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# Life events, genetic susceptibility, and smoking among adolescents ☆

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ABSTRACT

Although stressful life events during adolescence are associated with the adoption of unhealthy behaviors such as smoking, both social circumstances and physical traits can moderate the relationship. This study builds on the stress paradigm and gene–environment approach to social behavior by examining how a polymorphism in the serotonin transporter gene 5-HTTLPR moderates the effect of life events on adolescent smoking. Tests of interaction hypotheses use data from the Family Transitions Project, a longitudinal study of 7th graders followed for 5 years. A sibling-pair design with separate models for the gender composition of pairs (brothers, sisters, or brother/sister) controls for unmeasured family background. The results show that negative life events are significantly and positively associated with smoking. Among brother pairs but not other pairs, the results provide evidence of gene–environment interaction by showing that life events more strongly influence smoking behavior for those with more copies of the 5-HTTLPR S allele.

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## 1. Introduction

Tobacco use has obvious practical and policy importance as a topic of study because of its standing as the single largest source of preventable mortality in the United States. Recent estimates attribute 480,000 deaths per year to smoking in the United States (USDHHS, 2014, p. 659), and 12% of all deaths at ages 30 and over (about 5 million) across the globe (WHO, 2012). Despite considerable success from decades of anti-smoking messages, rising taxes on tobacco products, restrictions on the purchase and use of cigarettes, and social norms that shame and stigmatize smokers, the problem persists. According to the latest figures for the United States, 18% of adults report being current smokers (CDC, 2014) – a high level given societal opposition and public health concerns. Without a sudden and drastic change in behavior, current prevalence will translate into continued high levels of smoking-related mortality and morbidity.

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To understand the problem, much research has appropriately focused on the causes of smoking initiation during adolescence. Virtually all cigarette smoking begins before age 18 (USDHHS, 2014, p. 708). As teens tend to discount the difficulty of quitting, the early addiction to nicotine in adolescence often leads to a life-long habit (Slovic, 2000). Enforcement efforts to restrict the access of minors to cigarettes have had some success (DiFranza, 2012), as have programs to prevent initiation and promote quitting among young people (Jacobson et al., 2001). Still, among high school students, about 20% of males and 16% of females report smoking (USDHHS, 2014, p. 720). The unambiguous benefits of understanding and preventing teen smoking underscores the importance of investigating its determinants.

In addition to its public policy and health importance, smoking has special theoretical importance for sociology and other social sciences: It reflects an intriguing mix of both social and biological influences. On one hand, social position (Link, 2008) and group-based norms (Cockerham, 2000) greatly influence social patterns and population trends in smoking. For example, smoking has become concentrated among socioeconomically disadvantaged groups in recent decades (Pampel, 2005), thereby reinforcing other sources of health disparities (Miech et al., 2011). Among teens, the contexts of schools, neighborhoods, and peers similarly reflect the importance of social influences on smoking (Ellickson et al., 2003; Henriksen et al., 2008). On the other hand, smoking frequently involves physical addiction to nicotine, a stimulating substance that links the behavior to biological or genetic traits (Brody, 2006; Hecht, 2012). The addictiveness of nicotine has been well substantiated (USDHHS, 1988), and a large literature on biological mechanisms (Bock and Goode, 2006; Brunzell, 2008), genetic predispositions (Sullivan and Kendler, 1999), and related psychological attractions to smoking (Zuckerman, 2007) helps explain individual differences.

With some exceptions, literatures treat the two classes of tobacco initiation risk as separate and independent. The social approach tends to assume that social patterns of smoking similarly affect persons with varied genetic propensities, while the genetic approach tends to assume that individual propensities to addiction remain invariant across social contexts. On the surface, the assumptions appear reasonable. Largely stable genetic traits cannot explain changes in the social distribution of smoking, and changes in smoking prevalence do little to affect genetic traits.

In other ways, however, assumptions of independence may be flawed. Social conditions may facilitate or inhibit genetic propensities for addiction and smoking, and genetic influences may depend on social conditions (Boardman et al., 2010). Understanding patterns of smoking (as well as other aspects of health with biological components) requires combined attention to both social context and genetic propensities. This perspective follows from the emphasis on gene–environment behavior interactions in the Institute of Medicine's (2006) report "Genes, Behavior and the Social Environment: Moving Beyond the Nature-Nurture Debate." This report stresses the need for interdisciplinary collaborations among social, behavioral, and medical researchers to address the complex interactions among genetic endowments, social structures, and individual behaviors. Until recently, however, relatively little research has bridged these tracks to examine the joint influence of biological and environmental determinants of tobacco use.

In this paper, we seek to understand the combined influence of genetic predispositions and one key social component of early smoking – adolescent stress. We ask if genetic influences shape the harm of negative life events for smoking and if the gene–environment interplay varies by gender. The effort gives new insight into a persistent problem of unhealthy behavior among teens and to the combined influences of biology and environment on social behavior. Toward that end, we specify interactive hypotheses about the links between social stress, genetic traits, and smoking during adolescence, and we test the hypotheses with prospective longitudinal data and sibling fixed-effects models.

## 2. Stress, negative life events, and smoking

We begin with the literature on stress and tobacco use. In general, the concentration of acute social stressors is associated with social environments characterized by high levels of smoking. Previous research has shown that work-related stress (Otten et al., 1999), unemployment (Fagan et al., 2007), family stressors (Miller and Volk, 2002), negative life events (Balk et al., 2009), poor school performance (Johnson and Hoffman, 2000), poverty combined with single-parent childrearing (Graham, 1995; Marsh and McKay, 1994), socioeconomic disadvantage (Lynch et al., 1997), neighborhood deprivation (Duncan et al., 1999), and everyday life strains (Liu, 2003) are linked with smoking behavior.

In the stress paradigm, difficult social circumstances are both a source of adversity and a drain on the capacity to cope (e.g., Pearlin, 1989). Stress involves physiological and emotional arousal that, when prolonged, leads to changes in the immune system and brain (Lantz et al., 2005). In the face of stress and the bodily changes that result, smoking (as well as overeating, inactivity, alcohol abuse, and other unhealthy behaviors) represents a form of pleasure and relaxation that helps regulate mood (Lantz et al., 2005; Layte and Whelan, 2009; Wilkinson, 1996). The coping or self-medicating function of these behaviors raises the costs of giving them up and limits the ability to adopt healthy but challenging behaviors.

For adolescents, the transition from childhood to adulthood presents special stressors that can contribute to early substance use (Pampel et al., 2014). Adolescence is a period of new transitions, roles, and responsibilities that involve physical maturation, newfound freedom and desires, vulnerability to social and peer interactions, and resistance to continued parental, school, and community restrictions (Colten and Gore, 1991; Kim et al., 2003; Steinberg, 2001). As a result, teens may experience more stress or qualitatively different stress than adults and react in more impulsive and self-destructive ways (Hoffmann and Su, 1997; Van Gundy and Rebellon, 2010). Tendencies to use substances to cope with stressful problems of living are reinforced by peers who use the substances and exert pressures or serve as models for smoking (Kobus, 2003).

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