



Published in final edited form as:

*J Child Adolesc Subst Abuse*. 2009 ; 19(1): 48–65. doi:10.1080/10678280903400644.

## Examination of a Process Model of Adolescent Smoking Self-Change Efforts in Relation to Gender

**Laura MacPherson, Ph.D.** and

University of Maryland, Department of Psychology, CAPER Research and Treatment Clinic, 2103 Cole Field House, College Park, MD, 20742

**Mark G. Myers, Ph.D.**

VA San Diego Healthcare System & University of California, San Diego, Psychology Service 116B, Veterans Affairs San Diego Healthcare System, 3350 La Jolla Village Drive, San Diego, CA, 92161

Laura MacPherson: lmacpherson@psyc.umd.edu; Mark G. Myers: mgmyers@ucsd.edu

### Abstract

Little information describes how adolescents change their smoking behavior. This study investigated the role of gender in the relationship of motivation and cognitive variables with adolescent smoking self-change efforts. Self-report and semi-structured interview data from a prospective study of smoking self-change efforts were examined among 98 adolescent smokers ages 14–18 (55% female). Social disapproval motives and short-term consequence reasons for quitting, quit self-efficacy and intentions to quit were modeled in relation to prospective self-quit attempts assessed at a 6-month follow-up, separately by gender. Hypothesized mediating relationships were not supported although gender differences were noted. Social influence motives related to intention to quit and prospective self-quit attempts among girls. For boys, intention to quit predicted making a self-quit attempt. Findings emphasize the importance of examining adolescent models separately by gender and contribute to understanding of mechanisms involved in adolescent smoking change efforts.

### Keywords

adolescent; smoking; process model; self-change; gender

### Introduction

Cigarette smoking among adolescents remains a major public health concern given the frequent persistence of this behavior into adulthood, resulting in significant health risks. Yet, investigations of adolescent smokers consistently indicate the majority are seriously thinking about quitting and frequently attempt to modify cigarette smoking behaviors without formal treatment (i.e., engage in self-change efforts such as quit attempts) (Burt & Peterson, 1998; Sussman et al., 1998b; Holden, Hund, Gable, & Mowery, 2003). However, little is known about the self-change process in youth or about potentially important factors such as gender that may influence self-change efforts. Gender differences exist in endorsement of reasons for quitting smoking among youth (e.g., Fisher, Stanton, & Lowe, 1999; Reidel, Robinson, Klesges, & McLain-Allen, 2002; Sussman et al., 1998a) and gender may be an important moderator in adolescent smoking intervention response (e.g., Dino, Horn, Goldcamp, Fernandes, Kalsekar, & Massey, 2001) despite that gender differences in rates of smoking self-change efforts among youth have been equivocal (Sussman et al., 2002). Thus, better understanding of how gender influences the process of smoking self-change can inform the development of smoking cessation programs for adolescents.

Current models of substance use behavior change were developed on adults and thus may not adequately capture the adolescent self-change process. To address this issue, Brown (2001) has adapted the developmental social information processing model (Coie & Dodge, 1998) for the study of youth addictive behavior self-change (Brown, 2001; Brown, Anderson, Schulte, Sintov, & Frissell, 2005). Brown's (2001) model proposes that proximal cognitive and motivational states influence use of a substance within a social context. As proposed in this model, there is a key distinction in factors contributing to initial engagement in substance use self-change (i.e., quit attempts) vs. those necessary to maintain behavior change (cessation). Engaging in a quit attempt is considered one goal of adolescent smoking interventions targeting motivation enhancement (e.g., Brown et al., 2003; Myers & Brown, 2005). The question of what motivates an adolescent smoker to attempt to quit (e.g., Burt & Peterson, 1998; Myers, Brown, & Kelly, 2000) has received less attention relative to investigations of what predicts length of a quit attempt or 'cessation' per se for this group (e.g., Ellickson, Tucker, & Klein, 2001b; Sussman & Dent, 2007; Zhu, Sun, Billings, Choi, & Malarcher, 1999). Based on Brown's (2001) model, proximal factors hypothesized to influence engaging in a quit attempt include reasons for quitting, intentions to quit, quit self-efficacy, and expectations regarding outcomes of attempted behavior change. Clearer delineation of gender differences in the smoking self-change process can inform treatment to increase cessation success among adolescents.

Gender differences in adolescents' reasons for quitting have been examined in a handful of studies (Aung, Hickman, & Moolchan, 2003; Fisher et al., 1999; Peters, Kelder, Prokhorov, Agurcia, Yacoubion, & Essien, 2006; Riedel et al., 2002; Sussman et al., 1998a) and suggest social influence and approval/disapproval motives, such as appearance-related reasons for quitting and reasons connected to family and friends, may be more important for adolescent girls (e.g., Fisher et al., 1999; Peters et al., 2006; Riedel et al., 2002; Sussman et al., 1998a). These findings are consistent with studies reporting that perceived peer and familial smoking behavior and attitudes may be more influential on adolescent girls' smoking behavior (Flay, Hu, & Richardson, 1998; Wagner & Atkins, 2000) and cessation efforts (Ellickson et al., 2001b). Alternatively, short-term consequence or immediate reinforcement motives, such as performance, physical activity, and monetary motivators may be more important for boys (e.g., Aung et al., 2003; Peters et al., 2006; Turner & Mermelstein, 2004). Finally, future health concerns are the most commonly reported reasons for quitting in youth but gender differences across these motives have been equivocal (Aung et al., 2003; Riedel et al., 2002; Turner & Mermelstein, 2004).

However, these studies are primarily descriptive and cross-sectional in nature. We were able to identify only one study that has prospectively examined reasons for quitting in relation to smoking cessation among adolescents taking into account the role of gender. Turner & Mermelstein (2004) examined the interaction of three individual motives for quitting smoking (sports, appearance, smell) with gender in relation to seven-day point abstinence following a smoking intervention but found no significant interaction effects. Yet, it would likely be more appropriate to assess reasons for quitting smoking in relation to quit attempts rather than cessation outcomes (Brown, 2001; McCaul et al., 2006). In addition, analyzing individual items may fail to capture the collective influence of related motives. Understanding the prospective relation between broad dimensions of motives and (e.g., social influences) and behavior change variables (e.g., quit attempts) can provide important information as to the constellation of factors that may simultaneously motivate adolescents' purposeful efforts at change. Gender differences in a prospective relationship between motives and quit attempts among adolescent smokers not currently participating in smoking treatment have yet to be examined.

Although both self-efficacy to quit (Ellickson et al., 2001b) and intention to quit (Sargent, Mott, & Stevens, 1998) have been found to be prospectively related to adolescent cessation outcomes, their relationship to smoking self-quit attempts or the extent to which this relationship may differ across gender in youth is less well known. Quit self-efficacy predicts intention to quit (Friestad & Rise, 1998) and stage of change (Engels, Knibbe, DeVries, & Drop, 1998) in youth. With few exceptions (Ellickson et al., 2001b; Woodruff, Conway, & Edwards, 2008), an omission in the adolescent empirical literature is the lack of prospective investigations of quit self-efficacy in relation to actual attempts at smoking behavior change. Among studies that examined gender differences in self-efficacy, some studies reported no differences (Fagan et al., 2003; Stanton et al., 1999; Solomon, Bunn, Pirie, Worden, & Flynn, 2006), while another reported girls higher on self-efficacy than boys (Stanton et al., 1996). No studies were identified that examined the relationship between self-efficacy and adolescent smoking quit efforts prospectively taking gender into consideration as a potential moderator.

Consistent with the Theory of Planned Behavior (Ajzen, 1991), intention to quit predicts adolescent smoking cessation outcomes (Ellickson, McGuigan, & Klein, 2001a; Sargent et al., 1998). A difficulty in summarizing studies examining intentions in relation to adolescent cessation efforts is that some have measured intention to *smoke* in relation to cessation outcomes (e.g., Ellickson et al., 2001a; 2001b; Sussman & Dent, 2007) while others have examined intention to *quit* (Sargent et al., 1998). Again, intentions to quit have rarely been examined prospectively in relation to adolescent smoking self-quit attempts versus cessation outcomes (i.e., not smoking in the past 30 days; Sussman & Dent, 2007). Among the few studies that have examined gender in relation to smoking intentions, one reported no gender differences in intentions to quit (Friestad & Rise, 1998), while others identified a greater percentage of adolescent girl smokers than boy smokers intended to quit in the next year (Fagan et al., 2003; Stanton et al., 1999). Finally, quit self-efficacy and intentions to quit have yet to be integrated with reasons for quitting in a process model predicting adolescent smoking self-quit attempts or taking the role of gender into account.

The current study examines the role of gender in a prospective process model of motivation and cognitive variables for adolescent smoking self-quit attempts. Based on the social cognition model of addictive behavior self-change, reasons for quitting, quit self-efficacy and intention to quit were examined prospectively in relation to smoking self-quit attempts among adolescent boys and girls. It is expected that processes of smoking self-change efforts will differ across gender and thus models will be examined separately within gender. To our knowledge, this is the first study to prospectively examine reasons for quitting with other social cognitive variables in relation to adolescent self-change smoking cessation attempts while addressing the potential role of gender.

For adolescent girl smokers, it is expected that: 1) the relationship between social disapproval (i.e., social influences) motives for quitting, quit self-efficacy, and smoking self-quit attempts will be partially mediated by intentions to quit smoking. Further, due to the anticipated lower relative salience of immediate reinforcement motives for quitting for girls, 2) it is expected that the relationship between short-term consequence (i.e., immediate reinforcement) motivators and smoking self-change efforts will be fully mediated by intention to quit. See Figure 1. For adolescent boy smokers, the framework of the anticipated process model is the same but with the roles of the social approval and short-term consequence motivation reversed. Thus, it is expected that 3) the relationship between short-term consequence motivators, quit self-efficacy, and smoking self-quit attempts will be partially mediated by intentions to quit smoking and that 4) the relationship between social approval motives and smoking self-change efforts will be fully mediated by intention to quit. See Figure 2.

Other theoretically important variables likely predict smoking self-quit attempts in youth, such as age and ethnicity, peer smoking, current smoking behavior, level of nicotine dependence, and quit history (Sussman & Dent, 2007). Thus, we also examined the relationship between each of these variables and quit attempts, and included any variables found to be significant as control variables to examine the unique predictability of the process model within boys and girls.

## Methods

### Procedure

This study employed data from a sample of 14 to 18 year old adolescent smokers ( $N = 109$ ) participating in a longitudinal pilot study of adolescent smoking cessation self-change. Data were collected at baseline and at a 6-month follow-up through a combination of in-person structured interviews and self-report questionnaires. One hundred and nine adolescents were recruited from 3 high schools in metropolitan San Diego. Criteria for subject inclusion in the present study were: 1) 14–18 years of age and 2) having smoked cigarettes in the prior 30 days. Informed consent (assent for minors under age 18) was obtained from parents and adolescent participants. So as to maintain confidentiality, parents were not informed of their child's smoking status during the consent procedure. As an incentive for participation, each participant received a \$25 gift certificate for participation in the baseline and a \$35 gift certificate upon completing the follow-up assessment. Ninety-nine participants completed the 6-month follow-up interview, resulting in a 91% follow-up rate.

Included in the present study were 98 adolescents who had completed both the baseline and six-month follow-up interviews. One participant who completed both interviews was excluded from the present analyses due to having made a quit attempt prior to the baseline interview and not resuming smoking as of the follow-up interview. The included participants were on average 16.8 years of age ( $SD = 1.0$ ; range 14.3 – 18.8), 55% ( $n = 54$ ) were females, and 71% were White, 8% Hispanic, 6% Asian-American, 13% of Mixed background (primarily White & Hispanic) and 2% of other ethnicity. Participants who were unable to be contacted for follow-up or who declined participation in the follow-up interview ( $n = 10$ ) did not differ significantly from the current sample on age, gender, ethnicity, past 30 day smoking quantity and frequency, or level of nicotine dependence at baseline. Males ( $n = 44$ ) and females ( $n = 54$ ) who completed the follow-up interview differed significantly ( $p = .02$ ) only on age, with girls on average 6 months younger than boys. See Table 1 for demographics and smoking history.

All cognitive and motivational constructs, as well as potential control variables (peer smoking, current smoking behavior, level of nicotine dependence, and quit history) were assessed at baseline. The dependent variable was reporting a quit attempt assessed at the 6-month follow-up.

### Measures

**Predictors—Reasons for quitting smoking** were assessed using the 16-item Adolescent Reasons for Quitting Smoking measure (ARFQ; Myers & MacPherson, 2008) that was developed on a sample of adolescent smokers including participants in the present study. Items were scored on a 5-point Likert-type scale (unimportant to extremely important) reflecting importance for quitting. The measure contains three factors, (1) Short-term consequences (9 items), (2) Social disapproval (5 items) and (3) Long-term concerns (2 items). See Table 2 for scale items. Internal consistencies in the current sample were  $\alpha = .86$ ,  $\alpha = .73$ , and  $\alpha = .85$  for factors 1, 2, and 3 respectively. Scales correlate with intentions to quit and prospectively with self-quit attempts (Myers & MacPherson, 2008). For the present

study factor 3 was not included, as it is only represented by two items, and typically three or more items are necessary to adequately capture a latent factor (Fabrigar, Wegener, & MacCullum, 1999).

*Intentions to quit* in the subsequent six months was assessed as part of the baseline semi-structured interview and derived from the stage of change algorithm (SCA – Smoking; Velicer, Prochaska, Rossi, & Snow, 1992) and scored as a dichotomous variable (“Do you plan to stop smoking cigarettes for good within the next 6 months?” Yes/No).

*Quit self-efficacy* was assessed as a single item scored on a 10 point Likert-type scale assessing the level of the participant’s confidence in successfully quitting smoking (“On a scale of 1 to 10, how confident are you that you could quit smoking for good if you wanted to?”).

**Control Variables**—*Current cigarette use quantity and frequency* was assessed for the past 90 days using the Time-line Follow-back procedure (TLFB; Sobell & Sobell, 1992). The TLFB has been shown to have good reliability and validity with adolescent smoking (Lewis-Esquerre et al., 2005).

*Nicotine Dependence* was assessed using the 7-item Fagerström Tolerance Questionnaire modified for adolescents (mFTQ; Prokhorov, Pallonen, Fava, Ding, & Niaura, 1996). Adequate reliability and validity have been demonstrated for the mFTQ in adolescent populations (Prokhorov, Koehly, Pallonen, & Hudmon, 1998; Prokhorov et al., 1996).

*Peer smoking* was assessed at the baseline semi-structured interview as the percent of four closest friends who smoke cigarettes (Myers et al., 2000).

*Quit history* was assessed at the baseline semi-structured interview as whether or not the participant had ever made serious attempt to quit smoking lasting for at least 24 hours.

**Dependent Variable**—*Quit Attempts* were assessed during the interval between baseline and follow-up as part of each in-person semi-structured interview. Having made a quit attempt was defined as a ‘yes’ response to the question “Since our last interview, have you made a serious attempt to quit that lasted for at least 24 hours where you meant to quit smoking? (MacPherson, Myers, & Johnson, 2006; Mermelstein et al., 2002).

## Data Analyses

Univariate logistic and linear regression analyses were planned to examine within gender the relationships among the proposed process model predictors, mediators, and dependent variable. Similar analyses were also planned to examine the relationships between potential covariates and the dependent variable. Predictors and mediators found significant in the univariate analyses were included in multivariate analyses. Multi-group path analyses, in which separate path coefficients are produced for males and females, were proposed to evaluate the hypothesized models within gender. Multi-group path analysis allows for simultaneous estimation of the model paths for both boys and for girls. Thus the entire sample is used when estimating path coefficients for each gender (Muthen & Muthen, 1998–2007) rather than testing each model within boys and within girls separately. This allows approximately 10 observations per parameter to be estimated within each model (Kline, 1998). Because the dependent variable, likelihood of a quit attempt, was assessed dichotomously, path analytic techniques using the Weighted Least Square (WLS) method of estimation were employed (Muthén & Muthén, 1998–2001).

## Results

### Smoking and Cessation Characteristics

Boys and girls in the present sample did not differ in smoking characteristics or on any of the cognitive process model variables, thus the following smoking history results are reported for the full sample (See Table 1 for smoking history results by gender). Initiation of smoking occurred at a mean age of 13.12 years with progression to weekly smoking by age 14.17 years. Despite a relatively brief smoking history ( $M = 3.6$  years), 96% were categorized as established smokers based on having smoked at least 100 cigarettes in their lifetime (USDHHS, 1989) and 86% smoked daily. Almost 70% percent reported having attempted to quit in their lifetime, with 63% percent reporting a quit attempt within the past year. Level of nicotine dependence as assessed by the mFTQ was in the moderate range ( $M = 3.4$ ,  $SD = 1.5$ ). Thus, the present sample consisted primarily of established smokers with moderate symptoms of dependence.

At the 6-month follow-up, approximately 46% percent of boys and 43% percent of girls reported making a self-quit attempt that lasted at least 24 hours since their baseline interview. The median quit attempt length of the longest attempt for boys was 18 days and for girls, 29 days. Although both boys and girls returned to smoking at similar rates (95%) within three months of a quit attempt, the relapse curve differed slightly by gender with a greater proportion of boys (35%) than girls (17%) returning to smoking within the first week of the quit attempt but with girls (70%) catching up with boys (70%) by the one-month post-quit attempt mark.

Process model and smoking history variables for those who reported having made a self-quit attempt between the baseline interview and 6-month follow-up were examined across gender, with few differences identified. A greater proportion of boys (65%) than girls (35%) who attempted to quit had reported that they intended to quit in the next six months at the baseline interview ( $\chi^2(1) = 3.91$ ,  $p = .048$ ). No other significant gender differences were identified among those who engaged in a quit attempt.

### Examination of control variables

To address the potential relationship between other variables and a self-quit attempt, univariate analyses were conducted to examine the role of: 1) demographics 2) baseline smoking level (cigarettes smoked per smoking day), nicotine dependence, and quit history and 3) proportion of close friends that smoke. Predictors with significant univariate relationships to initiating a self-quit attempt by 6-month follow-up were considered for incorporation into the hypothesized models. However, no control variables were significantly related to quit attempts for girls or among boys.

### Mediation Process Models: Adolescent Girl Smokers

The first necessary condition for examining mediation is a relationship between the independent variable and the dependent variable. Univariate logistic regression analyses of the IVs in relation to quit attempts indicated a one unit increase in baseline social approval motives was associated with an approximately two-fold increase in the likelihood of having made a self-quit attempt (step  $\chi^2(1) = 5.47$ ,  $p = .027$ , OR = 1.93, CI = 1.08, 3.47). Short-term consequences motives (step  $\chi^2(1) = .31$ ,  $p = .58$ , OR = 1.02) and self-efficacy to quit (step  $\chi^2(1) = 0.63$ ,  $p = .43$ , OR = 1.08) were unrelated to prospective self-quit attempts for girls and thus were not considered for further analyses.

The second condition is that the mediating variable be related to the independent variable. To establish this, we conducted a univariate logistic regression with social approval motives

as the independent variable and intention to quit as the dependent variable. Social approval motives to quit were related with intention to quit such that a one unit increase in social approval motives was associated with a 2.31 greater likelihood of intending to quit in the subsequent six months (step  $\chi^2(1) = 7.69, p = .010, CI = 1.22, 4.37$ ).

The third necessary step for establishing mediation is a relationship between the proposed mediators and the dependent variable. With intention to quit as the independent variable in the univariate logistic regression, it did not significantly predict prospective quit attempts among adolescent girl smokers (step  $\chi^2(1) = .02, p = .89, OR = 1.09$ ). Thus the process model variables did not meet Baron & Kenny's (1986) three conditions for mediation.

### Mediation Process Models: Adolescent Boy Smokers

Univariate analyses among boys produced a different pattern of findings from the girls. In examining the first necessary condition as described above for the adolescent girls, short-term consequence motives (step  $\chi^2(1) = .08, p = .78, OR = .99$ ), social approval motives (step  $\chi^2(1) = .19, p = .66, OR = 1.03$ ) and quit self-efficacy (step  $\chi^2(1) = 1.65, p = .20, OR = .89$ ) were not prospectively related to making a quit attempt, nor were these variables significantly related to intention to quit among the adolescent boy smokers in the present sample. Although the first two necessary conditions for establishing mediation were not met for the adolescent boy smokers, intention to quit was significantly related to making a prospective quit attempt in the univariate logistic regression examining the relationship between the proposed mediator and the dependent variable. Intending to quit in the next 6 months was predictive of a 7.06 times greater likelihood for a prospective quit attempt (step  $\chi^2(1) = 9.07, p = .004, CI = 1.84, 27.14$ ). Thus requisite conditions for mediation were not obtained.

### Discussion

This study was designed to examine a prospective process model of motivation and cognitive variables for adolescent smoking self-change efforts in relation to gender. As expected, differences in the process models across gender were noted. Social approval motives were directly related with intention to quit and prospective quit attempts among girls but not boys. Alternatively, for boys, intention to quit emerged as the primary predictor of making a quit attempt. Quit self-efficacy did not predict self-quit attempts for either gender.

Consistent with the social cognition model of adolescent addictive behavior self-change, the present study demonstrated the importance of social approval motives in motivating quit attempts among girl smokers. As expected, social disapproval motives were also related to intentions to quit among girls, indicating that these motives may play a role not only in actual self-quit efforts but also in association with intermediary processes of change (Mermelstein, 2003). Such findings are consistent with and add to previous research suggesting that smoking behavior and attitudes towards smoking in one's social network are more influential for girls' cessation efforts (Ellickson et al., 2001b). Social disapproval motives reflect perceived social consequences of one's smoking and provide distinct information beyond exposure to smokers as predictors of self-change efforts. From a social information processing stand point, for girls, it appears that perceived negative feedback and consequences from one's social network provide an impetus for, and increase the likelihood of attempting to change smoking behavior. This is in contrast to the risk that smoking behavior in one's social network contributes to decreasing the likelihood of making a smoking quit attempt (Jones, Schroeder, & Moolchan, 2004; Sussman, 2002)

The nonsignificant relationship between intention to quit and quit attempts in adolescent girls is puzzling and discrepant from the theorized role of intentions in behavior change (Ajzen, 1991). It is possible that girls are more sensitive to social feedback such that if they sense social disapproval regarding their smoking, their intention to quit may change. As such, intention to quit may be more temporally labile, dependent on perceived feedback, for girls than boys when relied on to predict behavior change over a longer interval. However, Hughes et al. (2005) has provided empirical support that intention to quit among adults can change dependent on when it is assessed as well as the duration between assessment points. Thus, it is also possible that in the current study relying on one time point to assess quit intentions may have masked variability that would have been more predictive of smoking quit attempts among girls if repeated assessments were utilized.

In contrast to our findings for girls, the only variable related to quit attempts among boy smokers was intention to quit. A potential explanation for the lack of findings is that short-term consequences motives are not relevant to subsequent quit attempts. Yet, adolescents rely more on proximal consequences of actions in their decision-making processes in changing behavior (Brown, 2001; Chambers, Taylor, & Potenza, 2003). A more probable explanation for the limited findings among boys is that the interval between baseline predictors and assessment of subsequent quit attempts in the current study attenuated the prediction of short-term consequences motives for quitting that are by definition, transient. Although recommendations have been made that six months be considered a more appropriate time period for examination of the predictive utility of process variables (DiClemente, 2003), an interval of even this length may attenuate the predictive power of the processes among adolescent smokers due to changes in these variables between the baseline assessment and an actual quit attempt. Studies that include shorter intervals between examination of reasons for quitting and subsequent quit attempts may yield more information as to the relevance of these motives to efforts at behavioral change among boy smokers. Consistent with this assertion, there is likely greater temporal consistency of the social influences that played a role in cessation efforts for girls, which may have circumvented some of these methodological issues.

Contrary to expectations, quit self-efficacy was unrelated to quit attempts for either gender. There may be a number of reasons for these findings. Although the present study utilized a common measure of quit self-efficacy in adolescent smokers (e.g., Apodaca, Abrantes, Strong, Ramsey & Brown, 2007), reliance on a single item limits incorporation of contextual information (e.g., situations, affective states) that may mask the dynamic nature of this construct (e.g., Gwaltney et al. 2002) and thus impact its predictive utility. Confidence in one's ability to change a behavior may also be a more salient predictor of cessation success (e.g., abstinence) than of making a quit attempt. Among adults, self-efficacy to quit has generally been associated with smoking cessation success (e.g., Gulliver et al., 1995; Gwaltney et al., 2002). In addition, a recent study indicated higher quit self-efficacy among adolescent smokers predicted increased odds of 7-day point prevalence abstinence following participation in an internet-based intervention (Woodruff et al., 2008). Thus in the context of Brown's (2001) two-phase addictive behavior change model, it may be that quit self-efficacy is less relevant to initial engagement in behavior change than it is to sustaining such change. Alternatively, given that quit self-efficacy has been implicated across both stages in two-phase models of smoking behavior change among adults (e.g., Baldwin et al., 2006; Prochaska & Velicer, 1997), further research is needed to clarify the specificity of which aspects of cessation self-efficacy (Brandon, Herzog, Irvin, & Gwaltney, 2004) are most relevant to adolescent smokers' initial attempts at change vs. sustained success.

The present study did not provide an exhaustive assessment of potential predictors of quit attempts, and thus additional factors should be considered in future cessation research



among boy smokers. For example, use of other substances including alcohol and illicit drugs, is frequently associated with tobacco use among adolescents (e.g., Flay, Hu, & Richardson, 1998; Rhode, Kahler, Lewinsohn, & Brown, 2004; White, Pandina, & Chen, 2002), and corresponds with smoking persistence among adolescents and young adults (Paavola, Vartiainen, & Puska, 2001; Redmond, 2002). Conversely, engagement in exercise or onset of sports participation may be expected to increase smoking self-quit attempts (Green & Fisher, 2000; Patton et al., 1998). In sum, potentially important contextual and intrapersonal factors require investigation as predictors of smoking self-quit efforts among adolescent boys.

This initial investigation of the role of gender in a prospective process model of motivation and cognitive variables for adolescent efforts to quit smoking contributes to the adolescent smoking cessation literature in a number of areas. Although previous research has examined gender differences in cognitive process variables (e.g., Fagan et al., 2003; Stanton, Lowe, Fisher, Gillespie, & Rose, 1999) and reasons for quitting (e.g., Turner & Mermelstein, 2004) among adolescent smokers, no studies have examined how reasons for quitting may work in concert with cognitive process variables to prospectively predict self-quit attempts within gender. In addition, studies of prospective self-change efforts among adolescent smokers have rarely tested specific mechanisms of the relationship between process variables and quit efforts. The processes involved in adolescent decisions to change smoking behavior and subsequent self-quit attempts especially in relation to gender, remain relatively unknown. However, modifications to the process model, such as inclusion of other process variables not examined in the present study including decisional balance (i.e., the risks and benefits of quitting) and expected consequences of quitting (Metrik, McCarthy, Frissell, MacPherson, & Brown, 2004; Solomon, Bunn, Pirie, Worden, & Flynn, 2006), represent future directions for this line of research.

The current research has several limitations. Although we attained a 91% follow-up rate over a 6-month assessment interval, the relatively small sample size of this pilot study in combination with modest effects likely contributed to nonsignificant findings. Additionally, as mentioned earlier, the length of the follow-up interval may have attenuated our ability to prospectively investigate temporally unstable phenomena such as motives for quitting in relation to cessation efforts. Despite their common use, single item assessments of intention to quit and quit self-efficacy may have limited findings. Also, a potential methodological confound in the current study was using a sample on whom the ARFQ was developed to then examine prospective relations of this measure with smoking quit efforts. Clearly future studies are needed to further validate the ARFQ in independent samples of adolescent smokers. Finally, the present sample consisted of a relatively homogenous group of smokers, in that a substantial proportion were established regular smokers, which may limit generalizability of the present findings to other adolescent smokers.

Findings from this study highlight the need for further prospective research regarding the relationship of motivational and cognitive processes to adolescent smoking self-change efforts. Further, a key implication of the present study for adolescent smoking cessation research is the value of examining models separately for boys and girls. Continued identification of potential differential predictors of smoking self-quit efforts for boys and girls can have important implications for tailoring of smoking cessation interventions and intervention efforts geared towards motivating behavioral changes in youth.

## Acknowledgments

This research was performed through the Veterans Medical Research Foundation & University of California, San Diego. This research was supported by Tobacco Related Disease Research Program Grant # 10IT-0280 and National Institute on Alcohol Abuse and Alcoholism Grant # T32 AA13525. We thank Sandra A. Brown, Elizabeth

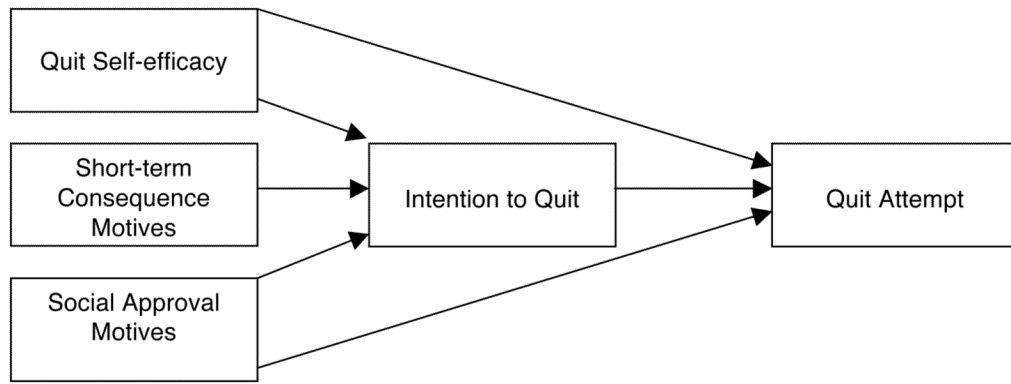
A. Klonoff, John P. Elder, and Tamara L. Wall for their comments on the first author's dissertation, a portion of which is presented in this article. Portions of this study were presented at the annual meeting of the Society for Research on Nicotine and Tobacco, March 22, 2005, Prague, Czech Republic.

## References

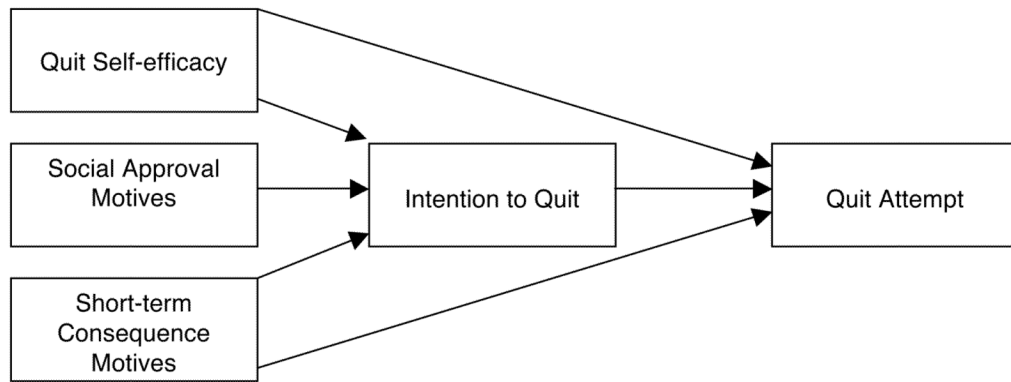
- Apodaca TR, Abrantes AM, Strong DR, Ramsey SE, Brown RA. Readiness to change smoking behavior in adolescents with psychiatric disorders. *Addictive Behaviors*. 2007; 32:1119–1130. [PubMed: 16950572]
- Aung AT, Hickman NJ, Moolchan ET. Health and performance related reasons for wanting to quit: Gender differences among teen smokers. *Substance Use & Misuse*. 2003; 38:1095–1107. [PubMed: 12901450]
- Azjen I. The theory of planned behavior. *Organizational Behavior and Human Decision Processes*. 1991; 50:179–211.
- Baldwin AS, Rothman AJ, Hertel AW, Linde JA, Jeffery RW, Finch EA, Lando HA. Specifying the determinants of the initiation and maintenance of behavior change: An examination of self-efficacy, satisfaction, and smoking cessation. *Health Psychology*. 2006; 25:626–634. [PubMed: 17014280]
- Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*. 1986; 51:1173–1182. [PubMed: 3806354]
- Brandon TH, Herzog TA, Irvin JE, Gwaltney CJ. Cognitive and social learning models of drug dependence: Implications for the assessment of tobacco dependence in adolescents. *Addiction*. 2004; 99(Suppl 1):51–77. [PubMed: 15128380]
- Brown RA, Ramsey SE, Strong DR, Myers MG, Kahler CW, Lejuez CW, Niaura R, et al. Effects of motivational interviewing on smoking cessation in adolescents with psychiatric disorders. *Tobacco Control*. 2003; 12:IV3–10. [PubMed: 14645934]
- Brown, SA. Facilitating change for adolescent alcohol problems: A multiple options approach. In: Wagner, EF.; Waldron, HB., editors. *Innovations in adolescent substance abuse intervention*. Oxford: Elsevier Science; 2001. p. 169-187.
- Brown SA, Anderson KG, Schulte MT, Sintov ND, Frissell KC. Facilitating youth self-change through school-based intervention. *Addictive Behaviors*. 2005; 30:1797–1810. [PubMed: 16111834]
- Burt RD, Peterson AV. Smoking cessation among high school seniors. *Preventive Medicine*. 1998; 27:319–327. [PubMed: 9612822]
- Chambers RA, Taylor JR, Potenza MN. Developmental neurocircuitry of motivation in adolescence: A critical period of addiction vulnerability. *American Journal of Psychiatry*. 2003; 160:1041–1052. [PubMed: 12777258]
- Coie, JD.; Dodge, KA. Aggression and antisocial behavior. In: Damon, W.; Eisenberg, N., editors. *Handbook of child psychology: Social, emotional and personality development*. New York, NY: John Wiley & Sons, Inc; 1998. p. 779-862.
- DiClemente, CC. *Addiction and Change: How addictions develop and addicted people recover*. New York: The Guilford Press; 2003. p. 22-43.
- Dino G, Horn K, Goldcamp J, Fernandes A, Kalsekar I, Massey C. A 2-year efficacy study of Not On Tobacco in Florida: an overview of program successes in changing teen smoking behavior. *Preventive Medicine*. 2001; 33:600–605. [PubMed: 11716656]
- Engels RCME, Knibbe RA, De Vries H, Drop MJ. Antecedents of smoking cessation among adolescents: Who is motivated to change? *Preventive Medicine*. 1998; 27:348–357. [PubMed: 9612825]
- Ellickson PL, McGuigan KA, Klein DJ. Predictors of late-onset smoking and cessation over 10 years. *Journal of Adolescent Health*. 2001a; 29:101–108. [PubMed: 11472868]
- Ellickson PL, Tucker JS, Klein DJ. Sex differences in predictors of adolescent smoking cessation. *Health Psychology*. 2001b; 20:186–195. [PubMed: 11403216]
- Fabrigar LR, Wegener DT, MacCullum RC, Strahan EJ. Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods*. 1999; 4:272–299.

- Fagan P, Eisenberg M, Frazier L, Stoddard AM, Avrunin JS, Sorensen G. Employed adolescents and beliefs about self-efficacy to avoid smoking. *Addictive Behaviors*. 2003; 28:613–626. [PubMed: 12726779]
- Fisher KJ, Stanton WR, Lowe JB. Healthy behaviors, lifestyle, and reasons for quitting smoking among out-of-school youth. *Journal of Adolescent Health*. 1999; 25:290–297. [PubMed: 10505847]
- Flay BR, Hu FB, Richardson J. Psychosocial predictors of different stages of smoking among high school students. *Preventive Medicine*. 1998; 27:A9–A18. [PubMed: 9808813]
- Friestad C, Rise J. Smoking attributions and adolescents' intention to try to quit smoking. *Addiction Research*. 1998; 6:13–26.
- Green, L.; Fisher, EB, Jr. Economic substitutability: Some implications for health behavior. In: Bickel, WK.; Vuchinich, RE., editors. *Reframing health behavior change with behavior economics*. Mahwah, NJ: Erlbaum; 2000. p. 115-144.
- Gulliver SB, Hughes JR, Solomon LJ, Dey AN. Self-efficacy and relapse to smoking in self-quitters. *Addiction*. 1995; 90:767–772. [PubMed: 7633293]
- Gwaltney CJ, Shiffman S, Paty JA, Liu KS, Kassel JD, Gnys M, Hickcox M. Using self-efficacy judgments to predict characteristics of lapses to smoking. *Journal of Consulting and Clinical Psychology*. 2002; 70:1140–1149. [PubMed: 12362964]
- Holden, DJ.; Hund, LM.; Gable, JM.; Mowery, P. *Youth Tobacco Cessation: Findings from the 2000 National Youth Tobacco Survey*. Washington, DC: American Legacy Foundation; 2003.
- Hughes JR, Keely JP, Fagerstrom KO, Callas PW. Intentions to quit smoking change over short periods of time. *Addictive Behaviors*. 2005; 30:653–662. [PubMed: 15833571]
- Jones DM, Schroeder JR, Moolchan ET. Time spent with friends who smoke and quit attempts among teen smokers. *Addictive Behaviors*. 2004; 29:723–729. [PubMed: 15135554]
- Kline, RB. *Principles and practice of structural equation modeling*. NY: Guilford Press; 1998.
- Lewis-Esquerre JM, Colby SM, Tevyaw TO, Eaton CA, Kahler CW, Monti PM. Validation of the timeline follow-back in the assessment of adolescent smoking. *Drug and Alcohol Dependence*. 2005; 79:33–43. [PubMed: 15943942]
- MacPherson L, Myers MG, Johnson M. Adolescent definitions of change in smoking behavior: An investigation. *Nicotine and Tobacco Research*. 2006; 8:683–687. [PubMed: 17008195]
- McCaul KD, Hockemeyer JR, Johnson RJ, Zetocha K, Quinlan K, Glasgow RE. Motivation to quit using cigarettes: a review. *Addictive Behaviors*. 2006; 31:42–56. [PubMed: 15916861]
- Mermelstein R. Teen smoking cessation. *Tobacco Control*. 2003; 12(Supl 1):25–34.
- Mermelstein R, Colby SM, Patten C, Prokhorov A, Brown R, Myers M, Adelman W, Hudmon K, McDonald P. Methodological issues in measuring treatment outcome in adolescent smoking cessation studies. *Nicotine & Tobacco Research*. 2002; 4:395–403. [PubMed: 12521399]
- Metrik J, McCarthy DM, Frissell KC, MacPherson L, Brown SA. Adolescent alcohol reduction and cessation expectancies. *Journal of Studies on Alcohol*. 2004; 65:217–226. [PubMed: 15151353]
- Muthén, LK.; Muthén, BO. *Mplus User's Guide*. 4. Los Angeles, CA: Muthén & Muthén; 1998–2007.
- Myers MG, Brown SA. A controlled study of a cigarette smoking cessation intervention for adolescents in substance abuse treatment. *Psychology of Addictive Behaviors*. 2005; 19:230–233. [PubMed: 16011397]
- Myers MG, Brown SA, Kelly JF. A smoking intervention for substance abusing adolescents: Outcomes, predictors of cessation attempts, and post-treatment substance use. *Journal of Child and Adolescent Substance Abuse*. 2000; 9:77–81.
- Myers MG, MacPherson L. Adolescent reasons for quitting smoking: Initial psychometric evaluation. *Psychology of Addictive Behaviors*. 2008; 22:129–134. [PubMed: 18298239]
- Paavola M, Vartiainen E, Puska P. Smoking cessation between teenage years and adulthood. *Health Education Research*. 2001; 16:49–57. [PubMed: 11252283]
- Pallonen UE, Prochaska JO, Velicer WF, Prokhorov AV, Smith NF. Stages of acquisition and cessation for adolescent smoking: An empirical integration. *Addictive Behaviors*. 1998; 23:303–324. [PubMed: 9668929]

- Patton GC, Carlin JB, Coffey C, Wolfe R, Hibbert M, Bowes G. Depression, anxiety, and smoking initiation: A prospective study over 3 years. *American Journal of Public Health*. 1998; 88:1518–1522. [PubMed: 9772855]
- Peters R, Kelder SH, Prokhorov AV, Agurcia CA, Yacoubian GS, Essien EJ. Beliefs regarding cigarette use, motivations to quit, and perceptions on cessation programs among minority adolescent cigarette smokers. *Journal of Adolescent Health*. 2006; 39:754–757. [PubMed: 17046516]
- Prokhorov AV, Pallonen UE, Fava JL, Ding L, Niaura R. Measuring nicotine dependence among high-risk adolescent smokers. *Addictive Behaviors*. 1996; 21:117–127. [PubMed: 8729713]
- Prokhorov AV, Koehly LM, Pallonen UE, Hudmon KS. Adolescent nicotine dependence measured by the modified Fagerstrom Tolerance Questionnaire at two time points. *Journal of Child and Adolescent Substance Abuse*. 1998; 7:35–47.
- Redmond WH. Smoking reduction among high school seniors: A test of selected indicators. *Journal of Adolescent Health*. 2002; 31:417–424. [PubMed: 12401428]
- Riedel BW, Robinson LA, Klesges RC, McLain-Allen B. What motivates adolescent smokers to make a quit attempt. *Drug & Alcohol Dependence*. 2002; 68:167–174. [PubMed: 12234646]
- Rhode P, Kahler CW, Lewinsohn PM, Brown RA. Psychiatric disorders, familial factors, and cigarette smoking II: Associations with progression to daily smoking. *Nicotine and Tobacco Research*. 2004; 6:119–132. [PubMed: 14982696]
- Sargent JD, Mott LA, Stevens M. Predictors of smoking cessation in adolescents. *Archives of Pediatric Adolescent Medicine*. 1998; 152:388–393.
- Sobell, LC.; Sobell, MB. Time-line follow-back: A technique for assessing self-reported alcohol consumption. In: Litten, RZ.; Allen, JP., editors. *Measuring Alcohol Consumption: Psychosocial and Biochemical Methods*. Pergamon Press; Totowa, NJ: 1992. p. 73-98.
- Solomon LJ, Bunn JY, Pirie PL, Worden JK, Flynn BS. Self-efficacy and outcome expectations for quitting among adolescent smokers. *Addictive Behaviors*. 2006; 31:1122–1132. [PubMed: 16139437]
- Stanton WR, Lowe JB, Fisher KJ, Gillespie AM, Rose JM. Beliefs about smoking cessation among out-of-school youth. *Drug and Alcohol Dependence*. 1999; 54:251–258. [PubMed: 10372798]
- Sussman S. Effects of sixty-six adolescent tobacco use cessation trials and seventeen prospective studies of self-initiated quitting. *Tobacco Induced Diseases*. 2002; 1:35–81. [PubMed: 19570247]
- Sussman S, Dent CW, Nezami E, Stacy AW, Burton D, Flay BR. Reasons for quitting and smoking temptation among adolescent smokers: Gender differences. *Substance Use & Misuse*. 1998a; 33:2703–2720. [PubMed: 9869439]
- Sussman S, Dent CW, Severson H, Burton D, Flay BR. Self-initiated quitting among adolescent smokers. *Preventive Medicine*. 1998b; 27:A19–A28. [PubMed: 9808814]
- Sussman S, Dent CW. Five-year prospective prediction of self-initiated quitting of cigarette smoking of high-risk youth. *Addictive Behaviors*. 2007; 32:1094–1098. [PubMed: 16876332]
- Turner LR, Mermelstein R. Motivation and reasons to quit: Predictive validity among adolescent smokers. *American Journal of Health Behavior*. 2004; 28:542–550. [PubMed: 15569588]
- U.S. Department of Health and Human Services. Reducing the health consequences of smoking: 25 years of progress. A report of the Surgeon General. Rockville, MD: USDHHS, Public Health Service, Centers for Disease Control; 1989.
- Velicer WF, Prochaska JO, Rossi JS, Snow MG. Assessing outcome in smoking cessation studies. *Psychological Bulletin*. 1992; 111:23–41. [PubMed: 1539088]
- Wagner EF, Atkins JH. Smoking among teenage girls. *Journal of Child and Adolescent Substance Abuse*. 2000; 9:93–110.
- White HR, Pandina RJ, Chen PH. Developmental trajectories of cigarette use from early adolescence into young adulthood. *Drug and Alcohol Dependence*. 2002; 65:167–168. [PubMed: 11772478]
- Woodruff SI, Conway TL, Edwards CC. Sociodemographic and smoking-related psychosocial predictors of smoking behavior change among high school smokers. *Addictive Behaviors*. 2008; 33:354–358. [PubMed: 17900818]
- Zhu S, Sun J, Billings SC, Choi WS, Malarcher A. Predictors of smoking cessation in U.S. adolescents. *American Journal of Preventive Medicine*. 1999; 16:202–207. [PubMed: 10198659]



**Figure 1.** Proposed self-change process model among adolescent girl smokers.



**Figure 2.**  
Proposed self-change process model among adolescent boy smokers.

**Table 1**

Demographics, Smoking History, and Process Model Variables for Boys, Girls and Full Sample.

	Boys (n = 44)	Girls (n = 54)	Full Sample (n = 98)
Demographic Variables:			
Age ( <i>M (S D)</i> ) * $p = .02$	17.0 (1.0)	16.5 (1.0)	16.7 (1.0)
Ethnicity			
% White	68.2	72.2	70.4
% Hispanic	6.8	9.3	8.2
% Mixed	22.7	5.6	13.3
% Asian/Pacific Islander	2.3	9.3	6.1
% Other	0.0	3.8	2.0
Smoking History Variables:			
Length of smoking history in months ( <i>M(SD)</i> )	44.4 (26.3)	42.9 (19.2)	43.6 (22.5)
Regular smokers – smoked 100 cigarettes in lifetime (%)	95.5	96.3	96.0
Level of nicotine dependence on FTND( <i>M(SD)</i> )	3.4 (1.7)	3.4 (1.4)	3.4 (1.5)
Past 90-day smoking quantity- frequency ( <i>M(SD)</i> )	6.1 (5.6)	5.8 (5.1)	7.2 (7.0)
Daily smokers (%)	86.4	85.2	85.7
Lifetime quit attempts (% yes)	70.5	68.5	69.4
Quit attempt in past year (% yes)	61.4	64.8	63.3
Process Model Variables:			
Quit attempt since baseline (% yes)	45.5	42.6	43.9
Intention to quit in next 6 months (% yes)	40.9	33.3	36.7
Self-efficacy to quit ( <i>M (SD)</i> )	5.6 (3.3)	5.8 (3.3)	5.7 (3.3)
ST consequence motives ( <i>M (SD)</i> )	20.3 (11.2)	19.7 (10.8)	20.0 (10.9)
Social Disapproval motives ( <i>M (SD)</i> )	8.6 (5.1)	8.1 (5.2)	8.3 (5.1)
LT concerns motives ( <i>M (SD)</i> )	5.5 (2.5)	6.2 (2.4)	5.9 (2.5)

Note:

\*  
 $p < .05$

**Table 2**

## Adolescent Reasons for Quitting Scale.

<b>Short Term Consequences</b>	
1	I walk up stairs and I'm out of breath.
2	I'm coughing up stuff every day.
3	I can't breathe when exercising (jogging, working out, surfing, etc.).
4	I feel like cigarettes were controlling my life.
5	Other people were thinking that I smelled or looked bad (yellow teeth/nails, bad breath, etc.).
6	I get sick more often because of smoking.
7	My stuff gets damaged because of my smoking (burns on clothes, car, etc.).
8	Smoking gets me in trouble at school or with the police (citations, etc.).
9	I keep smoking cigarettes out of habit, even though I don't want to.
<b>Social Disapproval</b>	
1	People I date/go out with don't like me smoking.
2	I don't want my parents to find out.
3	My friends who don't smoke gave me a hard time.
4	My parents are really upset about me smoking.
5	I joined a group that didn't like my smoking (church, youth group, etc.).