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A Longitudinal Study of Adolescents' Optimistic Bias about Risks and Benefits of Cigarette Smoking

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Abstract

Objectives—Optimistic bias, a perception that one's own risks are lower than others', can help explain why adolescents smoke cigarettes despite knowing their risks. We examined the extent and changes over time of adolescents' optimistic bias for various smoking-related perceptions of risks and benefits on the aggregate and individual level.

Methods—Longitudinal study (6 measurements over 3 years) of 395 adolescents (mean age 14 years, SD=0.4, at baseline) who rated the chance of occurrence of 19 short- and long-term health risks, social risks, addiction, and benefits related to cigarette smoking for self and comparable others.

Results—Optimistic bias was consistently found only for addiction (83% of comparisons; 37%-60% of adolescents). Addiction-related optimistic bias decreased significantly with time for "still be smoking in 5 years" ($\beta = -2.44$, $p < .001$) and for "become addicted" ($\beta = -1.71$, $p < .001$). This reduction resulted from a greater decrease in perceived risks for others rather than an increase in the adolescent's own perceived risk. For other risks and benefits, adolescents were either realistic or pessimistically biased.

Conclusions—Smoking-related optimistic bias in adolescents was not as prevalent as past studies showed. Anti-smoking interventions targeting adolescents should emphasize the risk of addiction and personal relevance of addiction.

Keywords

optimistic bias; smoking; adolescents; addiction

Cigarette smoking is a behavior that predominantly begins during adolescence.^{1,2} One of the factors that has been linked to smoking initiation is perceived risk of smoking.³ Perceived risk, defined here as perceived likelihood of a negative outcome occurring if one were to

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Human Subjects Statement

An institutional review board at the University of California San Francisco approved all study procedures.

Conflict of Interest Statement

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engage in the behavior, is a key element in explaining individuals' engagement in risk behavior, according to many theories of health behavior such as the Health Belief Model,⁴ Protection Motivation Theory,^{5,6} Theory of Reasoned Action,⁷ Theory of Planned Behavior,⁸ Precaution Adoption Process Model,⁹ Social Cognitive Theory,¹⁰ and the Extended Parallel Process Model.¹¹ These models of health risk behavior have been particularly applied to explanations of adolescents' risk behavior, as adolescents have been characterized as not being able to judge risks accurately.¹²⁻¹⁴

One way adolescents misjudge risks is by perceiving themselves as less susceptible to harm compared to others,¹⁵ a concept known as "optimistic bias." Optimistic bias, also called *unrealistic optimism* or *comparative optimism*, is the perception that one's own risk is lower than the risk of comparable others, and that one is more likely to experience positive outcomes compared to similar others.⁶

Research demonstrates that optimistic bias is pervasive across a variety of negative and positive events and in risk domains such as health, crime, employment, and academics,^{6,16} and occurs in many populations, from adolescents¹⁷ to cancer patients in clinical trials.¹⁸ The ubiquity of optimistic bias led some researchers to conclude that it might be an adaptive evolutionary development, and the neurological evidence from fMRI brain imaging studies demonstrates that people might be hardwired to be optimistically biased.¹⁹ Nevertheless, optimistic bias can be harmful when it results in the adoption of risky behavior (eg, smoking because one perceives low likelihood of harm compared to others) or discounting of protective behaviors (such as using sunscreen).

Optimistic bias might help explain why adolescents begin smoking cigarettes despite generally knowing the risks. However, current research on smoking-related optimistic bias in adolescents has been limited because studies only focused on a few perceptions of risks (eg, just focused on perceptions of harm from smoking).¹⁵ Research has shown that perceptions of lower risk and greater benefits are some of the best predictors of adolescent smoking behavior.^{3,20-23} However, these studies have focused on the absolute perceptions of risks and benefits and not on perceptions of optimistic bias. The current study is the first one to our knowledge to examine the optimistic bias of short-term and long-term outcomes related to health and social risks, addiction, and benefits of cigarette smoking. Furthermore, we evaluate the presence of optimistic bias on both aggregate and individual levels. Optimistic bias has been assessed generally on the aggregate, group level because it is difficult to estimate to what extent an individual's expectations are optimistic.⁶ Just because people on aggregate are optimistically biased does not mean that the majority of people are optimistic. Lacking is an understanding of the extent to which *individual* adolescents are biased, particularly as applied to the domain of smoking. Knowing what percentage of adolescents is optimistic and for which types of outcomes optimistic bias exists will help guide public interventions to target the areas with the highest proportion of optimists and divert scarce public resources from areas in which adolescents already acknowledge vulnerability.

Finally, we know little about whether optimistic bias changes over time. Shepperd, Helweg-Larsen, and Ortega²⁴ looked at changes across events and individuals (at 8 time points across 20 weeks) using college undergraduates and measuring optimistic bias by directly

asking participants if they were at more or less risk than others. They found that participants' comparative risk judgments were consistent across time points. Gerrard, Gibbons, Benthin, and Hessling²⁵ looked at adolescents at 2 time points over 12 months, also measuring optimistic bias via this direct method, but did not actually report how these perceptions change. Looking at changes in optimistic bias over time in adolescents is particularly important because it can help shed light on how adolescents' understanding of risk and their perceptions of risks and benefits change over time, in part, as a function of cognitive and psychosocial development, and in part, due to experience.²⁶ The generally accepted views posit that adolescents cannot judge risks, and they perceive themselves as invulnerable as a result of adolescent egocentrism stemming from cognitive development.^{12,13} Only as they age, adolescents learn to recognize personal risks. Therefore, we would expect optimistic bias to decrease with age. In this study we investigate how optimistic bias changes from age 14 through age 17.

The current study followed a group of adolescents every 6 months from 9th through 11th grade and addressed the following 2 questions: (1) To what extent does optimistic bias exist on the aggregate and individual level for a number of possible short-term and long-term risks, addiction, and benefits associated with smoking cigarettes? (2) Does smoking-related optimistic bias vary over time?

METHODS

Participants and Procedures

Participants in this study were 395 adolescents recruited from 2 Northern California public high schools. Data collection took place during 2001-2004. Recruitment at the 2 high schools occurred one year apart (School A in 2001-2002 and School B in 2002-2003). Study researchers went to classrooms to introduce the study and distribute information and consent forms. Interested students were asked to take the study information home to share with their parents. Assent forms were obtained from student participants, and parental consent forms were obtained from their parents.

The overall response rate, after initial distribution of 790 information and consent packets, was 50.0% at Time 1. The data from School A were collected at 6 time points (Time 1 – Time 6); the data from School B were collected at 4 time points (Time 1 – Time 4). Attrition was 14.7% over the first 4 time points: 395 students participated at Time 1, 364 at Time 2, 349 at Time 3, and 337 at Time 4. In School A, 193 students participated at Time 5 and 217 at Time 6.

Student participants completed a self-administered survey during a regular class period at their school every 6 months for 3 years, totaling 6 time points. The researchers explained the instructions for completing the survey before each survey and were available to answer participants' questions while the survey was being completed. In School A students who consented but were absent on the day of the survey were not surveyed; in School B teachers allowed the research team to leave 12 surveys for the absent students to be completed and mailed. Participants at one school were reimbursed with a movie gift certificate. The

administrators and teachers at the second school were reimbursed with money for school supplies.

At the time of recruitment, participants were 9th graders, and ranged in age from 12 to 15 years ($M=14.0$, $SD=0.40$), 53.4% girls (Table 1 shows participant demographic information). At Time 1, 49 participants (12.5%) reported having smoked a whole cigarette at least once. At Time 2, that number had increased to 54 participants (15.1%), at Time 3 to 62 (18.4%), and at Time 4 to 77 (23.1%). At Time 5 and 6, when data were collected only from School 1, 51 (26.7%) and 57 (29.4%) of participants respectively reported having smoked a whole cigarette.

All procedures were reviewed and approved by the University's Institutional Review Board. Details on procedures can be found elsewhere.^{3,20,27-29}

Measures of Optimistic Bias

Before presenting actual measures of optimistic bias used in this study, 2 methodological issues need to be discussed: measuring optimistic bias directly versus indirectly and with a conditional versus a non-conditional approach.

First, optimistic bias can be assessed either directly or indirectly. The direct method, which has been used more frequently,³⁰ involves asking respondents to rate their risk in comparison to a similar other, such as “my own risk is lower, the same, or greater than the risk of a comparable other.” In contrast, the indirect method asks participants to assign a risk estimate for a similar other and for themselves using separate questions, and the numerical estimates are subtracted from each other and compared. In this study we measured optimistic bias via the indirect method because it is more conservative^{31,32} and, more importantly, better differentiates between perceptions of own and others’ risk. For example, if optimistic bias decreases with age, we would be able to say whether it happens because perceptions of own risk increase, perceptions of others’ risk decrease, or both happen at various rates at various time points.

Second, many of the past studies examining perceptions of risk and optimistic bias were conducted using a non-conditional approach, where participants were asked just to estimate likelihood of risk or benefit, devoid of behavioral context. For example, a non-conditional question would read: “What is your chance of getting a speeding ticket?” whereas a conditional question would read “If you are driving 85 miles per hour on the highway, what is your chance of getting a speeding ticket?” Conditional risk assessments have been shown to be better predictors of behavior than non-conditional assessments.^{33,34} The current study utilized conditional measures of smoking-related risks and benefits.

Participants were given a conditional scenario for themselves and another scenario for a hypothetical other in the same grade and of the same sex. The scenarios provided were: “If you/John/Jill just started smoking 2-3 cigarettes per day...” (short-term smoker) and “If you/John/Jill continued to smoke 2-3 cigarettes per day for the rest of your/his/her life,...” (long-term smoker). After reading the scenarios, participants were asked to provide their estimate of the chance of themselves and the hypothetical other experiencing a variety of short- and

long-term smoking-related risks and benefits. Participants estimated the chances by using any percentage between 0% and 100%. For the short-term smoker, questions were asked about 4 categories of outcomes: social risk, social benefit, health risk, and addiction. The social risk outcomes were: “get into trouble,” “smell like an ashtray,” and “have bad breath.” The social benefit outcomes were: “look cool,” “feel relaxed,” “become more popular,” “look more grown-up,” and “be thinner.” The health risk outcomes were: “get a bad cough,” “have trouble catching your/his/her breath,” and “get bad colds.” The addiction-related outcomes were: “become addicted,” “still be smoking in 5 years,” and “quit if you/he/she wants.” The smoking-related outcomes for the long-term smoker were all health risk outcomes: “get lung cancer,” “get a bad cough,” “have trouble catching your/his/her breath,” “have a heart attack,” and “get wrinkles on your/his/her face.” Past research highlights the importance of delineating between health and social risks and benefits^{20,35} when examining predictors of adolescent smoking; thus, for our paper we wanted to examine perceptions of various social and health risks and benefits separately.

Statistical Analyses

Before conducting our main analyses, we conducted preliminary analyses separately for each school and found that patterns of results remained the same. Therefore, we combined the data for 2 schools in waves 1-4 as was done previously in other studies.^{20,27} The data were not combined in wave 5 and wave 6 because for these waves data were collected only from School A. The data for each time point were examined separately.

To assess prevalence of optimistic bias on a group level, dependent t-tests were conducted to determine whether differences between ratings of risks or benefits for self and others were significantly different from zero. Descriptive statistics were used to assess optimistic bias on an individual levels, and participants were classified as optimists if their perception of risk for self was lower than perception of risk for a comparable other; for benefits, they were optimistic if their perception of benefit was higher for self than for a comparable other.

To assess change in optimistic bias over time, descriptive statistics and repeated-measures ANOVAs were used. In addition, to determine the predictive role of time in changes in optimistic bias and perceptions of own and others' risks, we built an unconditional growth model,³⁶ where time was an independent variable and the intercept and slope were free to vary across individuals. We also built a conditional growth model where sex, race/ethnicity and mother's level of education were entered as fixed effects and smoking experience (having smoked a whole cigarette at each time point) was added as a time-varying covariate. However, for all 3 outcomes (that is, “still be smoking cigarettes in 5 years,” “can quit smoking cigarettes if want to,” and “become addicted to cigarettes”), none of the demographics or smoking experience were significant predictors. Therefore, for parsimony we only report the results of the unconditional growth models. All results were considered statistically significant at the alpha level of .05. All of the analyses were performed with SPSS v.23.0 (Armonk, NY).

RESULTS

Extent of Optimistic Bias at the Group Level

To assess the prevalence of optimistic bias for various perceptions on a group level, we subtracted participants' judgments of their own risk from their judgments for comparable others for each item for each of the 6 waves and then conducted dependent t-tests to determine whether the difference scores were significantly different from zero. Prevalence of optimistic bias measured on the group level is shown in Table 2. Positive numbers with asterisks in Table 2 indicate significant optimistic bias, whereby participants as a group believed they are less likely to experience negative outcomes and more likely to experience benefits compared to the hypothetical other. Negative numbers with asterisks indicate significant pessimistic bias – participants on average perceived themselves to be more likely to experience smoking-related negative outcomes or less likely to experience smoking-related benefits than comparable others. Overall, out of 114 comparisons, optimistic bias was present for only 25 (22%) comparisons. Pessimistic bias was more prevalent; participants were significantly pessimistic in 36 (32%) comparisons. Almost half (46%) of comparisons did not reveal significant bias, showing that participants' perceptions of own risks and benefits from smoking did not differ significantly from perceptions of others' risks or benefits.

Presence of optimistic bias on a group level varied across different types of outcomes. The only area where optimistic bias was consistently present was addiction – across all 6 time points, 83% of comparisons revealed optimistic bias; that is, participants believed that they were less likely to become addicted to smoking than others of their sex and age. Significant optimistic bias for addiction ranged between 3.7 (SD=26.2) for risk of becoming addicted to cigarettes at time 4 to 16.0 (SD=34.5) and 16.0 (SD=30.2) for risks of still smoking cigarettes in 5 years at time 3 and becoming addicted to cigarettes at time 3, respectively. In contrast, optimistic bias was present for 50% of comparisons on social risk of having bad breath, ranging between 2.4 (SD=20.2) at time 2 and 3.8 (SD=19.7) at time 1, one-third of comparisons for social risk of smelling like an ashtray and long-term health risks of getting lung cancer and getting a bad cough. Optimistic bias was present for only one social benefit item (look cool, 2.3 [SD=21.0] at time 2) and was absent for short-term health risks and social benefits items. On the contrary, as a group, adolescents were predominantly pessimistically biased about short-term health risks (especially having many really bad colds from smoking, 83% of comparisons), social benefits (eg, every comparison for feeling relaxed had significant pessimistic bias ranging from -5.1 (SD=31.0) at time 3 to -11.7 (SD=27.8) at time 2), and social risks (eg, participants believed themselves to be more likely to get into trouble for smoking than comparable others across all 6 time points ranging from -7.5 (SD=25.4) at time 1 to -12.3 (SD=35.8) at time 6). For long-term health risks, participants were predominantly realistic: 67% of comparisons did not reveal a significant bias and participants actually became significantly pessimistic about long-term health outcome at Time 6. Thus, only the items related to the risk of addiction consistently showed optimistic bias in adolescents.

Extent of Optimistic Bias at the Individual Level

To assess prevalence of optimistic bias on the individual level, for each outcome across 6 time points each individual was classified as an optimist if they rated their own estimates of risk lower than the estimates for comparable other or rated own estimates of benefits higher than estimates for comparable other. Prevalence of optimistic bias on the individual level is presented in Table 3.

Overall, across all items and 6 time waves, we did not see an overwhelming majority of optimists. Only about one-third (32%) of participants were optimistic. The highest proportion of optimists was present for the addiction items; across different items and all 6 time points, 37%-60% of participants believed their own risk of addiction was lower than the risk of comparable others. On the other hand, only 20% of participants believed that their popularity would increase as a result of smoking as compared to the popularity of someone else who smokes.

Changes in Optimistic Bias over Time

When optimistic bias was measured on a group level, the number of items with significant optimistic bias decreased gradually over time, from 6 and 7 outcomes at T1 and T2 to 4 outcomes at T3 and T4 to 1 at T5 to 3 at T6, respectively (Table 2). Because optimistic bias on a group level was found consistently only for addiction items, we examined overtime changes in optimistic bias only for perceptions of the risk of addiction. As Figure 1 shows, perceptions of the others' risk decreased steadily, but perceptions of own risk dropped sharply first and then stayed about the same, thereby showing that optimistic bias decreased with time. Repeated-measures ANOVAs for the 3 items measuring addiction were significant for 2 of them – “still be smoking in 5 years” and “become addicted.” Figure 1 shows the specific F-values.

Results of unconditional growth models are discussed next. For the item “still be smoking in 5 years,” optimistic bias decreased significantly with time ($\beta = -2.44$, $p < .001$). This change in optimistic bias was mostly accounted for by reduction in the perceptions of this risk for others ($\beta = -4.5$, $p < .001$), which dropped at a greater rate than perceptions of own risk ($\beta = -1.84$, $p < .001$). Likewise, for the item “become addicted,” optimistic bias decreased significantly with time ($\beta = -1.71$, $p < .001$). This change appears to be due to reduction in perceptions of others' risks ($\beta = -4.59$, $p < .001$) which was more substantial than the reduction of perceptions of own risks ($\beta = -2.92$, $p < .001$). Optimistic bias on the item “able to quit” and perception of own and others' risk did not change significantly with time (OB $\beta = -.66$, own risk $\beta = .77$, others' risk $\beta = .22$, $ps > .05$).

Changes in perceptions of own and others' risks and benefits were examined, but are not shown graphically. For all short-term health risks and short-term social risks outcomes, and for almost all short-term social benefits and long-term health risk outcomes, the perceptions of own and others' risks and benefits decreased steadily over time at similar rates. For 3 items (look cool, be more popular, get wrinkles) the perceptions of own and others' risks and benefits did not change across the 6 time points (data not shown).

When optimistic bias was measured on the individual level, overall percentage of optimists across all items showed a decreasing trend over time, from 35% of all participants at Time 1 believing they are less likely to experience risks and more likely to experience benefits than comparable others to 28% of participants at Time 6 (Table 3). Looking at changes in percentage of optimists for each type of outcome (not shown graphically) indicates a general decline in proportion of optimists for both short-term and long-term health risks, as well as benefits. Particularly drastic change in proportion of optimists is evident for beliefs about getting lung cancer if a person smoked 2 or 3 cigarettes a day for the rest of his or her life. At Time 1, 51% of participants were optimistic; that is, they estimated that they were less likely than others to develop lung cancer, but at Time 6 only 23% of participants remained optimistically biased.

DISCUSSION

Despite the importance of optimistic bias to theories and research on adolescent smoking behavior, many gaps remain in our understanding of both the existence and manifestation of smoking-related optimistic bias among adolescents. This study examined the prevalence of optimistic bias in regards to perceptions of risks and benefits of cigarette smoking in a sample of adolescents followed over 3 years, from 9th through 11th grade. Optimistic bias was evaluated on both the group and individual level, and assessed for a number of short-term and long-term health risks, social risks, addiction, and benefits. Results showed that optimistic bias for smoking-related outcomes, as analyzed both at the aggregate and individual levels, was not as widespread as previous studies found.^{37,38} Optimistic bias manifested consistently only for perceptions of the risk of addiction; for other risks and benefits, adolescents were either realistic or pessimistic, believing that bad things are more likely to happen to them as a result of smoking compared to other people. As adolescents grew older, optimistic perceptions of the addiction risk decreased, due largely to decreases in perception of risk for others rather than increases in perceptions of own risk.

This paper extends literature on optimistic bias in several ways. To our knowledge, this is the first study to investigate optimistic bias not only for health risks, but also for perceptions of addiction, social risks, and benefits of smoking, assessing risk on the level of individuals for various outcomes, and tracking those perceptions over time. Some findings were unexpected. Optimistic bias has been a robust finding in many studies of social perceptions.³⁰ However, in our longitudinal study on adolescents' perceptions of risks and benefits of smoking, optimistic bias was found to be far less pervasive than previously reported. Only 22% of items showed optimistic bias when it was assessed on the aggregate (group) level, and only 32% of participants were optimistically biased across items when assessed on the individual level. The comparative scarcity of optimistic bias found in this study could be explained by the fact that we used conditional measures of risks and benefits, asking participants about their perceptions in specific hypothetical situations (eg, "If you continued to smoke 2-3 cigarettes per day for the rest of your life...") rather than asking about their risks in general.³³ A review³⁹ also found that optimistic bias was uniformly present when smokers compared themselves to other people in general or to non-smokers, but when smokers compared themselves to other smokers, optimistic bias was inconsistent. These inconsistencies were explained by national, cultural, secular, and methodological

differences among studies.³⁹ An additional explanation for the lack of optimistic bias in our study could be that we examined optimistic bias in adolescents. Despite commonly held beliefs that adolescents perceive themselves as invulnerable to harm, some research demonstrated the opposite – that adolescents think of themselves as more vulnerable than adults do.⁴⁰ It also could be that realistic perceptions of negative health and social outcomes of smoking have been instilled into adolescents as a result of exposure to multiple public communication campaigns and health outreach efforts. For example, from the original 1967 anti-smoking mass media campaign to the most recent *Tips From Former Smokers*,⁴¹ *truth@*,⁴² and *Real Cost*⁴³ campaigns, messages of negative health consequences of smoking were prevalent in the media.

Anti-smoking media campaigns increase perceptions of risk of smoking.⁴⁴ However, their effects on optimistic bias have been less studied. Some studies found that media messages were able to reduce optimistic bias regarding driving accidents⁴⁵ and consequences of binge drinking.⁴⁶ However, a study on the effects of anti-smoking media messages on optimistic bias showed the opposite effect – young adult smokers in the United Kingdom who saw these messages exhibited greater optimistic bias.⁴⁷ The authors explained this finding by stating that smokers likely reacted defensively to the hard-hitting messages about consequences of smoking. However, to our knowledge, the effect of media messages on reducing smoking-related optimistic bias in adolescents has not been explored yet, and this remains a promising area for future research.

Our results add support to the small but important literature showing that adolescents do not understand addiction and perceive themselves at low risk for becoming addicted.^{20,48} Unlike findings showing that adolescents generally understand long-term smoking-related risks,⁴⁹ research suggests that adolescents lack an understanding of nicotine addiction.⁵⁰ Although it has been shown that adolescents easily become addicted to smoking, with about 20% of adolescents manifesting nicotine dependence symptoms within just one month after initiating smoking,⁵¹ this is not common knowledge among adolescents. Adolescents minimize their risk of addiction, decrease their estimates of addiction risk as they grow older, and perceive less risk of addiction if they smoke.²⁰ Furthermore, adolescents believe that they can quit smoking at any time,²⁰ and believe that addiction is something that is only applicable to adults,⁵² or is a sign of personal weakness and genetic predisposition.⁵³ In our study, when adolescents were asked about their risk of becoming addicted to smoking, they persistently believed that they are much less likely to become addicted than the hypothetical other. In every other area – short- and long-term health risks and negative and positive social outcomes – participants were relatively realistic, judging their chances of getting sick or becoming unpopular as the same or higher than the risks of similar others.

One explanation for why addiction may not be perceived as a salient outcome of smoking by adolescents and why we found consistent optimistic bias for the risks of addiction could be the lack of mass media interventions targeting beliefs about addiction at the time of the study (2001-2004). For example, at the time of study, the Surgeon's General Report¹ mentioned only one mass media anti-smoking campaign that used messages of smoking addiction – the Wisconsin Anti-Tobacco Media Campaign.⁵⁴ Our research and findings from other studies strongly suggest that campaigns targeting perceptions of tobacco-related

addiction in adolescents would be a fruitful area of intervention, and other campaigns, such as FDA's *The Real Cost*⁴³ campaign, have specifically focused on addiction and it would be useful for future studies to evaluate not only how exposure to this campaign's messages affected perceptions of risks of addiction for self, but also how it might have affected adolescents' optimistic bias.

We also found that when optimistic bias was present for the perceptions of addiction it decreased with time. This decrease was due to reduction in estimates of the risks of others, which decreased at a greater rate than the estimates for own risk. Therefore, even when optimistic bias was reduced it happened not because adolescents began to see themselves as more likely to become addicted to smoking, but because they saw others as less prone to becoming addicted. This finding demonstrates the importance of measuring optimistic bias via an indirect method (by asking separate questions about own and others' risk), which allows us to discern the mechanisms behind the time changes in optimistic bias. Furthermore, this finding indicates that interventions aimed at reducing optimistic bias should focus on increasing perceptions of own vulnerability to addiction to counteract the drop in evaluation of others' risks.

Consistent with the literature showing the importance of perceived benefits on adolescent tobacco use,³ this study is one of the first to examine whether adolescents are optimistically biased in their perceptions of benefits of smoking – that is, whether they think good things that come out of smoking (eg, feeling relaxed, looking cool) are more likely to happen to them compared to similar others. We found no evidence of optimistic bias for social benefits of smoking; in contrast, adolescents were pessimistic and thought that overall smoking has few social benefits (chances of positive outcomes of smoking were rated below 50% on average), and that benefits are more likely to befall others than themselves. We can speculate that although adolescents hear about potential benefits of smoking, they discount them as not likely to happen to them. This also could be a result of public communication campaigns emphasizing short-term negative social outcomes of smoking (yellow teeth, bad breath).^{1,55}

Limitations and Directions for Future Research

We only examined smoking-related optimistic bias; therefore, the findings cannot be generalized to other risky behaviors, such as drinking or consuming marijuana, or to other tobacco products, such as electronic cigarettes or hookah. Because the sample consisted of adolescents 14-17 years old, the findings cannot be generalized to the prevalence of smoking-related optimistic bias in earlier or later ages. Our sample contained few African-American participants and had relatively educated parents, further limiting the generalizability of findings. Future research on optimistic bias in adolescents should examine more diverse adolescents and include other products, for example, evaluating optimistic bias about electronic cigarettes, the rates of use of which are now higher than rates of smoking among adolescents,⁵⁶ or evaluating optimistic bias about cigar products among African-American adolescents. In addition, we did not include variables explaining the reasons for optimistic bias or the effects of optimistic bias (or the lack thereof) on health and behavioral outcomes. For example, it should be explored what role positive and negative experiences with cigarette smoking (either personal or vicarious through one's friends) play in changes in

optimistic bias and subsequent behavior over time.²⁰ Changes in optimistic bias with time can be explained by greater experience (as people grow, they experience more negative events, and might adjust their perceptions of risks to become more in-line with reality) or due to developmental changes (adolescents learn to recognize that they hold a cognitive bias and adjust their estimations accordingly). Alternatively, if experience with smoking is positive (or at least not negative), this would account for persistence of optimistic bias.

Conclusion

We found that optimistic bias about risks and benefits of smoking is not as prevalent in adolescents as previously believed. In our study, optimistic bias was found consistently only related to perceptions of risks of addiction. Optimistic bias decreased with time; this occurred mainly due to the reduction in estimates of the level of others' risk. These findings indicate that increasing adolescents' perceptions about their own risk of addiction to smoking might be a fruitful area for future youth-directed smoking interventions aimed to reduce optimistic bias, and subsequently, to reduce smoking.

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Figure 1.
Changes in Optimistic Bias about Cigarette Smoking Addiction in Adolescents over Time
Note.
Data from School A and School B are combined for time points T1-T4, data only from
School A are available for T5-T6.

Table 1

Demographic Characteristics of the Sample at Baseline, Total and by School

	Total	School A	School B
N	395	228	167
Mean Age (SD)	14.0 (.40)	14.0 (.42)	14.02 (.36)
Sex (%)			
Girls	53.4	57.0	48.5
Boys	46.6	43.0	51.5
Race/Ethnicity (%)			
White	47.8	61.8	28.7
Asian	17.0	8.8	28.1
Hispanic	14.7	18.4	9.6
Other	15.0	4.8	28.7
Mother's Education (%)			
High school or less	18.7	14.0	25.2
Some college	21.3	25.0	16.2
College degree or higher	46.4	51.3	39.6
Don't know	11.1	8.3	15.0
Ever Smoked a Cigarette (% yes)	12.5	11.4	14.0

Note.

Data collected in 2001-2002 school year in School A and in 2002-2003 school year in School B. The numbers do not add up to 100% due to missing data and rounding.

Table 2

Means (SD) of Optimistic Bias Measured on a Group Level across Various Outcomes

Outcome	Item	T1	T2	T3	T4	T5	T6	OB	PB
Addiction	Still be smoking cigarettes in 5 years	12.8 (30.7) *	16 (34.5) *	13 (32.5) *	6.6 (31.3) *	1.8 (31.3)	6.5 (31.6) *	83%	0%
	Can quit smoking cigarettes if want to	3.2 (34.3)	10.5 (31.9) *	5.5 (34) *	8.6 (30.1) *	10.1 (30) *	7.3 (28.6) *	83%	0%
	Become addicted to cigarettes	8.1 (27.3) *	16 (30.2) *	7.8 (27.7) *	3.7 (26.2) *	1.4 (28.1)	6 (30.8) *	83%	0%
Short-term health risks	Get a bad cough	1 (25.3)	0.8 (23.4)	-3.7 (25.4) *	-2.6 (24.5)	-0.1 (26.1)	-1.3 (29.2)	0%	17%
	Have a lot of trouble catching breath	-4.3 (27) *	-1.9 (22.3)	-6.1 (26.4) *	-3.5 (24.3) *	-4.7 (25.1) *	-3 (27.6)	0%	67%
	Have many really bad colds	-5.3 (26.6) *	-3.3 (26.7) *	-7.9 (25.7) *	-4.1 (26.3) *	-5.9 (29.8) *	-3.3 (28.5)	0%	83%
Long-term health risks	Get lung cancer	6.5 (21.7) *	2.2 (20.2) *	0.8 (21.1)	1.4 (20.6)	0.6 (23.2)	-6.5 (20.5) *	33%	17%
	Get a bad cough	2.5 (21.5) *	1.8 (17.8)	0.3 (21.9)	2.4 (21.1) *	1.3 (23.5)	-4.2 (24.1) *	33%	17%
	Have a lot of trouble catching breath	1.1 (23.3)	0.8 (17.8)	-5.3 (23.6) *	0 (22.7)	-0.3 (23.5)	-3.1 (22.6)	0%	17%
	Have a heart attack	-0.2 (22.9)	1 (19.7)	-3.8 (24.2) *	-1.4 (22.2)	0.6 (19.4)	-5.4 (21.4) *	0%	33%
	Get wrinkles on her face	1.3 (22.6)	1.2 (19.9)	-1.1 (21.2)	0.5 (22.2)	0.3 (22.9)	-5.1 (20.9) *	0%	17%
Social risks	Get into trouble	-7.5 (25.4) *	-7.8 (26) *	-8.9 (28.2) *	-9.2 (28.1) *	-11.3 (31) *	-12.3 (35.8) *	0%	100%
	Smell like an ashtray	2.1 (17.8) *	3.9 (19.6) *	1.7 (22.9)	2.1 (21.7)	0.9 (23.7)	2.6 (25.7)	33%	0%
	Have bad breath	3.8 (19.7) *	2.4 (20.2) *	3.3 (22.2) *	1.7 (24.1)	-0.6 (23.7)	2.1 (24.2)	50%	0%
Social benefits	Look cool	1.6 (20.7)	2.3 (21) *	1.3 (18.6)	2.1 (23.4)	2.6 (18.3)	2 (22.7)	17%	0%
	Feel relaxed	-10.6 (29.1) *	-11.7 (27.8) *	-8.9 (27.5) *	-9.6 (28.8) *	-5.1 (31) *	-8.2 (30.9) *	0%	100%
	Be more popular	-2.8 (20.3) *	-2.8 (18.6) *	-2.7 (23.4) *	-2.8 (23.7) *	-2.2 (20)	-3.1 (23.8)	0%	67%
	Look grown up	-2.2 (26.4)	-2.1 (25.9)	-1.9 (27.3)	-3.1 (24.8) *	-2.4 (29)	-2 (24)	0%	0%
	Be thinner	-3 (26.3) *	-4.6 (26.8) *	-1.9 (26.1)	-4.3 (27.8) *	-2.1 (26.8)	-2.5 (27.7)	0%	50%

Note.

Cells show the mean difference between perceptions of outcome for oneself and for a comparable other. For the ease of interpretation, positive numbers indicate optimistic bias, negative items indicate pessimistic bias.

OB – Optimistic Bias (percent of times (out of 6) a significant optimistic bias is exhibited for each outcome)

PB – Pessimistic Bias (percent of times (out of 6) a significant pessimistic bias is exhibited for each outcome)

* $p < .05$, dependent t-tests

Table 3

Prevalence of Optimistic Bias Measured on an Individual Level (Percentage of Participants at Each Time Who Expressed Optimistic Bias)

Outcome	Item	T1	T2	T3	T4	T5	T6	Total ^a
Addiction	Still be smoking cigarettes in 5 years	52	54	54	45	37	45	48
	Can quit smoking cigarettes if want to	44	49	45	45	47	44	46
	Become addicted to cigarettes	50	60	51	40	43	45	48
Short-term health risks	Get a bad cough	39	34	30	29	36	32	33
	Have a lot of trouble catching breath	33	30	30	28	30	28	30
	Have many really bad colds	32	35	26	25	31	26	29
Long-term health risks	Get lung cancer	51	33	37	29	37	23	35
	Get a bad cough	42	33	35	36	37	25	35
	Have a lot of trouble catching breath	39	32	27	34	32	33	33
	Have a heart attack	36	36	31	31	32	23	32
	Get wrinkles on her face	34	33	29	28	28	19	28
Social risks	Get into trouble	23	21	22	20	22	21	21
	Smell like an ashtray	27	33	29	29	30	28	29
	Have bad breath	27	33	34	29	26	28	29
Social benefits	Look cool	30	23	22	19	23	20	23
	Feel relaxed	24	21	20	21	31	24	23
	Be more popular	26	19	20	19	16	18	20
	Look grown up	28	29	28	25	24	21	26
	Be thinner	32	32	34	26	36	30	31
Total percentage of optimists^b		35	34	32	29	31	28	32

Note.

^aTotal column indicates the proportion of participants who exhibited optimistic bias for each item, averaged across 6 time points.

^bTotal row indicates the proportion of participants who exhibited optimistic bias at each time point, averaged across 19 outcomes.