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Gender and racial/ethnic differences in adolescent intentions and willingness to smoke cigarettes: Evaluation of a structural equation model

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Abstract

Dual-process theories may be effective at predicting adolescent smoking; however, little is known about the effectiveness of these models across race/ethnicity and gender. Adolescents ($N = 4035$) completed biopsychosocial and tobacco-related perception measures in Grade 7 and reported on smoking initiation in Grade 10. Using structural equation modeling and comparing models by gender and race/ethnicity showed differences, where both intentions and willingness predicted smoking initiation for only Black and male adolescents, compared to their Latino and White and female counterparts. Intentions and willingness appear to play a role in whether an adolescent will initiate smoking in the future, but this does not apply universally across gender and race/ethnicity.

Keywords

adolescent, cigarette smoking, dual-process model, gender, race/ethnicity

An estimated 37.7 million (~16%) adults in the United States were classified as current cigarette smokers in 2016 (Jamal et al., 2018). Most cigarette smoking begins during adolescence, with almost 90 percent of current adult smokers having already tried smoking by age 18 (US Department of Health and Human Services (USDHHS), 2012), and US national data indicate that approximately 2.2 percent of middle (12–13 years old) and 8 percent of high (14–18 years old) school youth are current cigarette smokers (Jamal et al., 2017). Cigarette smoking continues to be the largest preventable cause of death and illness in the United States, and despite significant declines in cigarette smoking over the last few decades, a clear understanding of factors associated with smoking

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during adolescence is still needed and key to reducing smoking prevalence and for preventing smoking initiation.

Numerous biological, psychological, and sociodemographic factors are associated with smoking during adolescence, including gender, race/ethnicity, pubertal status, self-control, self-esteem, parent smoking, parental monitoring, peer smoking, and availability of cigarettes (Chen and Jacobson, 2012; Chuang et al., 2005; Gerrard et al., 2005; Stock et al., 2013; Wills et al., 2013). Adolescents who have early pubertal development, are non-Latino White, have parents or peers that smoke, and have tobacco more easily accessible are more likely to try cigarette smoking, but those with higher levels of self-control, self-esteem, and parental monitoring are less likely.

A great deal of health research has focused on the constructs that health risk behavior represents a deliberate choice and that decisions to engage in such behaviors are made rationally (Gibbons et al., 2012). Examples of theories based on such a "reasoned path" include the health belief model (Rosenstock, 1974), the theory of reasoned action (Fishbein, 1979), and the theory of planned behavior (Ajzen, 1991). However, more recent research has shown that theories focused on reasoned decision making may be more effective at predicting adult health-promoting behaviors and may be less effective at predicting adolescent behavior and risk behaviors like cigarette smoking. Consequently, new dual-process theories, which incorporate emerging neuroscientific research indicating differences in adolescent decision making, have been developed. These dual-process theories incorporate an unplanned or "reactive" path in addition to the "reasoned" path (Gibbons et al., 2012).

One of the dual-process models that is gaining support for use with adolescent risk behavior is the prototype willingness model (PWM; Gerrard et al., 2005; Todd et al., 2014; Wills et al., 2013). The PWM posits that two processes influence health risk behavior: a reasoned or planned path (behavioral intention) and a reactive or unplanned path (behavioral willingness; Gerrard et al., 2005; Gibbons et al., 1998; Wills et al., 2013). The PWM specifically incorporates two new concepts: *willingness* to engage in a behavior and *risk images* based on perceptions of others who engage in the behavior. This theory has been found to be predictive across several adolescent health risk behaviors, including alcohol abuse (Dal Cin et al., 2009) and substance abuse (Gerrard et al., 2005). A meta-analysis found support for the PWM and models based on the PWM across 81 studies examining various health behaviors (Todd et al., 2014).

This study examined all of these factors together in the context of a modified dual-process model (see Figure 1), largely based on the PWM, to predict cigarette smoking (Gibbons et al., 1998). Both intentions and willingness to smoke have been linked to adolescent cigarette smoking (Todd et al., 2014). However, findings about which process is a stronger predictor of adolescent cigarette smoking have been inconsistent (Andrews et al., 2008; Gibbons et al., 1998; Hukkelberg and Dykstra, 2009). Furthermore, previous research focusing on the association between behavioral intentions and actual behavior has found it to be small (van den Eijnden et al., 2006). Results from one longitudinal study indicated that although both childhood intentions and willingness to smoke predicted cigarette smoking 7 years later in high school, intentions were the stronger predictor (Andrews et al., 2008). In contrast, other studies have found that willingness is more strongly associated with smoking compared to intentions (Gibbons et al., 1998) or that only willingness is predictive of smoking initiation (Hukkelberg and Dykstra, 2009).

Previous research also indicates that biological (e.g. pubertal status), psychological (i.e. self-control), and environmental (i.e. parental monitoring and peer tobacco use) factors may influence adolescent tobacco-related cognitions and behaviors. Yet, thus far, only a small number of studies have examined these factors in the context of a dual-process model. Specifically, early pubertal development (Walls and Whitbeck, 2011), decreased self-control (Wills et al., 2013), and having friends who smoke cigarettes (Gerrard et al., 2005) have all been

found to be associated with increased smoking intentions, willingness, and future initiation. In addition, being closely monitored by a parent has been related to decreased smoking willingness and initiation (Gerrard et al., 2005).

Even less is known about the usefulness and effectiveness of dual-process models, such as the PWM, across gender and racial/ethnic groups (Andrews et al., 2008; Wills et al., 2013). We found only one study assessing gender differences for cigarette smoking initiation using a model based on the PWM. Results indicated that the relationship between smoking intentions and initiation 7 years later was stronger for females, but there were no gender differences for smoking willingness (Andrews et al., 2008). National surveys indicate that tobacco use may vary by adolescent gender, with male youth initiating and using tobacco at a higher rate than females (Wang et al., 2018). To our knowledge, no study has examined whether the PWM predicts cigarette smoking across racial/ethnic groups. A substantial and growing body of research has highlighted that drastic differences in health and health behaviors exist for those of different racial/ethnic groups in the United States, further highlighting the need to examine health behavior models with diverse samples to enable comparisons (Barr, 2008). Indeed, only one study has collected data examining substance use (a composite variable of alcohol, drug use, and smoking) from two diverse samples (Wills et al., 2013). However, sample differences were only assessed using simple comparisons of estimates of association, with an evaluation of racial/ethnic differences made by comparing correlations among groups.

Prior research has been further limited by the use of mainly cross-sectional designs. Fewer studies have examined how factors during adolescence predict smoking in later adolescence using longitudinal designs. Finally, despite research indicating a significant relationship of smoking initiation with pubertal status, self-control, self-esteem, parental monitoring, parent smoking, and peer smoking, no study has examined all these potentially important factors jointly to assess their role in the tobacco-related intentions and willingness and smoking initiation. Examination of these factors and their associations with adolescent smoking within the context of a dual-process health behavior theory has the potential to enhance prediction of smoking initiation and may further assist in prevention and cessation efforts.

This study

The aims of this study were to test (1) a modified dual-process model based on previous research and the PWM that identifies how intentions and willingness to smoke predict initiation of cigarette smoking and (2) whether this model applies across male and female, African American/Black, Latino, and White adolescents. The modified PWM tested in this study does not include the concept of *risk images*, which are based on perceptions of others who engage in the behavior. As depicted in Figure 1, we hypothesized that (1) pubertal status, self-esteem, self-control, parental monitoring, parent and peer smoking, availability of cigarettes, smoking intentions, and willingness to smoke measured at Grade 7 would predict initiation of cigarette smoking by Grade 10 and (2) intentions and willingness to smoke would mediate the association between pubertal status, parent and peer smoking, and tobacco availability with initiation of cigarette smoking. Finally, in the absence of a basis for stating hypotheses, we also explored whether the relationships in Hypotheses 1 and 2 would differ among males and females and among African American /Black, Latino, and White adolescents.

Methods

Participants

Data for this project came from the second and third waves of the Healthy Passages™ study, a longitudinal, multi-site study of health and health behaviors in youth (Schuster et al., 2012; Windle et al., 2004). The sample includes youth initially recruited and enrolled during the first

wave of data collection at 10–11 years old (M age = 11.12). Participants were recruited from public schools with ⩾25 students in regular academic classrooms in metropolitan areas of Birmingham, Alabama, Los Angeles, California, and Houston, Texas. Schools and students were selected using a two-stage probability sampling procedure where stratified sampling was used to ensure adequate sample sizes of the three largest racial/ethnic groups: non-Latino African American/Black (Black), Latino, and non-Latino White youth. Of the 11,532 fifth graders eligible for the study, 58 percent of parents agreed to be contacted and receive information about the study, and of these, 77 percent completed the assessment (N = 5147). The sample closely resembled the target population on basic demographic characteristics, and sampling weights adjusted for any selection bias due to differential nonresponse. Overall exclusion criteria included not attending a regular academic classroom or having a caregiver (parent or legal guardian) who could not complete interviews in English or Spanish.

After 2 years, 4773 participants (93% retention) completed the assessment in Grade 7 (T1 in this analysis) of which 4521 (95% retention from T1) completed the assessment in Grade 10, 3 years later (T2). Only participants who identified as being members of one of the three major racial/ethnic groups, Black (36%), Latino (37%), and White (24%), were included in the analysis (n = 4459). Because this study focuses on cigarette smoking initiation between T1 and T2, only participants who had never tried cigarette smoking by T1 (Grade 7) were examined resulting in the analysis sample N = 4035.

Procedure

Following standard procedures approved by the Institutional Review Boards at each of the three data collection sites and the Centers for Disease Control and Prevention, two trained interviewers completed the full assessment protocol with the adolescent participant and one parent/caregiver (biological mother, 87%; father, 6%; other, 6%; hereafter referred to as parent) at their home or another agreed upon location. Informed consent was provided by the parent and the adolescent provided assent. The interviews were conducted using both computer-assisted personal and self-interview procedures with the adolescent and parent separated in private spaces (Windle et al., 2004). Both adolescent and parent were given a choice of completing the interviews in English or Spanish (prepared using committee method translation), with 96% of participants and 83% of parents completing the interview in English at T1.

Measures

Pubertal status (T1) was measured using a revised version of the Tanner scale where participants were asked two gender-specific questions referencing depictions of five pubertal physical development stages (Taylor et al., 2001). Each question has five depictions corresponding to five stages, where stage 1 indicates no pubertal development and stage 5 indicates full pubertal development. The two questions were combined for each participant to create an average score ranging from 1 to 5, where higher scores indicate more advanced pubertal development.

Self-esteem (T1) was measured using the Global Self-Worth subscale from the Self-Perception Profile for Adolescents (SPPA-SW) consisting of six items (Harter, 2012). Items asked the participants to identify which contrasting description fit them best (e.g. "Some teenagers like the kind of person they are, other teenagers often wish they were someone else") and how true it was for them ("sort of true" or "really true"). Each item is scored from 1 to 4 with some item scores reversed, such that the total score ranges from 6 to 24, with higher scores indicating higher self-esteem (α = .62 in this sample).

Self-control (T1) was measured with seven items from the Social Skills Rating System Self-Control subscale (SSRS-SC) reported by the participant's parent (Gresham and Elliott, 1990). Items assessed how often (*never, sometimes*, and *very often*) the participant exhibited

self-control in certain situations (e.g. "How often does your child control his or her temper when arguing with other children?"). The seven items were used as indicators of the latent construct "Self-control" ($\alpha = .81$).

Parental monitoring (T1) was measured using five questions from a previous study (Brown et al., 1993) where participants were asked to indicate on a 4-point scale (1 = *do not know much* and 4 = *know a lot*) how much their parent knew about what they did with their free time (e.g. "How much do your parents know about where you are most afternoons after school?") and who their friends were (e.g. "How much do your parents know about who your friends really are?"). The five items were used as indicators of the latent construct "Parental Monitoring" ($\alpha = .80$).

Parent tobacco use (T1) was measured with one question posed to the participant's parent, "During the past 12 months, how many cigarettes did you smoke per day?" (0 = *none* and 7 = *more than* 30 *per day*). A dichotomized variable was created, where "0 = None" was recoded as a "No" (0) and all other response combinations were coded as "Yes" (1).

Perceived peer smoking (T1) was measured with one question, "How many of your closest friends do you think have smoked cigarettes?" (1 = *none* and 3 = *many*). This was converted into a dichotomized score with 0 = *no peer use* or 1 = *peer use*.

Cigarette availability (T1) was assessed with one question, "Has anyone ever offered you a cigarette?" (0 = *no* or 1 = *yes*).

Intentions to smoke (T1) were measured by asking "Do you think you will smoke cigarettes at any time during the next year?" with responses including 0 = *no*, 1 = *maybe*, or 2 = *yes.* This was recoded into a dichotomized variable with 0 = *no* and 1 = *maybe/yes*.

Willingness to smoke (T1) was assessed with the question "If one of your closest friends offered you a cigarette, would you smoke it?," with responses including 0 = *no*, 1 = *maybe*, or 2 = *yes.* This was recoded into a dichotomized variable with 0 = *no* and 1 = *maybe/yes*.

Cigarette smoking initiation (T2) was measured with the question, "Have you ever tried cigarette smoking, even one or two puffs?" (0 = *no* and 1 = *yes*).

Control variables. The parent-reported highest level of education achieved in the household, which was classified into four categories ranging from less than high school graduation (1) to completion of a college degree or higher (4). Race/ethnicity was based on the parent report about the participant's race/ethnicity; the parent was asked whether any of several Latino designations applied, followed by seven race categories. Using census-style classification, the participant was classified as Latino if so indicated regardless of race category. Others were classified as Black, White, or other (including multiracial/ethnic youth), with the latter category excluded from the analysis. Participant-reported gender (male/female) was also included.

Data analysis

All analyses were conducted with design weights to account for differential probabilities of selection of students according to their school and a cluster variable to account for clustering of students within schools using IBM SPSS Statistics™ Complex Sampling module and M*plus* version 7.4 (Muthén and Muthén, 2012). Weighting accounted for non-participation (by school, race/ethnicity, gender, and combinations thereof) initially and then for dropout, producing unbiased estimates among respondents if the characteristics used in the weights account for all nonresponse bias.

Descriptive statistics and tests for group differences (one-way analysis of variance (ANOVA) and chi-square tests) by gender and race/ethnicity were first conducted. Prior to testing the hypotheses using structural equation modeling (SEM), confirmatory factor analyses (CFAs) were conducted in M*plus* to verify that all measured items would constitute the latent factors *self-control* (seven items) and *parental monitoring* (five items; see Supplementary Materials). Because all items were categorical,

models were estimated with weighted least squares mean and variance adjusted (WLSMV) and theta parameterization. The initial SEM was tested with socioeconomic status (SES) included as a covariate to obtain associations among all latent factors and the observed variables of intentions, willingness, and cigarette smoking initiation and to examine the direct and indirect effects. Mediation in this SEM was determined by the strength and significance of indirect versus direct effects (Cheong and MacKinnon, 2012). The indirect effects were compared by gender and race/ethnicity using the Wald test (Ryu, 2015). Model fit was assessed using the comparative fit index (CFI), Tucker–Lewis index (TLI), and root mean square error of approximation (RMSEA) index.

Using M*plus* (version 7.4), the hypothesized structural model depicted in Figure 1 was tested using SEM. The first step was to test measurement invariance (MI) for the measurement models of the latent variables *self-control* and *parental monitoring* across gender and racial /ethnic groups (a detailed account of the MI process is available in the Electronic Supplementary Material 1). MI testing indicated that the constructs of *self-control* and *parental monitoring* were not comparable across gender or race/ethnicity, suggesting that observed mean differences may not reflect true differences in self-control or perceived level of monitoring by parents. A multiple group SEM was then conducted to address the specific aims and examine whether direct and indirect effects according to Figure 1 were equivalent across racial/ethnic groups and gender. As a part of the MI process, two models were tested and compared using fit indices: (1) an overall baseline model where associations between variables or factors were allowed to be freely estimated across groups and (2) a constrained model where associations were constrained in turn to be equal across gender and racial/ethnic groups. Model fit was assessed using the CFI and change in CFI (ΔCFI), and relative model adequacy was evaluated using the Bayesian information criterion (BIC) and the sample size adjusted Bayesian information criterion (SSABIC; Schwarz, 1978). For ΔCFI, values that are smaller than or equal to –.01 indicate invariance of the current model compared to the previous model (Cheung and Rensvold, 2002) and for the BIC and SSABIC, the model with the lowest relative index is considered to be the optimal model out of those compared. The traditional measure to use for invariance testing is the chi-square, even though it is dependent on the sample size where reasonable models may be rejected if the sample size is large. Consequently, this measure was not used in this study because model estimation was conducted using data imputation procedures, and the included measures capture the scope of the model assessment as well as the more traditional measure (Cheung and Rensvold, 2002).

One T1 predictor variable, pubertal status (5%), the T2 outcome variable, smoking initiation (9%), and two covariates, education (2%) and income (8%), had missing data. Multiple imputation, where 50 imputed data sets were created containing unique and plausible replacement scores that are averaged to produce estimates, was used to estimate these few missing values.

Results

Preliminary analysis and descriptive findings

Descriptive information appears in Table 1 for all study variables by gender and race/ethnicity (for correlations, see Table 1 in the Electronic Supplementary Material 1).

Focusing on the smoking-related cognitions and behaviors of interest in this study, we found that more males (29.9%) had initiated cigarette smoking by Grade 10 compared to females (26.5%; χ^2 (1, n = 3678) = 5.37, p = .04), but there were no significant differences in intentions and willingness to smoke. More Latino adolescents reported having intentions (χ^2 (4, n = 4030) = 23.59, p = .001) and being willing (χ^2 (4, n = 4026) = 19.10, p = .001) to smoke compared to Black and White adolescents. However, there were no racial/ethnic group differences in smoking initiation.

Table 1. Sample characteristics by gender and race/ethnicity.

Categorical variables	Overall		Female	Male	Black	Latino	White
	$N = 4035$		$n = 2058$	$n = 1976$	$n = 1456$	$n = 1486$	$n = 1091$
	Raw *n*	Wtd%	Wtd%	Wtd%	Wtd%	Wtd%	Wtd%
Gender—female	2058	49.3	–	–	48.7	51.3	46.3
Highest education in household							
Less than high school graduate	727	22.8	24.3	21.3	9.0[a]	43.0[b]	1.8[c]
High school graduate	795	21.4	22.2	20.8	28.9[a]	24.2[a]	7.1[b]
Some college or 2-year degree	1088	25.8	25.3	26.3	37.4[a]	22.6[b]	17.6[c]
Four-year degree or more	1368	30.0	28.2	31.7	24.7[a]	10.2[b]	73.5[c]
Parental tobacco use (Grade 7)	840	20.2	20.0	20.4	26.9[a]	16.2[b]	19.4[b]
Believe friends smoke (Grade 7)	1068	27.4	26.5	28.3	31.2[a]	30.4[a]	17.2[b]
Cigarettes available (Grade 7)	446	11.6	11.4	11.9	12.9[a]	13.5[a]	6.5[b]
Willingness to smoke (Grade 7)	149	3.9	4.7	3.2	3.0[a]	5.6[b]	1.9[a]
Intentions to smoke (Grade 7)	176	4.5	4.7	4.3	4.8[a]	5.8[a]	1.7[b]
Smoking initiation (Grade 10)	1032	28.2	26.5[a]	29.9[b]	28.9	27.9	28.0
Continuous variables	*M* (*SD*)		*M* (*SE*)	*M* (*SE*)	*M* (*SE*)	*M* (*SE*)	*M* (*SE*)
Pubertal development	2.48 (0.93)		2.52 (0.03)[a]	2.43 (0.03)[b]	2.69 (0.03)[a]	2.39 (0.04)[b]	2.35 (0.04)[c]
Self-control	9.15 (2.64)		9.06 (0.11)[a]	8.95 (0.13)[b]	9.01 (0.09)[a]	8.32 (0.11)[b]	10.29 (0.13)[c]
Parental monitoring	12.56 (2.48)		12.77 (0.10)[a]	12.22 (0.11)[b]	12.38 (0.10)[a]	11.96 (0.10)[b]	13.62 (0.08)[c]

Wtd: weighted; ANOVA: analysis of variance.
% is calculated with weights to reflect sampling.
[a,b,c]Different superscripts within gender and race/ethnicity subgroups for row variable indicates statistically significant difference between groups as per chi-square tests (gender $p < .025$ and race/ethnicity $p < .017$ per Bonferroni correction) or ANOVA test ($p < .05$).

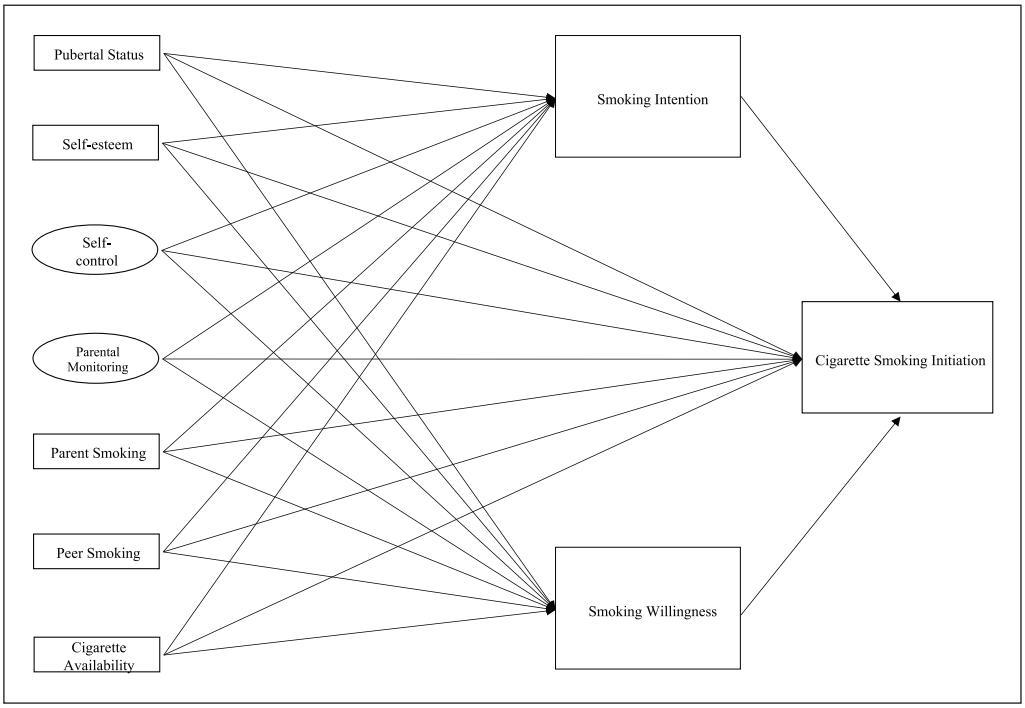

Figure 1. Hypothesized dual-process model to predict initiation of cigarette smoking.

Structural model

Associations. CFA analyses revealed that all observed variables significantly loaded onto their respective latent factors *self-control* and *parental monitoring*, both for the overall sample and for race/ethnicity and gender (see Figures 1 and 2 in the Electronic Supplementary Material 1).

Figure 2 shows the resulting significant paths for racial/ethnic groups and genders combined (RMSEA = .05, CFI = .77, and TLI = .73). Although the CFI and TLI values do not meet conventional criteria, where values less than <.80 indicate poor fit, the RMSEA value indicated good fit (Hu and Bentler, 1999). It is recommended to use more than one measure of fit (Hutchinson and Olmos, 1998), and taken together, all fit criteria combined suggest an adequate model fit. With all variables (including SES) in the overall model, 7 percent of the variance in cigarette smoking initiation was explained (R^2 = .07). Seventh grade smoking intentions and willingness to smoke significantly predicted cigarette smoking initiation by Grade 10 (p = .001 and p = .04, respectively). Cigarette smoking initiation was also predicted by having parents who smoked (p = .001), believing cigarettes to be available (p = .001), having friends who smoked (p = .001), and having a more mature pubertal development in Grade 7 (p = .001). Increased parental monitoring was associated with both decreased smoking intentions and willingness to smoke in Grade 7 (p = .001 and p = .004, respectively), and higher self-esteem was associated with decreased willingness to smoke (p = .005). Finally, reporting that friends smoked and perceiving cigarettes to be available was associated with increased intentions (ps < .001) and willingness to smoke (p = .001 and p = .006, respectively).

Gender differences. Although the multi-group model, testing for equivalence across gender, fit the data adequately (RMSEA = .05, CFI = .76, and TLI = .75) and fit indices indicated invariance (ΔCFI = .01, ΔBIC = −91.51, and

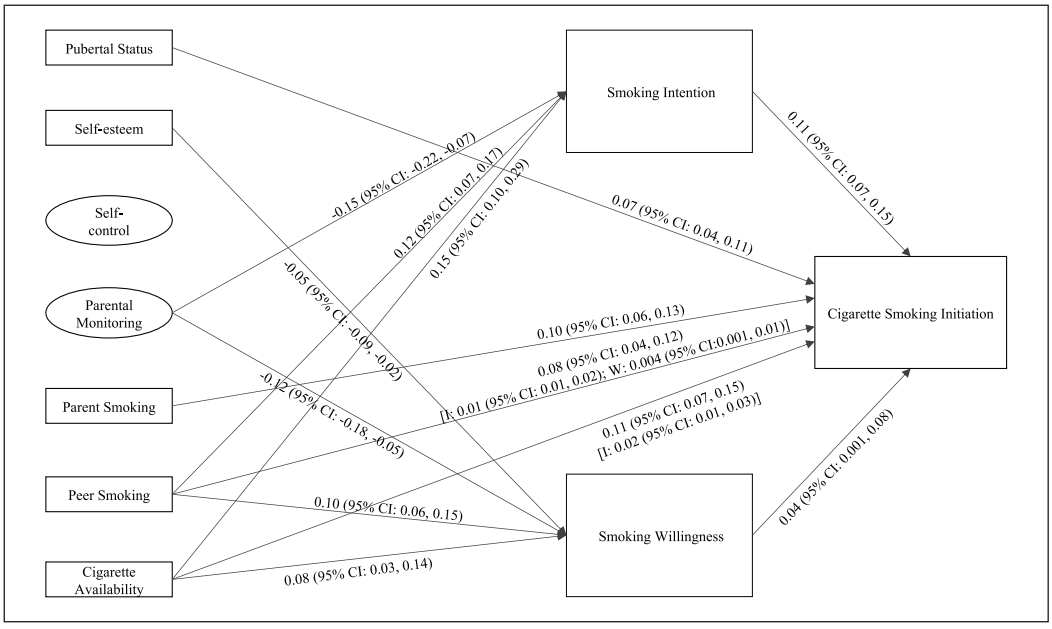

Figure 2. Overall dual-process model with significant paths to predict initiation of cigarette smoking (controlling for SES).
CI: confidence interval; I: intentions; W: willingness.
All variables except initiation were measured at Grade 7. Square brackets indicate indirect effects. All estimates in the figure are significant at $p < .05$.

ΔSSABIC = −12.06), further examination of the path coefficients for females and males revealed some significant differences. Eight percent of the variance in cigarette smoking initiation was explained by variables for the male model ($R^2 = .08$) and 6 percent in the female model ($R^2 = .06$). As shown in Figure 3, intentions to smoke in Grade 7 positively predicted smoking initiation for both males and females, but willingness to smoke only for males.

Having a more mature pubertal development was associated with increased smoking intentions and predicted smoking initiation for males, but not females, and high self-control was associated with decreased smoking intentions for females, but not males. Higher level of parental monitoring was associated with fewer intentions and less willingness to smoke for males, but not females. Higher level of self-esteem was associated with decreased willingness to smoke for males only, and having friends who smoked was associated with smoking intentions for only females. The perception that cigarettes were available was associated with increased willingness to smoke for females, but not males.

Racial/ethnic group differences. Results from the multiple group SEM to assess differences by racial/ethnic group indicated poor fit for the multi-group model (RMSEA = .05, CFI = .65, and TLI = .64), with fit indices indicating lack of invariance across groups (ΔCFI = .05, ΔBIC = −208.40, and ΔSSABIC = −367.28). In total, 10 percent of the variance in cigarette smoking initiation was explained by variables in the model for White adolescents ($R^2 = .10$), which was reduced to 8 and 6 percent for the Latino and Black models, respectively (R^2s = .08 and .06).

As shown in Figure 4, intentions to smoke in Grade 7 predicted smoking initiation for Black and Latino, but not White adolescents, and willingness to smoke only predicted smoking for Black adolescents. Having more pubertal

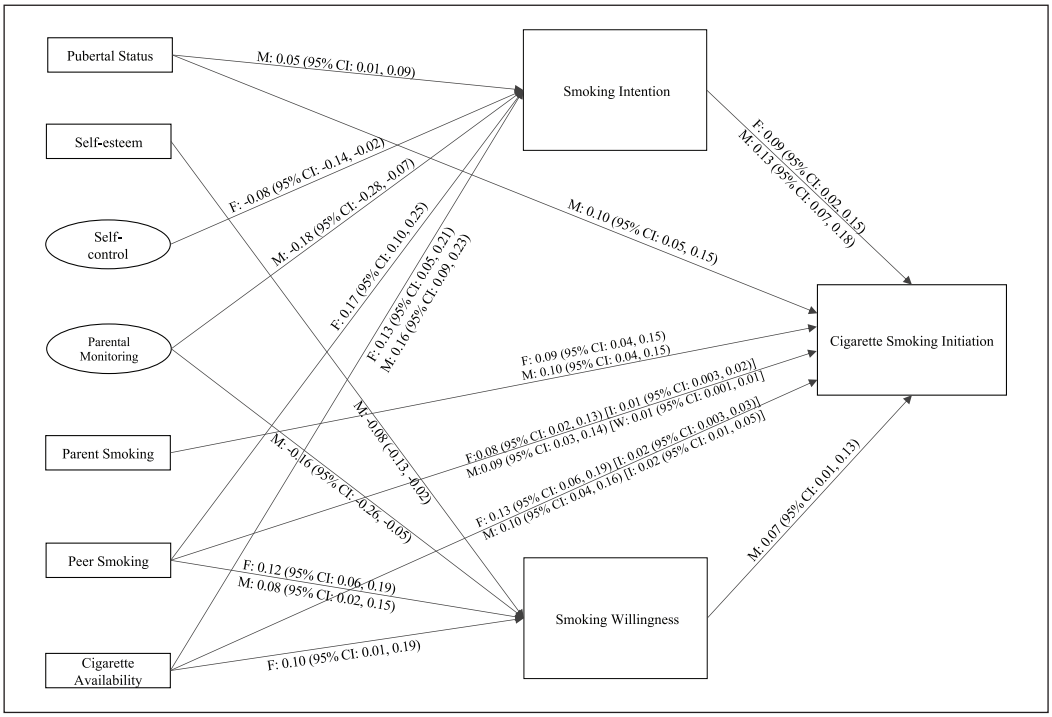

Figure 3. Dual-process model with significant paths to predict initiation of cigarette smoking across gender.
CI: confidence interval; F: female; I: intentions; M: male; W: willingness.
All variables except initiation were measured at Grade 7. Square brackets indicate indirect effects. All estimates in the figure are significant at $p < .05$.

development and friends who smoked predicted smoking initiation for Latino and White, but not Black adolescents.

Self-esteem was negatively associated with smoking intentions for Latino adolescents and with willingness to smoke for Black adolescents. Believing cigarettes to be available was associated with increased intentions to smoke for Black, Latino, and White adolescents, but only associated with willingness for Black adolescents. Having friends who smoked was associated with increased willingness to smoke for Black and Latino adolescents and increased smoking intentions for Latino and White adolescents.

Mediation. The hypothesized mediation, where intentions and willingness to smoke mediated the association between pubertal status, parent and peer smoking, and tobacco availability with initiation of cigarette smoking, was partially supported. Intentions partially mediated the relationship between peer smoking and smoking initiation for the overall sample ($p < .001$), females ($p = .002$), and Latino ($p = .001$) adolescents in the multiple group SEM, but not for male, Black, and White adolescents. Intentions also partially mediated the relationship between the perception that cigarettes were available and smoking initiation for the overall sample ($p < .001$), Black ($p = .02$), and Latino ($p = .03$) adolescents, but not for White adolescents. Willingness partially mediated the association between peer smoking and smoking initiation for the overall sample ($p = .04$) and males ($p = .03$), but not females. Wald tests compared the indirect effects by gender (female and male) and race/ethnicity (Black, Latino, and White). Results indicated that the indirect effects were not significantly different between females and

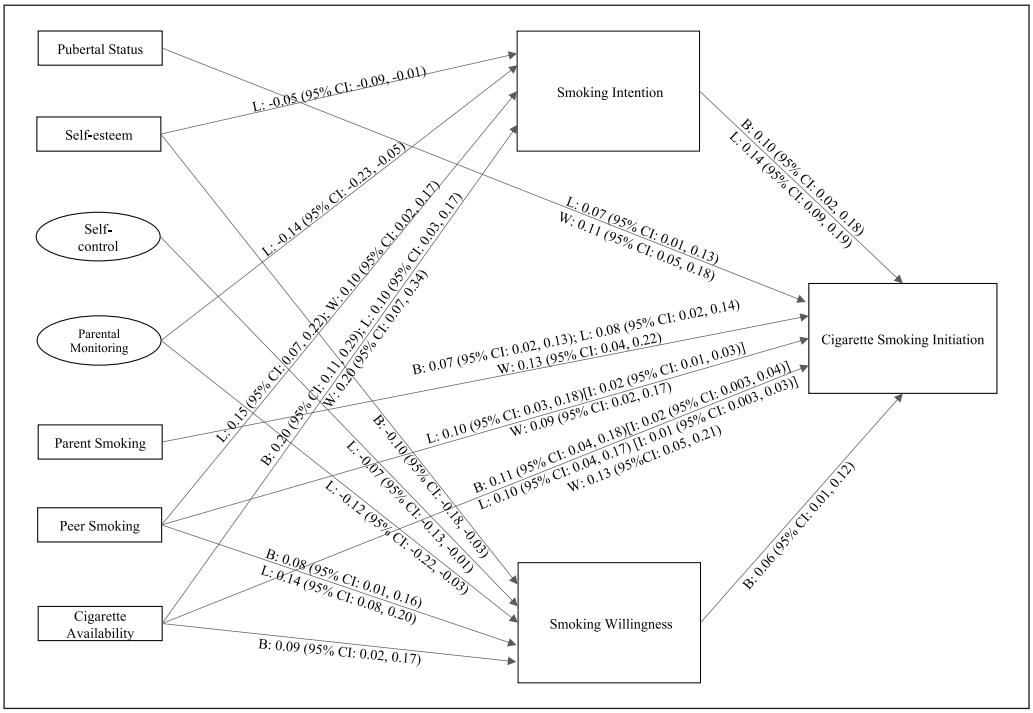

Figure 4. Dual-process model with significant paths to predict initiation of cigarette smoking across race/ethnicity.

B: Black; CI: confidence interval; L: Latino; I: intentions; W: White.

All variables except initiation were measured at Grade 7. Square brackets indicate indirect effects. All estimates in the figure are significant at $p < .05$.

males (Wald test estimate = 5.31, $p = .50$) and not significantly different among Black, Latino, and White participants (Wald test estimate = 7.339, $p = .29$).

Discussion

Our examination of the modified dual-process model revealed that, for the overall sample, the dual pathways of smoking intention and willingness reported at Grade 7 predicted cigarette smoking initiation by Grade 10. Findings indicated that intentions were the stronger predictor of smoking initiation compared to willingness, supporting findings in one previous study (Andrews et al., 2008). Parental, peer, and community factors were more influential on these smoking-related cognitions for the overall sample compared to biological and psychological factors. Contrary to expectations from prior research, pubertal status, self-control, and self-esteem were generally not associated with smoking intentions and willingness (Wills et al., 2011, 2013). Our study did find that greater smoking initiation was predicted by decreased parental monitoring, having parents or friends who smoked, and the perception that cigarettes were available. Consistent with previous research (Andrews et al., 2008; Gerrard et al., 2005; Hukkelberg and Dykstra, 2009), these were also associated with intentions and willingness to smoke.

An important focus of this study was to examine gender and racial/ethnic differences in the dual-process model of associations between smoking and smoking-related variables. Findings indicated that the model was not equivalent across racial/ethnic or gender groups. In this

study, the finding that the model differed across gender is in contrast to findings in an earlier study (Andrews et al., 2008). Differences may be due to the previous study enrolling a racially /ethnically homogeneous (predominately White) sample drawn from one region in the Northern United States. Because no previous studies have examined racial/ethnic differences in a dual-process model of smoking initiation, our finding that both intentions and willingness to smoke were predictive of smoking initiation among only Black adolescents is novel. This finding may reflect racial/ethnic differences in how health cognitions influence health behavior. For some groups, risk behaviors, like smoking cigarettes, may be initiated after plans are made to try that behavior, while for other groups these behaviors may be both planned and reactive given a motivating situation. For Black adolescents, both level of stress and racial identification, meaning how much one identifies with one's racial/ethnic group, have been shown to influence tobacco use. Although not measured in this study, it may be that either or both low levels of racial identification and high levels of stress may increase the likelihood of unplanned or reactive behaviors such as trying cigarette smoking (Stock et al., 2013).

When comparing the model by gender, findings revealed the model to be similar as for the overall sample with both females and males combined; however, associations between individual variables did vary. Intentions and willingness were only predictive of smoking initiation 3 years later for males, which is contrary to previous work (Andrews et al., 2008) where gender differences were not found among the associations of smoking intentions, willingness, and initiation. Only parent and peer factors were associated with smoking intentions, willingness, and initiation. However, the exact associations did vary for males and females. For females, only peer smoking was associated with smoking intentions and willingness, whereas for males, parental monitoring emerged as more influential. This is partially supported by previous work and theory that social influences, such as peer smoking, are more important for females compared to males (Andrews et al., 2008; Mason et al., 2014). For males, parental monitoring was important (Steinberg et al., 1994).

In contrast to the overall findings, the same pattern did not emerge when comparing racial /ethnic groups. Both psychological (i.e. self-esteem) and social factors, including parental monitoring, parent and peer use, and cigarette availability, emerged as important correlates of smoking intentions, willingness, and initiation, but as with gender, the specific relationships varied by race/ethnicity. Consistent with this study, previous research has indicated that being more advanced in pubertal development is a risk factor for cigarette smoking for Latino and White youth (Walls and Whitbeck, 2011). Our finding that self-esteem was associated with smoking-related cognitions for Latino adolescents is in line with prior work indicating that "self-attitudes" (i.e. self-esteem) may be especially relevant for Latino adolescents (Wills, 1994). Consistent with the literature, for Latino adolescents, the level of monitoring by parents was influential for smoking-related cognitions (Mahabee-Gittens et al., 2012). As in previous research, our study found that for White adolescents, peer influence was strongly related to both smoking intentions and initiation, whereas tobacco availability was important for Black adolescents (Headen et al., 1991).

This study is one of the first to examine the association of biological, psychological, and social factors with cigarette smoking intentions, willingness, and initiation in a racially/ethnically diverse sample of adolescents using a prospective longitudinal design. The findings have implications for future dual-process theory and tobacco-related research as well as tobacco policy. That both the dual-process pathways of intentions and willingness predicted cigarette smoking initiation 3 years later for only certain racial/ethnic and gender groups may call into question how we use health behavior theory to predict risk behaviors, such as smoking, among diverse youth. Our findings suggest that approaches targeting different processes may be needed in different groups. While we found

differences when examining the model by gender and race/ethnicity separately, previous research has also shown that there may exist differences within racial/ethnic subgroups by gender (e.g. Black females compared to Black males and females from other racial/ethnic groups). An important direction of future research will be to examine model differences when accounting for both gender and race/ethnicity simultaneously.

Smoking prevention efforts need to be initiated in primary school (K-6 grade) and may be especially critical for male and Black youth, where initial research has indicated that targeting social images and willingness to smoke might be particularly effective (Gerrard et al., 2005). The shift toward addressing cigarette smoking on a population level through smoke-free laws and public bans has also been effective, but has not completely eliminated this dangerous health behavior. It may be that general population-level policies will not fully work and instead we may need to consider turning toward more group-tailored approaches to enhance prevention of tobacco use. Future research needs to examine the effectiveness of commonly used health behavior theories in informing prevention approaches that work for different groups, especially concerning race/ethnicity. In the absence of empirically demonstrated group invariance, we can no longer assume these to be universal.

Among the limitations of this study are that data were drawn from a sample of youth in three specific urban regions of the United States, which is not representative of the national adolescent population. Latinos in this study were mainly recruited from two cities that represent a heritage primarily from Mexico, further limiting generalizability to the overall national Latino population. All measures were obtained by self-report, including cigarette smoking, and future studies may benefit from verifying cigarette smoking through biological measures such as cotinine. A specific measure of an adolescent's social image of a smoker (or prototype), which is often included in PWM research, was not available to us. Previous research has indicated that prototypes are predictive of willingness to smoke which may reduce the overall predictability of initiation of cigarette smoking by the current model. Finally, only report of cigarette smoking initiation was included as the outcome. Other key tobacco-related outcomes, such as number of cigarettes smoked per day or time until smoking after waking up in the morning, if included, could be informative as well.

In conclusion, our research shows that both intentions and willingness appear to play important roles in whether an adolescent will initiate cigarette smoking, but these factors may not apply uniformly across gender and race/ethnicity. Given a growing body of research that highlights drastic differences in health risk behavior by racial/ethnic groups (Adler and Rehkopf, 2008; Fagan et al., 2007; Leischow et al., 2000), that current racial/ethnic minority groups are projected to be the majority among youth soon, and that the societal costs of smoking are high, effective health behavior theory informing effective intervention efforts is needed to curb this preventable cause of mortality and morbidity.

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Supplemental Material

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