In the United States, adolescent smoking has been increasing since the early 1990s, although with some decreases since 2000. Based on an estimate made in 2002, approximately 4,000 youths aged 12-17 try their first cigarette each day in the U.S (Centers for Disease Control and Prevention, 2004). Studies that examine the factors leading to teen smoking have been a continuous effort. Prior research has shown that some individual characteristics and smoking behaviors of parents and peer group can have important impact on initiating adolescent smoking behaviors. In addition to these individual attributes and social influences, recent studies have started to look into the roles played by schools and neighborhood/community and to examine how contextual factors affect adolescents' involvement in tobacco use.

The outcome variables that are often being studied are either risk of smoking initiation or risk of progressing to regular smokers. While not every adolescent smoke, those who smoke do not always become daily smokers, and even among daily smokers, some of them successfully quit smoking, researchers should pay more attention to the "trajectories" of teenagers' smoking behaviors. Yet, it seems that none of the existing studies have dependent variables that capture adolescent smoking trajectories. If studies can tune into the differential smoking paths adolescents went through, intervention programs can benefit more from empirical research by knowing what factors lead to smoking onset, progression to daily smokers, and quitting. Therefore, the goal of this study is to draw on the findings of prior research and to examine the factors that lead to differential smoking trajectories of adolescents in emerging adulthood by utilizing a high-quality dataset with nationally representative sample.

Literature Review

Prior research has shown that individual characteristics, family, peer group, and neighborhood have significant influences on adolescents' smoking behaviors. For example, adolescent with certain personality traits, such as aggressiveness and risk-taking, are more prone to smoking (Conrad, Flay and Hill, 1992; Brook et al., 1997). Those with symptoms of depression or part-time employment are also at higher risk of smoking (Patton et al., 1996). As for family characteristics, parental separation (Kirby, 2002) and low family socioeconomic status (Harrell et al., 1998; Soteriades and DiFranza, 2003) are major predictors of teen smoking. The social and behavioral influences from adolescents' friendship networks have been an important area of inquiry to gain insights into teen tobacco use. The subculture perspective argued that deviant behaviors are learned through peer interactions that involve communication, sanctioning, and

modeling. Indeed, past studies have continuously found that smoking by significant others, especially friends, is by far the most consistent predictor of adolescent smoking (Alexander et al., 2001; Taylor et al., 2004; Tucker et al., 2003; Wang et al., 1995). According to social disorganization theory, neighborhoods that lack social control and have many violence and drug issues tend to facilitate deviant behaviors (Shaw and McKay, 1942).

Theoretical Frameworks and Research Hypotheses

According to Hirschi's (1969) social control theory, individuals with strong attachments to others are presumed to be less likely to violate social norms. As shown by some studies reviewed above, close attachments to parents and schools can be salient inhibitors of smoking initiation and other problem behaviors in adolescence. In turn, the first hypothesis for this study is: *Adolescents who are more attached to parents and schools are less likely to have persistent smoking behaviors.*

The second framework is Bandura's social learning theory (1977). This perspective is sometimes called the contagion model, which posited that observing and modeling behaviors of others contribute to the reinforcement and initiation of problem behaviors. This theory has been applied to investigate the social influences from significant others, such as parental and peer smoking behaviors, on teen smoking onset or progression to regular smokers. Thus, the second hypothesis for this study is: *Adolescents who have parents or friends who smoke in adolescence are more likely to use cigarettes persistently during emerging adulthood.*

Finally, another framework from the Chicago-school's social disorganization theory proposed by Shaw and McKay (1942) will be utilized. This theory maintained that ethnic heterogeneity, low economic status, residential mobility, and family disruption will result in community social disorganization. A disorganized community, in turn, becomes a hotbed for increasing crime and delinquency. Social disorganization theory has been applied to the adolescent smoking research by examining how absence of community-level social control mechanisms can increase adolescents' smoking rates. Therefore, the third hypothesis for this study is: *Adolescents who live in more socially disorganized communities have higher odds of persistent smoking behaviors than their counterparts living in more favorable communities.*

Research Design

Data and Sample. The data used for this study is the National Longitudinal Study of Adolescent Health (Add Health). A sample of 80 high schools that include 11th grade and has enrollment of

more than 30 students was selected by using systematic sampling method and implicit stratification. These two sampling methods ensure that the eighty schools sampled are representative of schools in the United States in terms of region, urbanicity, school type, ethnicity, and school size. Given the goal of this longitudinal study is to examine the smoking trajectories of teenagers from adolescence to emerging adulthood, the sample included in this study will be restricted to those who were surveyed in all three waves. In addition, the sample will be restricted to adolescents who were in their early and mid adolescence (ages 12 to 16) in wave 1, so that these adolescents will become ages 19 to 23 (emerging adulthood) in wave 3. They should also have parents participating in the in-home survey in wave 1 so that parental smoking status can be linked to the adolescent data. The weightings for each adolescent respondent provided in the Add Health data to account for oversampling (i.e., minority adolescents and those from special subpopulation) will be utilized to adjust for the unequal probability of selection into the data.

Variables. The dependent variable for this study is the number of cigarettes used during the past 30 days. This question was asked about adolescent respondents across all three waves of data collection. The independent variables include parent-child attachment, school attachment, and smoking status of best friend(s) and parents. These are individual-level variables. On the community level, several indicators of social disorganization will be used in this study. These factors include modal household type, median household income, and unemployment rate. These variables will be acquired from the contextual database of Add Health. As for control variables, adolescents' race, gender, work status (i.e., number of hours spent in working during semester), family structure, family SES (measured by two variables, total family income and the parent respondent's education), availability of tobacco at home, depression, and delinquency will all be controlled in the analyses.

Statistical Analyses. Descriptive analysis will first be conducted to give an overview of the distribution and characteristics of the entire sample. Next, to better capture the smoking trajectories of adolescents, hierarchical nonlinear growth curve method will be adopted to analyze a three-level model. The reason for fitting a nonlinear growth curve model is based on the results of an initial plotting of 150 adolescents' number of cigarettes used in past 30 days across three waves. The chart showed that the slopes from wave 2 to wave 3 deflect quite a bit from the ones from wave 1 to wave 2 for the majority of the sample. Thus, having a quadratic

term in the model seems to better capture the possible concaving (either up or down) smoking trajectories of teen smoking behaviors. The variable "Time" in level-1 is the time metric for wave 1 through wave 3 and "Time^2" is the quadratic term used to estimate the differential slopes between three time periods. In level-2, X_1 is a vector of the individual characteristics variables for each adolescent respondent. Similarly in level-3, X_2 is a vector of the community-level variables used to measure the social disorganization of a community. The complete regression equations with all variables included in three levels are shown below:

Level-1 Model: Y_{tij} (no. of cigarettes smoked) $= \pi_{0ij} + \pi_{1ij}*(\text{Time})_{tij} + \pi_{2ij}*(\text{Time})^2_{tij} + e_{tij}$

Level-2 Model:
$$\pi_{0ij} = \beta_{00j} + \beta_{01j}*(X_1, \text{Individual Characteristics})_{ij} + \gamma_{0ij}$$
$$\pi_{1ij} = \beta_{10j} + \beta_{11j}*(X_1, \text{Individual Characteristics})_{ij} + \gamma_{1ij}$$
$$\pi_{2ij} = \beta_{20j} + \beta_{21j}*(X_1, \text{Individual Characteristics})_{ij} + \gamma_{2ij}$$

Level-3 Model:
$$\beta_{00j} = \gamma_{000} + \gamma_{001}(X_2, \text{Community Characteristics})_j + u_{00j}$$
$$\beta_{01j} = \gamma_{010} + \gamma_{011}(X_2, \text{Community Characteristics})_j + u_{01j}$$
$$\beta_{10j} = \gamma_{100} + \gamma_{101}(X_2, \text{Community Characteristics})_j + u_{10j}$$
$$\beta_{11j} = \gamma_{110} + \gamma_{111}(X_2, \text{Community Characteristics})_j + u_{11j}$$
$$\beta_{20j} = \gamma_{200} + \gamma_{201}(X_2, \text{Community Characteristics})_j + u_{20j}$$
$$\beta_{21j} = \gamma_{210} + \gamma_{211}(X_2, \text{Community Characteristics})_j + u_{21j}$$

Initially, an unconditional model without any level-2 or level-3 predictors in the equations will be fitted to investigate whether the amount of cigarettes smoked changed significantly over time. The regression equations of this model are shown below:

Level-1 Model: Y_{tij} (no. of cigarettes smoked) $= \pi_{0ij} + \pi_{1ij}*(\text{Time})_{tij} + \pi_{2ij}*(\text{Time})^2_{tij} + e_{tij}$

Level-2 Model:
$$\pi_{0ij} = \beta_{00j} + \gamma_{0ij}$$
$$\pi_{1ij} = \beta_{10j} + \gamma_{1ij}$$
$$\pi_{2ij} = \beta_{20j} + \gamma_{2ij}$$

Level-3 Model:
$$\beta_{00j} = \gamma_{000} + u_{00j}$$
$$\beta_{10j} = \gamma_{100} + u_{10j}$$
$$\beta_{20j} = \gamma_{200} + u_{20j}$$

In level-2, the level-1 intercept (π_{0ij}) is allowed to vary as a function of β_{00j} (the mean initial smoking status within community j), because every adolescent smoked different numbers of

cigarettes in wave 1 in different neighborhoods. Also, the slopes of π_{1ij} and π_{2ij} are allowed to vary due to the fact that some adolescents smoked increasingly more cigarettes, whereas others may smoked fewer over time. In level-3, the level-2 β_{00j} is allowed to vary as a function of the overall mean initial smoking status (γ_{000}). Similarly, β_{10j} and β_{20j}, the mean number of cigarettes smoked across three waves within community j, is a function of the overall mean number of cigarettes smoked across all three waves (γ_{100} and γ_{200}). These are the basic rationales for building subsequent multilevel models with predictors included in higher levels.

Next, level-2 individual characteristics, such as parent-child attachment and school attachment, will be included to examine how social bonds can affect smoking trajectory, holding constant the series of factors listed as the control variables. Next, smoking behaviors by parents and friends will be added into the level-2 model to acquire the effects of social learning on teen smoking. Finally, community characteristics of modal household type, median household income, and unemployment rate will be included in the level-3 model to investigate the impact of disorganized neighborhoods on adolescents' smoking history.

All subsequent models built after the unconditional model will be tested against the prior one, using deviance tests, to examine model fitness. Based on the deviance test results, appropriate adjustments will be applied to each additional model, either by dropping insignificant predictors or altering random effect specifications.

Expected Findings

Drawing on the findings in prior research, the following results are expected to be found in this study. First, adolescents who are more attached to parents and schools are expected to have less persistent smoking patterns. They might be more likely to decrease the number of cigarettes used overtime, or become nonsmokers. Second, adolescents who have parents or friends who smoke in adolescence are expected to use cigarettes more persistently during emerging adulthood. Finally, adolescents who live in more socially disorganized communities are expected to have higher odds of continuous smoking behaviors than their counterparts living in more favorable communities.