- 2.
- 3.
- 4.
5. EXTREMELY HARD
8. DON'T KNOW
9. REFUSED

INTERVIEWER:

IF RESPONDENT ANSWERS 1 OR 2, CONFIRM BY SAYING:

So it's not very hard for teenagers to smoke on school property?

IF RESPONDENT ANSWERS 4 OR 5, CONFIRM BY SAYING:

So it's quite hard for teenagers to smoke on school property?

Q0740

In restaurants?

CLARIFY IF NECESSARY:

On a scale from 1 to 5, where 1 is not at all hard and 5 is extremely hard, how hard would it be for a teenager, under age 18, to smoke in the following places?

1. NOT AT ALL HARD
- 2.
- 3.
- 4.
5. EXTREMELY HARD
8. DON'T KNOW
9. REFUSED

INTERVIEWER:

IF RESPONDENT ANSWERS 1 OR 2, CONFIRM BY SAYING:

So it's not very hard for teenagers to smoke in restaurants?

IF RESPONDENT ANSWERS 4 OR 5, CONFIRM BY SAYING:

So it's quite hard for teenagers to smoke in restaurants?

Q0750

In a shopping mall?

CLARIFY IF NECESSARY:

On a scale from 1 to 5, where 1 is not at all hard and 5 is extremely hard, how hard would it be for a teenager, under age 18, to smoke in the following places?

1. NOT AT ALL HARD
- 2.
- 3.
- 4.
5. EXTREMELY HARD
8. DON'T KNOW
9. REFUSED

INTERVIEWER:

IF RESPONDENT ANSWERS 1 OR 2, CONFIRM BY SAYING:

So it's not very hard for teenagers to smoke in a shopping mall?

IF RESPONDENT ANSWERS 4 OR 5, CONFIRM BY SAYING:

So it's quite hard for teenagers to smoke in a shopping mall?

Q0760

In a pool hall, arcade, or bowling alley?

CLARIFY IF NECESSARY:

On a scale from 1 to 5, where 1 is not at all hard and 5 is extremely hard, how hard would it be for a teenager, under age 18, to smoke in the following places?

1. NOT AT ALL HARD
- 2.
- 3.
- 4.
5. EXTREMELY HARD
8. DON'T KNOW
9. REFUSED

INTERVIEWER:

IF RESPONDENT ANSWERS 1 OR 2, CONFIRM BY SAYING:

So it's not very hard for teenagers to smoke in a pool hall, arcade, or bowling alley?

IF RESPONDENT ANSWERS 4 OR 5, CONFIRM BY SAYING:

So it's quite hard for teenagers to smoke in a pool hall, arcade, or bowling alley?

Q0770

How about in parks or playgrounds?

CLARIFY IF NECESSARY:

On a scale from 1 to 5, where 1 is not at all hard and 5 is extremely hard, how hard would it be for a teenager, under age 18, to smoke in the following places?

1. NOT AT ALL HARD
- 2.
- 3.
- 4.
5. EXTREMELY HARD
8. DON'T KNOW
9. REFUSED

INTERVIEWER:

IF RESPONDENT ANSWERS 1 OR 2, CONFIRM BY SAYING:

So it's not very hard for teenagers to smoke in parks or playgrounds?

IF RESPONDENT ANSWERS 4 OR 5, CONFIRM BY SAYING:

So it's quite hard for teenagers to smoke in parks or playgrounds?

Q0780

In your home?

CLARIFY IF NECESSARY:

On a scale from 1 to 5, where 1 is not at all hard and 5 is extremely hard, how hard would it be for a teenager, under age 18, to smoke in the following places?

1. NOT AT ALL HARD
- 2.
- 3.
- 4.
5. EXTREMELY HARD
8. DON'T KNOW
9. REFUSED

INTERVIEWER:

IF RESPONDENT ANSWERS 1 OR 2, CONFIRM BY SAYING:

So it's not very hard for teenagers to smoke in your home?

IF RESPONDENT ANSWERS 4 OR 5, CONFIRM BY SAYING:

So it's quite hard for teenagers to smoke in your home?

Q0790

In your best friend's home?

CLARIFY IF NECESSARY:

On a scale from 1 to 5, where 1 is not at all hard and 5 is extremely hard, how hard would it be for a teenager, under age 18, to smoke in the following places?

1. NOT AT ALL HARD
- 2.
- 3.
- 4.
5. EXTREMELY HARD
8. DON'T KNOW
9. REFUSED

T: 20 3

INTERVIEWER:

IF RESPONDENT ANSWERS 1 OR 2, CONFIRM BY SAYING:

So it's not very hard for teenagers to smoke in your best friend's home?

IF RESPONDENT ANSWERS 4 OR 5, CONFIRM BY SAYING:

So it's quite hard for teenagers to smoke in your best friend's home?

Q0800

In a coffee house?

CLARIFY IF NECESSARY:

On a scale from 1 to 5, where 1 is not at all hard and 5 is extremely hard, how hard would it be for a teenager, under age 18, to smoke in the following places?

1. NOT AT ALL HARD
- 2.
- 3.
- 4.
5. EXTREMELY HARD
8. DON'T KNOW
9. REFUSED

INTERVIEWER:

IF RESPONDENT ANSWERS 1 OR 2, CONFIRM BY SAYING:

So it's not very hard for teenagers to smoke in a coffee house?

IF RESPONDENT ANSWERS 4 OR 5, CONFIRM BY SAYING:

So it's quite hard for teenagers to smoke in a coffee house?

Q0810

In a teen dance club?

CLARIFY IF NECESSARY:

On a scale from 1 to 5, where 1 is not at all hard and 5 is extremely hard, how hard would it be for a teenager, under age 18, to smoke in the following places?

1. NOT AT ALL HARD
- 2.
- 3.
- 4.
5. EXTREMELY HARD
8. DON'T KNOW
9. REFUSED

INTERVIEWER:

IF RESPONDENT ANSWERS 1 OR 2, CONFIRM BY SAYING:

So it's not very hard for teenagers to smoke in a teen dance club?

IF RESPONDENT ANSWERS 4 OR 5, CONFIRM BY SAYING:

So it's quite hard for teenagers to smoke in a teen dance club?

Q0820

On the same scale from 1 to 5, how hard would it be to find a place to smoke during school hours?

1. NOT AT ALL HARD
- 2.
- 3.
- 4.
5. EXTREMELY HARD
8. DON'T KNOW
9. REFUSED

INTERVIEWER:

IF RESPONDENT ANSWERS 1 OR 2, CONFIRM BY SAYING:

So it's not very hard for teenagers to find
a place to smoke during school hours?

IF RESPONDENT ANSWERS 4 OR 5, CONFIRM BY SAYING:

So it's quite hard for teenagers to find a place to smoke during school hours?

Q0830

Would you say that cigarettes have gotten more expensive, less expensive or is the price about the same compared to six months ago, or you don't know?

1. MORE EXPENSIVE
3. LESS EXPENSIVE
5. ABOUT THE SAME
8. DON'T KNOW
9. REFUSED

Q0840

For each of the following statements, please tell me if you agree, disagree, or if you're undecided.

Cigarette companies are trying to get young people to smoke.

AGREE - Would you say you strongly agree or somewhat agree?

1. STRONGLY AGREE
2. SOMEWHAT AGREE
3. UNDECIDED

DISAGREE - Would you say you strongly disagree or somewhat disagree?

4. SOMEWHAT DISAGREE
5. STRONGLY DISAGREE
9. REFUSED

Q0870

Cigarette companies get too much blame for young people smoking.

AGREE - Would you say you strongly agree or somewhat agree?

1. STRONGLY AGREE
2. SOMEWHAT AGREE
3. UNDECIDED

DISAGREE - Would you say you strongly disagree or somewhat disagree?

4. SOMEWHAT DISAGREE
5. STRONGLY DISAGREE
9. REFUSED

Q0900

Cigarette companies are making too much money off of young people.

AGREE - Would you say you strongly agree or somewhat agree?

1. STRONGLY AGREE
2. SOMEWHAT AGREE
3. UNDECIDED

DISAGREE - Would you say you strongly disagree or somewhat disagree?

4. SOMEWHAT DISAGREE
 5. STRONGLY DISAGREE
 9. REFUSED
-

Q0930

When someone's angry or nervous, a cigarette can calm them down.

AGREE - Would you say you strongly agree or somewhat agree?

1. STRONGLY AGREE
2. SOMEWHAT AGREE
3. UNDECIDED

DISAGREE - Would you say you strongly disagree or somewhat disagree?

4. SOMEWHAT DISAGREE
 5. STRONGLY DISAGREE
 9. REFUSED
-

Q0960

Cigarettes are good for when a person is bored.

AGREE - Would you say you strongly agree or somewhat agree?

1. STRONGLY AGREE
2. SOMEWHAT AGREE
3. UNDECIDED

DISAGREE - Would you say you strongly disagree or somewhat disagree?

4. SOMEWHAT DISAGREE
5. STRONGLY DISAGREE
9. REFUSED

Q0990

When a person is feeling down, a cigarette
can really make them feel better.

AGREE - Would you say you strongly agree or somewhat agree?

1. STRONGLY AGREE
2. SOMEWHAT AGREE
3. UNDECIDED

DISAGREE - Would you say you strongly disagree or somewhat disagree?

4. SOMEWHAT DISAGREE
 5. STRONGLY DISAGREE
 9. REFUSED
-

Q1020

Cigarettes can help people control their weight.

AGREE - Would you say you strongly agree or somewhat agree?

1. STRONGLY AGREE
2. SOMEWHAT AGREE
3. UNDECIDED

DISAGREE - Would you say you strongly disagree or somewhat disagree?

4. SOMEWHAT DISAGREE
 5. STRONGLY DISAGREE
 9. REFUSED
-

Q1050

Smoking cigarettes as a teenager is likely to cause real harm.

AGREE - Would you say you strongly agree or somewhat agree?

1. STRONGLY AGREE
2. SOMEWHAT AGREE
3. UNDECIDED

DISAGREE - Would you say you strongly disagree or somewhat disagree?

4. SOMEWHAT DISAGREE
5. STRONGLY DISAGREE
9. REFUSED

Q1080

During the past year, did you rehearse ways to refuse tobacco in any of your classes at school?

1. YES
 5. NO
 8. DON'T KNOW
 9. REFUSED
-

Q1090

My last few questions are about you.

What grade are you in?

GRADE

98. NOT IN SCHOOL
 99. REFUSED
-

Q1100

What is the name of your school?

Q1110

Which of the following do you consider yourself to be?

INTERVIEWER: CHECK ALL THAT APPLY

1. African American or Black,
2. American Indian or Alaskan Native,
3. Asian,
4. Hispanic or Latino,
5. White,
6. Or something else? (WRITE IN)
7. REFUSED

Q1120

In an average week, how much money do you get that you can decide how to spend? For example, money from allowance, work, or gifts?

DO NOT READ

1. \$5 OR LESS
2. \$6 - \$10
3. \$11 - \$25
4. \$26 - \$50
5. MORE THAN \$50
9. REFUSED

Q1130

Do you think you will go to college, join the armed forces, get a full-time job, or do you plan to do something else after high school?

1. COLLEGE
2. ARMED FORCES
3. FULL-TIME JOB
4. SOMETHING ELSE
8. DON'T KNOW
9. REFUSED

Q1140

Has the size of your shoe changed in the last 12 months?

1. YES
5. NO (Skip to NAMEADD1)
8. DON'T KNOW (Skip to NAMEADD1)
9. REFUSED (Skip to NAMEADD1)

Q1150

How many sizes has it changed?

1. HALF SIZE
 2. ONE SIZE
 3. ONE AND ONE-HALF SIZES
 4. TWO SIZES
 5. MORE THAN TWO SIZES
 8. DON'T KNOW
 9. REFUSED
-

NAMEADD1 (Records the first name of the teen)

Okay, just one last thing. We'll be sending you a check for \$10.00 within the next couple of weeks. Just to be sure we make out the check correctly, can I get your first and last name?

ENTER FIRST NAME

VERIFY ACCURACY OF SPELLING.
MAKE SURE INFORMATION IS COMPLETE.

NAMEADD2 (Records the last name of the teen)

Okay, just one last thing. We'll be sending you a check for \$10.00 within the next couple of weeks. Just to be sure we make out the check correctly, can I get your first and last name?

ENTER LAST NAME

VERIFY ACCURACY OF SPELLING.
MAKE SURE INFORMATION IS COMPLETE.

GOODBYE

Thank you very much.
We may be talking to you again in about six months.