The version of the following full text has not yet been defined or was untraceable and may differ from the publisher's version.

For additional information about this publication click this link.
http://hdl.handle.net/2066/90720

Please be advised that this information was generated on 2017-08-04 and may be subject to change.
Adolescent smoking cessation: Not just a lucky strike!

Een wetenschappelijke proeve op het gebied van de Sociale Wetenschappen

Proefschrift

Ter verkrijging van de graad van doctor aan de Radboud Universiteit Nijmegen
Op gezag van de Rector Magnificus, Prof. mr. S. C. J. J. Kortmann
Volgens het besluit van het College van Decanen
In het openbaar te verdedigen op ... 2009, om ... uur

door

Rinka Marina Petronella van Zundert

Geboren op 5 augustus 1981
te Rucphen
Promotiecommissie

Promotor
Prof. dr. R. C. M. E. Engels

Beoordelingscommissie
Prof. dr. J. M. A. M. Janssens
Prof. dr. R. A. Knibbe
Prof. dr. D. van de Mheen
Prof. dr. ir. C. P. van Schayck
Dr. B. Wanner

Print:
ISBN:
Correctors:
Grafisch ontwerp:
# Contents

Chapter 1   General Introduction 4

## Part 1: Predictors of adolescent smoking cessation outcomes

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 2</td>
<td>Adolescent smoking continuation: Reduction and progression in smoking after experimentation and recent onset</td>
<td>30</td>
</tr>
<tr>
<td>Chapter 3</td>
<td>The role of smoking cessation-specific parenting in adolescent smoking-specific cognitions and readiness to quit</td>
<td>54</td>
</tr>
<tr>
<td>Chapter 4</td>
<td>Longitudinal test of smoking cessation-specific parenting on adolescent smoking cessation</td>
<td>74</td>
</tr>
<tr>
<td>Chapter 5</td>
<td>Parental factors in adolescents’ smoking relapse</td>
<td>96</td>
</tr>
<tr>
<td>Chapter 6</td>
<td>Testing Social Cognitive Theory as a theoretical framework to predict smoking relapse among daily smoking adolescents</td>
<td>112</td>
</tr>
<tr>
<td>Chapter 7</td>
<td>Dynamic effects of self-efficacy on smoking lapses and relapse among adolescents</td>
<td>129</td>
</tr>
<tr>
<td>Chapter 8</td>
<td>Contextual correlates of adolescents’ self-efficacy after smoking cessation</td>
<td>153</td>
</tr>
<tr>
<td>Chapter 9</td>
<td>Nicotine withdrawal symptoms following a quit attempt: An ecological momentary assessment study among adolescents</td>
<td>185</td>
</tr>
<tr>
<td>Chapter 10</td>
<td>Dynamic effects of withdrawal symptoms on adolescent smoking cessation</td>
<td>205</td>
</tr>
<tr>
<td>Chapter 11</td>
<td>Alcohol consumption and smoking relapse among adolescents</td>
<td>226</td>
</tr>
</tbody>
</table>

## Part 2: The role of asthma in adolescent smoking cessation

| Chapter 12 | Asthma and the development of nicotine dependence among adolescents: A longitudinal study (short report) | 242  |
| Chapter 13 | Parents’ and best friends’ smoking, smoking-specific cognitions, and nicotine dependence in relation to readiness to quit smoking: A comparison between adolescents with and without asthma | 253  |

| Chapter 14 | General Discussion                                                                 | 275  |

| Appendix I | Unpublished results of asthma-specific factors                                           | 310  |
| Publications (this thesis) |                                                                                      | 320  |
Chapter 1

General Introduction
Welcome to my thesis! I will take you on a thrilling ride through the rocky world of adolescent smoking cessation. We will venture out into this world with scant knowledge, but we will return with our pockets full of information on a largely uncovered area of science. We will disentangle complex interplays between environmental influences, individual characteristics, and psychophysiological factors. We will conquer the wetlands of cognition, and fight the fires of smoking temptations and withdrawal. And yes, we will be exposed to ferocious smoking cues. But we will leave no path unexplored! Beware, however, this ride is not for the faint-hearted: we will travel along treacherous roads where just one slip can have us fall into the abyss of relapse. I dare you to come along! (You might want to bring along your inhaler).

Now seriously, why is adolescent smoking cessation important?

Although smoking rates seem to gradually decrease among both adults and adolescents (Johnston, O’Malley, & Bachman, 2001; Stivoro, 2008), smoking still represents the number one preventable cause of disease, disability, and death, worldwide. Diseases caused by smoking or exposure to second-hand smoke include heart disease, strokes, lung, larynx, oesophageal, and oral cancers, chronic obstructive pulmonary disease (COPD), lower respiratory tract infections, and asthmatic symptoms or attacks (Centers for Disease Control, 2008a). Cigarette smoking during adolescence reduces the rate of lung growth, maximum lung function, and overall levels of fitness, and increases the risk of respiratory problems. Despite these great health risks, a large number of both adults and adolescents use tobacco products. Figure 1 depicts the distribution of smoking status among adolescents in the ages between 10 and 19 in the Netherlands in 2008. As can be seen in the figure, around 22% smokes monthly, and 18% smokes daily.
These prevalence figures concur with those in the United States (Centers for Disease Control, 2008b), and averages among other European countries (Hibell et al., 2007). Although a large number of adolescents smoke, as much as between 60% and 67% of adolescent smokers report that they have tried to quit smoking in the past year (Abrantes, Lee, MacPherson, Strong, Borrelli et al., 2009; Burt & Peterson, 1998; Riedel, Robinson, Klesges, & McLain-Allen, 2002). Unfortunately, these attempts prove to be unsuccessful most of the time (Mermelstein, 2003), which particularly applies to daily smoking adolescents. Daily smoking adolescents have been shown to display successful unaided smoking cessation rates ranging from no more than 5.3% (Stanton, McClelland, Elwood, Ferry, & Silva, 1996) to 12.3% (Sargent, Mott, & Stevens, 1998). Success rates are somewhat higher among adolescents who have received some kind of intervention, such as 17% in a teen school-based clinic cessation program (Sussman, Dent, & Lichtman, 2001), and between 6.5% and 17.7% with nicotine replacement aids (Moolchan, Robinson, Ernst, Cadet, Pickworth et al., 2005). Nonetheless, approximately 90%-95% of all adolescents who make an unaided attempt to quit smoking will eventually relapse, mostly within a short period of time (Mermelstein, 2003; Sussman, 2002).

These low success rates can be considered deplorable since the benefits of smoking cessation during the adolescent years are substantial. The negative health consequences of smoking are already evident in adolescence and young adulthood, as smoking seems to activate asthmatic symptoms and attacks, and reduces lung growth (USDHHS, 1994). Early cessation is also advisable because a shorter smoking history and a longer period of abstinence from smoking are associated with lower levels of nicotine dependence (USDHHS, 1990). This is advantageous as nicotine dependence is a major barrier to successful cessation.
later on (Kleinjan, Engels, Van Leeuwe, Brug, Van Zundert, & Van den Eijnden, 2009), and transitions to higher levels of dependence will make it even harder for people to quit. Thus, cessation efforts during the adolescent years have positive health effects both during adolescence and into adulthood.

Adolescents with asthma and smoking

The adverse health effects of smoking pose a threat to the physical wellbeing of healthy adolescents, but are particularly hazardous to the health of adolescents with respiratory problems, such as asthma. Asthma is a chronic inflammatory pulmonary disorder that is characterized by reversible obstruction of the airways. The inflammation of the airways is responsible for frequent episodes of wheezing, breathlessness, chest tightening, and coughing. These symptoms usually arise during childhood, but they can develop throughout life (NHLBI, 1997). Asthma is the most common disease in children and adolescents, and an estimated 300 million people of the entire world population suffer from this disease (WHO, 2006). In the Netherlands, recent figures show that 12.9% of Dutch 12-14 year-olds have had lifetime asthma (Van de Ven, Van den Eijnden, & Engels, 2006a), and that 8.5% of this age group had current asthma (Van de Ven, Engels, Otten, & Van Den Eijnden, 2007).

Although several irritants may worsen asthmatic symptoms, tobacco smoke is listed as the number one cause of triggering and exacerbating asthma (NHLBI, 1997). It is surprising then to conclude that the prevalence of smoking among persons with asthma is similar to the prevalence of smoking among persons without asthma (Backer, Nepper-Christensen, Ulrik, von Linstow, & Porsbjerg, 2002; Brook & Shiloh, 1993; Forero, Bauman, Young, & Larkin, 1992), and in some instances even higher (Forero, Bauman, Young, Booth, & Nutbeam, 1996; Sherman, Tosteson, Tager, Speizer, & Weiss, 1990; Van De Ven, Van Den Eijnden, & Engels, 2006b). Among individuals with asthma, smoking cessation improves asthma-specific quality of life scores, reduces the intake of rescue beta2-agonists and inhaled corticosteroids, reduces asthma symptoms, improves lung function, facilitates a fall in sputum neutrophil count, and causes reductions in bronchial hyperreactivity (Chaudhuri, Livingston, McMahon et al., 2006; Tønnesen et al., 2005). However, very few studies have been conducted to examine which factors obstruct or facilitate smoking cessation among people with asthma, and even fewer have focused on adolescent smoking cessation (Tercyak, 2006).
Current status of research on adolescent smoking cessation

So how do we increase the odds that adolescents will successfully quit smoking, and will not relapse once having done so? Truth is that we do not know all too much about how to achieve this. While research on smoking initiation and continuation flourished, there seemed to be an almost singular concentration on prevention, with little thought or attention paid to cessation up until the beginning of the 21st century. Even when smoking cessation became a topic of interest, it remained largely restricted to research among adults. Much less is even known about adolescent smoking relapse. Enter these three words in any literature database and one will not find one match in title. This could be due to the term “smoking cessation” being applied broadly in the sense that authors might be (mistakenly) referring to relapse, but taking a closer look, one finds that studies on adolescent smoking relapse are rare. As a result, we know very little about the processes and mechanisms underlying adolescent smoking cessation and relapse.

The main reasons why the field of adolescent smoking cessation has been neglected are well outlined by Robin Mermelstein in her review of the field in 2003. The lack of attention to cessation seemed to be based, in part, on the following assumptions: “(1) that prevention was the more effective means to reduce tobacco use among adolescents; (2) that adolescent smokers were unlikely to be dependent on nicotine and could probably stop smoking if they wanted to; (3) that adolescents were not interested in stopping smoking; and (4) that effective cessation programmes for adults could easily generalise to adolescents.” (Mermelstein, 2003, p. 25). Empirical evidence, however, has countered each of the above assumptions. First of all, most prevention programs for adolescents, in particular those that are school-based, seem to produce minimal effects (Sowden & Stead, 2003). Second, adolescents do develop nicotine dependence, in fact, many do quite quickly after initiation, and symptoms may arise even after smoking only a few cigarettes (DiFranza, Savageau, Fletcher et al., 2002; DiFranza, Savageau, Rigotti et al., 2002; Kandel, Hu, Griesler, & Schaffran, 2007; O’Loughlin, DiFranza et al., 2002). In addition, most adolescent smokers do in fact claim that they wish to quit smoking at some point in time (Grimshaw, Stanton, Blackburn, Andrews, Grimshaw et al., 2003), and as noted above, there is a consistent prevalence of roughly two-third of smoking adolescents who has ever embarked on a quit attempt (Abrantes et al., 2009; Burt & Peterson, 1998; Riedel et al., 2002). Lastly, effective cessation programmes for adults might not as easily generalise to adolescents as previously
thought. There is no guarantee that successful adult program components easily translate to
the adolescent population, as we will outline below.

Differences between adolescents and adults

Several reasons can be proposed as to why adolescents would differ from adults in
various stages of the cessation continuum, starting with becoming motivated to quit and
arriving at prolonged abstinence or relapse. First and foremost, the adolescent years comprise
a developmental phase in which impulsivity, novelty seeking, and suboptimal decision
making are considered to be common characteristics (or “transition traits”) and behaviors
(Chambers, Taylor, & Potenza, 2003). These commonalities, or transition traits, are linked to
maturational changes in the brain, in particular those areas that serve cognitive, emotional and
behavioral regulation (e.g., impulse control) (Chambers et al., 2003; Clark, Thatcher, &
Tapert, 2008; Goldstein, & Volkow, 2002). This maturational process involves among others
the development of abilities such as self-reflection and introspection (Beyth-Marom &
Fischhoff, 1997; Steinberg & Cauffman, 1996). The fact that these maturational changes have
not yet been completed before reaching (young) adulthood has been posited to account for
these transition traits to be so pronounced, and are thought to predispose adolescence to being
a critical period of addiction vulnerability in the first place (Chambers et al., 2003). Alongside
changes in the brain, hormonal processes and social, cognitive and environmental influences
that are uniquely associated with adolescence contribute to adolescents’ moods being different
from those of young children and adults (Buchanan, Eccles, & Becker, 1992).

These increased levels of impulsivity and not yet fully developed cognitive capacities
may have several repercussions for adolescent smoking cessation. Firstly, adolescents’
sensitivity to impulsive behavior and suboptimal decision making may cause them to be
indecisive about quitting or to prevent any plans – if made – from being followed through.
One example is that adolescents who are in the early stages of shaping a motivation to quit
smoking seem to move into action prematurely, and adolescents tend to move back and forth
between motivational stages more so than adults (Pallonen, 1998). Qualitative research in
which focus group interviews were conducted has also demonstrated that adolescents hardly
seem to plan their quit attempts, and that the attempts that were undertaken often had been
instigated by external factors (such as quitting at the insistence of a boy- or girlfriend) (Balch,
1998). The same study revealed that adolescents were hesitant about how they would go about
quitting and that they seemed to lack the ability of formulating a concrete plan or to know where to go for help. This is consistent with recent quantitative studies that show that adolescents display minimal engagement in cognitive and active behavioral strategies that should facilitate behavior change (‘transtheoretical processes of change’; Prochaska, Norcross, Fowler, Follick, & Abrams, 1992), and that these strategies do not seem to aid successful cessation among adolescents (Guo, Aveyard, Fielding, & Sutton, 2009; Kleinjan, Brug, Van den Eijnden, Vermulst, Van Zundert, & Engels, 2008; Kleinjan, Van den Eijnden, Van Leeuwe, Brug, Van de Ven, & Engels, 2008). In fact, when asked about how one should approach quitting, the preponderance of teenagers admitted not to have thought through what might be involved (Balch, 1998). It is possible that adolescents indeed set out on their quit attempts with relative ignorance as is also reflected by ‘the use of willpower’ being frequently mentioned as the chosen ‘strategy’ as well as the least helpful strategy used to quit smoking (Stanton, 1995).

Adolescents’ increased impulsivity may also predispose them to be more reactive to external stimuli, such as peer pressure and smoking-related cues, than adults. If so, their impulsivity and suboptimal decision making may cause them to deal differently, and perhaps less adequately, with high-risk situations compared to adults. Lastly, there are differences in the social environment and social partners that may play a role in the cessation process. Many studies on adult smoking cessation, for example, have focused on the role of partner support. Although some adolescents may have a romantic partner, the support of parents may be more significant to adolescent smoking cessation.

While more differences between adolescents and adults might be at play than listed above, we conclude with the proposition that adolescents could differ from adults in their experience of and vulnerability to withdrawal symptoms, which have been shown to be associated with relapse among adults (McCarthy, Piasecki, Fiore, & Baker, 2006; Piasecki, Jorenby, Smith, Fiore, & Baker, 2003). Withdrawal symptoms refer to physical and mental discomforts that emerge when individuals are deprived from smoking, such as cigarette craving, irritability, restlessness, insomnia, anxiety, depression, increased appetite and poor concentration (see Hughes, 2007, for a review). Despite that adolescents have been shown to experience withdrawal symptoms during abstinence as well, and that they report similar symptoms (Prokhorov, Hudmon, Cinciripini, & Marani, 2005; Smith, Cavallo, McFetridge, Liss, & Krishnan-Sarin, 2008), no studies have hitherto examined how withdrawal symptoms evolve over time after quitting, and whether they can predict failure to quit or smoking relapse among adolescents. One exception is the study by Smith and colleagues (2008) who assessed...
adolescents’ withdrawal symptoms weekly during the four weeks after they had quit smoking. The authors found that just as among adults, craving and restlessness among adolescents peaked after cessation, but symptoms of depressed mood, irritability, difficulty concentrating, appetite, sleep problems, and anxiety on the quit day did not significantly differ from the baseline assessments, which is in contrast with adult reports (Hughes, 1992; Jorenby, Hatsukami, Smith, Fiore, Allen et al., 1996; Piasecki et al., 1998; for an exception see Shiffman et al., 1997). It is possible that negative affect plays a different role in adolescent smoking cessation than it does among adults, since teenagers seem subject to more variable and more intense moods, more variable energy levels, more restlessness, and more anxiety than individuals at other stages of development (Buchanan et al., 1992). All in all, there are compelling reasons to examine the smoking cessation process in adolescent populations in addition to the available literature on adult smoking cessation.

*Several stages of the smoking cessation continuum*

Once adolescents have taken up smoking, there are several phases that are related to smoking cessation: decreasing one’s frequency and/or intensity of smoking, becoming and being motivated, planning or getting ready to quit, embarking on a quit attempt, achieving abstinence, and either maintaining abstinence or relapsing. This dissertation will deal with each of these phases.

*Smoking reduction*

Those who are not prepared to fully quit the habit might decrease their levels of smoking. Decreasing one’s frequency and intensity of smoking has been shown to be a precursor of eventual cessation (Carpenter, Hughes, Solomon, & Callas, 2004).

*Readiness or motivation to quit*

Most theories on health behavior share the tenet that changing one’s behavior needs to be preceded by having a certain degree of psychological motivation to quit (e.g., Theory of Planned Behavior [Ajzen, 1991], and The Transtheoretical Model (TTM) [Prochaska, DiClemente, & Norcross, 1992]). It has also been posited that several stages of motivation to change behavior can be distinguished, the so called ‘stages of changes’ (Prochaska et al., 1992). In ascending order, these five sequential stages of
change include: 1 ‘precontemplation phase’ (not planning to quit within 6 months), 2 ‘contemplation phase’ (planning to quit within 6 months, but not within the next month), 3 ‘preparation phase’ (planning to quit within 1 month and having made a previous quit attempt in the past year), 4 ‘action phase’ (having quit within the past 6 months), and 5 ‘maintenance phase’ (having quit for more than 6 months). These five stages are sometimes further divided into 9 stages of motivation to quit (Dijkstra, Bakker, & De Vries, 1997; Kleinjan et al., 2009).

**Smoking cessation**

Smoking cessation can be defined as either a) smoking at one time-point and reporting not to smoke (or not to have smoked for a certain period of time) at the second measurement, or b) maintaining cessation once abstinence is achieved. In the present thesis, we will mostly refer to smoking cessation in the way mentioned first.

**Lapse and relapse**

Resumption of substance use after someone has achieved some period of abstinence from the substance is referred to as ‘relapse’. Relapse differs from a ‘slip’ or lapse in that it implies a return to previous behavior patterns, as opposed to a one-time occurrence. In studies on adult samples, relapse is most commonly defined as ‘smoking at least five cigarettes for three consecutive days’ (e.g., Shiffman, Hickcox, Paty, Gnys, Kassel, & Richards, 1996). However, given that adolescents have shorter histories of smoking, common definitions of relapse as applied to adult smokers might be too stringent to apply to adolescent samples. The literature on adolescent smoking does not provide standard definitions of relapse that are suitable for adolescents specifically. Therefore, we defined relapse in two ways: 1) smoking at least one cigarette per day for three consecutive days (‘mild relapse’), and 2) smoking at least 5 cigarettes per day for three consecutive days (‘heavy relapse’). The first lapse was defined as the first report of smoking after achieving 24 hours of abstinence (even if only a puff).

**Theories on smoking cessation**

There are several theories that aim to model the mechanisms by which behavior is developed and by which change of behavior is supposed to be executed. Here, we will briefly outline some of those models that are being applied to smoking, smoking cessation, and relapse.
Social learning theory

To begin with, several social learning models have been developed to explain why people smoke. The designation of “social learning theory” has been used to refer to any social behavioristic approach (Bandura, 1977; Jessor & Jessor, 1977), and proposes that the principal mechanisms through which behavior is learned involve: a) social interaction; direct and indirect interaction with others, b) reinforcement; instrumental learning through punishment and reward, c) imitation; observational learning, and d) attitudes toward the behavior (Akers & Lee, 1996). Regarding social interaction and observational learning, there is abundant evidence that if persons in the immediate social environment smoke, such as friends and parents, that the odds are much higher that adolescents will take up smoking as well (e.g., Flay et al., 1994; Flay, Hu, & Richardson, 1998; Otten, Engels, Van de Ven, & Bricker, 2007), and that they subsequently seem less motivated to quit smoking and undertake fewer quit attempts (Burt & Peterson, 1998; Farkas, Distefan, Choi, Gilpin, & Pierce, 1999; Kleinjan et al., 2009). These social influences may be direct or indirect. Direct peer pressure, for example, may occur in the form of encouragement, dares, or actual offers of cigarettes. Indirectly, adolescents can be influenced by peers in the smoking cessation process in the sense that when they associate with peers, smoking may appear to be normative behavior, cigarettes become more readily available, and smoking may be perceived as a portal to social acceptance (Conrad, Flay, & Hill, 1992; Hawkins, Catalano, & Miller, 1992). Positive attitudes and social benefits may obstruct motivation to quit, and exposure to smoking and cigarette availability may frustrate maintenance of abstinence once achieved (Gwaltney et al., 2008). Thus, attitudes, such as the pros of smoking and the pros of quitting, can in part be modified by persons in the social environment, and in turn are known to be related to smoking (Tyas & Pederson, 1998), and smoking cessation (Hansen, Collins, Johnson, & Graham, 1985).

Finally, social learning theory assumes that smoking behavior can be learned and reinforced through punishment and reward. These reinforcers can be related to other people and attendant social benefits, but they can also include direct physical effects of using a certain substance, such as alcohol. The reinforcement through punishment and reward may be executed by parents by means of their parenting skills. Smoking-specific parenting, or “anti-smoking socialization,” refers to parenting practices that aim to affect the development of children’s cognitive and behavioral norms toward smoking (Jackson & Henriksen, 1997), such as setting rules, and communication about smoking and related risks. Engagement in this type of parenting has been demonstrated to successfully decrease the odds that children will
start or continue to smoke (De Leeuw, Scholte, Harakeh, Van Leeuwe, & Engels, in press; Engels & Willemsen, 2004; Ennett, Bauman, Foshee, Pemberton, & Hicks, 2001; Henriksen & Jackson, 1998; Jackson & Henriksen, 1997; Middlecamp Kodl & Mermelstein, 2004; Sargent & Dalton, 2001). Parenting practices attuned to adolescent smoking cessation specifically, however, have not yet been sufficiently explored.

**Social Cognitive Theory.** Another important theory governing research on human health behavior is the Social Cognitive Theory, which was developed by Bandura (1986, 2004). The core determinants of this theory include knowledge of health risks and benefits of different health practices, belief in one’s efficacy to exercise control over the intended behavior, outcome expectations about the expected costs and benefits (pros and cons), the concrete plans and strategies individuals set for realizing the intended behavior, and the perceived social and structural facilitators and impediments to the intended change in behavior. To start with the latter, social impediments and facilitators may present themselves in the shape of parents and peers and their behavior, attitudes and norms toward the behavior one wants to execute or change, as we have discussed above in the light of social learning theory. The outcome expectations that are supposed to affect health behavior take several forms; the physical outcomes (pleasurable and aversive effects), the social reactions the behavior elicits (approval and disapproval), and self-evaluative reactions to one’s behavior (positive and negative). In the context of smoking, outcome expectations have been operationalized as pros and cons of smoking, where the pros of smoking involve the perceptions of the advantages of smoking, and cons refer to the disadvantages of smoking. Prior research on the pros and cons of smoking also used measures of the pros of quitting next to the pros of smoking (De Vries & Backbier, 1994; Dijkstra et al., 1997). The literature has quite consistently demonstrated an association between the pros of smoking and the pros of quitting on the one hand and quitting behavior on the other among adults (De Vries & Backbier, 1994; Dijkstra, De Vries, & Bakker, 1996; Greening, 1997; Prochaska, DiClemente, & Norcross, 1992; Rose, Chassin, Presson, & Sherman, 1996), and adolescents (Hansen et al., 1985; Pallonen, 1998; Pallonen, Prochaska, Velicer, Prokhorov, & Smith, 1998). The association between adolescents’ pros of smoking and quitting and relapse after cessation, however, is at present understudied.

Furthermore, according to SCT, one’s sense of self-efficacy of having control over the (change in) behavior is the common pathway through which psychosocial influences affect health functioning. In fact, it is considered to be the foundation of human motivation and action. As Bandura (2004) formulated: “Unless people believe they can produce desired
effects by their actions, they have little incentive to act or to persevere in the face of difficulties. Whatever other factors may serve as guides and motivators, they are rooted in the core belief that one has the power to produce desired changes by one’s actions.” (p. 144). Despite that self-efficacy has been accredited such an important role in the main theories on health behavior, relatively little study has been devoted to the association between self-efficacy and adolescent smoking cessation and relapse. The few studies that did were limited in that they studied a mixture of daily smokers and very low rate smokers (for whom the process of quitting may be very different), and that they addressed long-term change (up to as long as three years later), but did not examine success in a particular quit effort (Chang et al., 2006; Engels, Knibbe, De Vries, & Drop, 1998; Tucker, Ellickson, & Klein, 2002). Thus, despite its assumed importance, little is known about the role of self-efficacy in adolescent smoking cessation and relapse.

Theory of Planned Behavior

Closely related to SCT is the Theory of Planned Behavior (TPB) (Ajzen, 1991), which shares with social learning and social cognitive theories the notion that behavior is preceded by cognitions and the intention to perform this particular behavior. In TPB, the sequence of behavior is thought to originate from attitudes toward the behavior, subjective norm of significant others toward the behavior, and the amount of control one thinks to have to perform the behavior (self-efficacy). These cognitions in turn are presupposed to shape the intention to perform the planned behavior, which will ultimately engender behavior change. Both the Theory of Planned Behavior and Social Cognitive Theory endorse the importance of self-efficacy, and consequently, self-efficacy has been incorporated into theories that deal with substance use and relapse specifically.

Dynamic regulatory feedback model

The importance of self-efficacy takes on a central role in models such as the dynamic regulatory feedback model, that proposes self-efficacy to be the main mediating factor in all associations between other relevant factors and relapse (Niaura, 2000; Niaura et al., 1988). These other factors include affect states and external stimuli (such as smoking cues) that are thought to trigger both cognitive and physiological reactions (such as outcome expectations and arousal) and urge (in this case, urge to smoke). This accumulation of cognitive and physiological responses and urges is supposed to interact with cognitive-behavioral coping efforts and attributions such that when the cue responses are overwhelming, one’s confidence
in achieving or sustaining the pursued goal is weakened and the risk of relapse is looming. In this model, self-efficacy is - again - thought to be the central component that inhibits urges and outcome expectations and increases the likelihood of coping. The result of this process is then thought to reaffect urges and outcome expectations that in turn again influence self-efficacy, creating a cyclical pattern in which self-efficacy will eventually be the final determinant of relapse.

As for affect states and external stimuli, there is considerable evidence that they influence smoking cessation outcomes among adults. Affect states such as craving (or urge to smoke) and negative affect (e.g., nervousness, anger, frustration, irritability, and feeling depressed [Kassel, Stroud, & Paronis, 2003]), are present during on-going smoking, but increase substantially upon quitting, and are then often referred to as ‘withdrawal symptoms’. When averaged across individuals, withdrawal symptoms typically show a strong increase during the first week of deprivation after which they gradually revert to an equal or even lower level than that at baseline (Hughes, 1992; Jorenby et al., 1996; Piasecki et al., 1998; for an exception see Shiffman, Engberg, Paty, Perz, Gnys et al., 1997). Adolescents seem to experience withdrawal symptoms during smoking deprivation as well, and they report symptoms similar to adults (Prokhorov et al., 2005; Smith et al., 2008). Yet only very few studies have modeled the natural history of withdrawal in adolescents following a quit attempt and related the course of withdrawal over time to relapse outcomes (Smith et al., 2008). Dynamic effects of daily variations also have not yet been examined among adolescent smokers.

Regarding external stimuli, research on the precipitants of lapse and relapse episodes suggests that environmental stimuli and events play a substantial role in the relapse process. Those environmental stimuli and events include the presence of other smokers, alcohol consumption, and coffee consumption (Baer & Lichtenstein, 1988; Shiffman, 1982; Shiffman, Paty, Gnys, Kassel, & Hickcox, 1996). The only study so far that examined the association between external stimuli and adolescent relapse after quitting involved a pilot study (Gwaltney, Bartolomei, Colby, & Kahler, 2008). The exploratory analyses of the latter study suggested that adolescents’ first lapses are associated with seeing other people smoke and availability of cigarettes. Beside these results, little to nothing is known about the relevance of smoking-related cues in the process of quitting and relapse among adolescents.
Measurement & methodology

Before outlining the research questions and data characteristics of the studies included in this thesis, we briefly introduce several methodological concepts and analytic strategies that are relevant to the present thesis.

Ecological momentary assessment (EMA)

Assessment in clinical psychology typically relies on global retrospective self-reports administered at only one time-point, which are limited by recall bias and not well-suited to address how behavior changes over time and across contexts. To obviate this major shortcoming in traditional research designs, ecological momentary assessment (EMA) methods have been developed and have undergone a tremendous increase in their application to social sciences. EMA involves repeated assessment of subjects’ current behaviors and experiences in real-time, in subjects’ natural environments. EMA aims to minimize recall bias, maximize ecological validity, and allow study of micro-processes that influence behavior in real-world contexts (Shiffman, Stone, & Hufford, 2008). In other words, EMA aims to ‘capture life as it is lived’ (Bolger, Davis, & Rafaeli, 2003). Given its important assets of capturing fluctuations in behavior and dynamic effects thereon, EMA methods have been used in smoking cessation research since the early nineties and are on a rise still, that is, among adult samples. To our knowledge, there are almost no studies that have examined adolescent smoking cessation and relapse through means of EMA. One exception is an EMA pilot study conducted among 13 adolescents who embarked on a quit attempt. This study revealed that compliance with the protocol (several assessments per day) was high and that EMA seems to be a feasible approach among adolescent smokers (Gwaltney et al., 2008). The present thesis includes several studies on adolescent smoking relapse using an EMA design.

Structural equation analysis

Firstly, we used structural equation modelling (SEM) in chapters 3, 4, and 13. SEM refers to a statistical modeling technique that is a combination of factor analysis and regression or path analysis, in which multiple equations can be tested simultaneously (Jöreskog & Sörbom, 1996; Kline, 2005). Among the major advantages of SEM is its ability to model constructs as latent variables. Latent variables are variables that are not measured directly, but that are estimated in the model by using the measured variables (‘observed
variables’) as its indicators. This allows the measurement error in the model to be explicitly accounted for, which - in theory - allows the structural relations between latent variables to be more accurately estimated. SEM models typically consist of a ‘structural model’ that represents the potential causal associations between endogenous (dependent) and exogenous (independent) variables, and a ‘measurement model’ that estimates the relations between the latent variables and their indicators. An example of a structural equation model that is based on the measurement model only is confirmatory factor analysis (CFA), in which one imposes a hypothesized factor structure on the data to test whether the hypothesized factor structure provides a good fit to the actual data. CFA was applied to test the newly developed smoking cessation-specific parenting scale in chapter 3.

Latent growth curve modeling

Further, if we want to study change, latent growth curve (LGC) analysis is a suitable method (Muthén & Muthén, 1998-2006). Simply put, change, or ‘growth’, can be negative or positive, it can start at a certain degree or level (intercept), it evolves at a certain pace (slope), and its shape can be linear or non-linear. All of these attributes can be modeled with LGC. In chapter 9, LGC is applied to examine how withdrawal symptoms evolve over time, and to test if characteristics of growth can predict prolonged abstinence among adolescents.

Hierarchical linear modeling

Individuals belonging to one group may differ from individuals from another group as a function of group characteristics. Think of the classical example of pupils that are nested within schools. The performance of pupils within the same class will be correlated, as will the performance of pupils within the same school. These correlations must be represented in the model to correct for this partial interdependence of observations. Hierarchical linear modeling (also known as ‘multi-level modeling’) deals with the nested structure of data by explicitly modeling both individual and group level residuals (within- and between group-variance) (Raudenbush & Bryk, 2002). In addition, HLM models permit examination of both the lower level unit and higher level unit variance in the outcome measure, while maintaining the appropriate level of analysis for the independent variables. For repeated measures data, time, or situations, can be considered as a level (situational level) which occurs within participants (individual level). In chapters 8 and 11, we applied HLM to test whether variables on the situational level (such as daily measures of self-efficacy, craving, and alcohol use) as well as on the individual level (such as age, sex, and baseline smoking status) are related to cessation
outcomes, and whether individual level factors can explain the associations between situational variables and cessation outcomes among daily smoking adolescents.

*Cox proportional hazards survival analysis*

Survival analysis is concerned with studying the time between a certain begin point (such as quitting smoking) and a subsequent event (such as relapse into smoking). Cox regression (or ‘proportional hazards regression’) is a method for investigating the effect of one or more variables on the amount of time it takes for a certain event to occur (Cox, 1972). This procedure takes into account that some individuals have not (yet) experienced the event before the end of the study (‘censored’ cases). The relative risk of how often a particular event happens in one group compared to how often it happens in another group over time is expressed through the ‘hazard ratio’. A hazard ratio of 1 means that there is no difference in survival between the two groups. A hazard ratio of greater than 1 or less than 1 means that survival was better in one of the groups. When individuals are followed over time, the values of the covariates may change with time. In such cases, the Cox model is extended by including time-dependent, or time-varying covariates. This technique of Cox regression with time-varying covariates is used in chapters 7 and 10.

*Research questions and study characteristics*

Here, we will give an itemized overview of the research questions that have been addressed in the present thesis. They are ordered in the sequence of the chapters in which they are addressed.

- Are smoking-specific cognitions (pro-smoking attitudes, perceived social norms regarding smoking, and self-efficacy to resist smoking) prospectively related to adolescent smoking progression and reduction after experimentation with cigarettes?
- Are parental smoking and smoking cessation-specific parenting related to adolescent’s readiness to quit, and if so, are there indirect pathways from parents to readiness to quit via adolescents’ cognitions?
- Can parental smoking and smoking cessation-specific parenting predict readiness to quit and actual cessation one year later?
• Can parental smoking and smoking cessation-specific parenting predict relapse among daily smoking adolescents who have quit smoking?
• Can individual differences in smoking-specific cognitions (pros of smoking, pros of quitting, and self-efficacy) predict relapse among daily smoking adolescents who have quit smoking?
• Can daily variations in self-efficacy predict lapses and relapse among adolescents?
• What are the situational correlates of self-efficacy to resist smoking during adolescents’ quit attempts?
• Do adolescents experience withdrawal symptoms after quitting, and if so, how do these symptoms evolve over time?
• Can day-to-day variations in withdrawal symptoms predict lapses and relapse among adolescents?
• What role does alcohol consumption play in adolescent smoking relapse?
• What is the prevalence of smoking cessation among adolescents with asthma?
• Do adolescents with asthma develop nicotine dependence at the same pace as non-asthmatic peers?
• Do adolescents with asthma differ from non-asthmatic peers in the associations between environmental factors, nicotine dependence, and readiness to quit smoking?

*Table 1. Characteristics of the datasets included in the present thesis.*

<table>
<thead>
<tr>
<th>Chapters</th>
<th>2</th>
<th>3, 4, 12, 13</th>
<th>5, 6, 7, 8, 9, 10, 11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>Longitudinal</td>
<td>Cross-sectional and longitudinal</td>
<td>Cross-sectional and short-term longitudinal</td>
</tr>
</tbody>
</table>
| Assessment | 3; 6-month intervals | 4; 1-year intervals | Pre-quit: 1 week before EMA  
EMA: 4 weeks, 3 times a day  
Post-quit: Immediately after EMA  
Follow-up: 2 months after end EMA |
| Sample    | 397 adolescents aged 11-15 | ≤ 1,055 adolescents aged 14-18 | 149 adolescents aged 15-19 |
| Data collection | At school | At school | Natural habitat |
Overview of this thesis

Part 1 of this thesis focuses on the mechanisms underlying several phases of the smoking cessation continuum among adolescents with and without asthma. We will begin with the earliest stage of smoking cessation in Chapter 2, in which we examine the role of smoking-specific cognitions (pro-smoking attitudes, perceived social norms regarding smoking, and self-efficacy to resist smoking), and interactions between cognitions, on progressions and reductions in smoking over time. We have examined this in a sample of adolescents who had experimented with smoking or who had only recently taken up smoking.

In chapters 3, 4 and 5, we examine the role of parents in several stages of the smoking cessation process. Chapter 3 deals with the cross-sectional associations between parental smoking, smoking cessation-specific parenting, and readiness to quit smoking among adolescents who smoke weekly or daily. We elaborated on this study in Chapter 4 by testing the longitudinal effects of parental smoking and smoking cessation-specific parenting on readiness to quit and actual smoking cessation one year later. To test whether parents also play a role after adolescents have quit smoking, we examined the associations between parental smoking, smoking cessation-specific parenting and relapse among daily smoking adolescents in Chapter 5.

After elaborating on the role of parents, we turn to the role of cognitions. In Chapter 6, we tested whether individual differences in smoking-specific cognitions (pros of smoking, pros of quitting, and self-efficacy to resist smoking) predicted the first lapse and relapse into smoking after adolescents had achieved 24 hour abstinence. Next, to gain more insight into the micro-processes and day-to-day variations in cognitions, we examined to what extent adolescents’ self-efficacy varies from day to day, and whether daily variations in self-efficacy predict the first and second lapse and relapse the next day in Chapter 7. Given that chapter 7 revealed the importance of variations in daily self-efficacy, we devoted Chapter 8 to examining the situational correlates of momentary (situational) self-efficacy. The situational factors included were internal states (craving and negative affect), and external stimuli (seeing others smoke, drinking coffee or alcohol, and experiencing a stressful event).

We further examined the role of craving and negative affect in the light of withdrawal symptoms in chapters 9 and 10. Chapter 9 encompasses findings on the course over time of withdrawal symptoms (craving, negative affect, and hunger) among daily smoking adolescents before, during, and after a quit attempt. Growth curves were estimated to model
the course over time, and parameters of the growth curves were used to predict cessation outcomes. *Chapter 10* subsequently provides a more in-depth view on the dynamic effects of day-to-day variations in craving and negative effect on several cessation milestones, such as the first lapse and relapse. We close Part 1 by examining the association between alcohol consumption on a given day and the first lapse and relapse in *Chapter 11*. We also tested whether these potential associations are moderated by individual characteristics, such as age, sex, and smoking status at baseline.

Part 2 of this thesis comprises the results that relate to asthma-specific factors and differences in smoking cessation processes between adolescents with and without asthma. In *Chapter 12*, we first provide asthma-specific prevalence figures and unpublished data on asthma-specific factors as related to smoking cessation. This chapter will also provide a closer examination of the development of nicotine dependence over time and history of quit attempts among adolescents with asthma in particular. To further elucidate the role of asthma in the smoking cessation process, *Chapter 13* aims to gain insight into the differences between adolescents with and without asthma regarding parents’ and best friends’ smoking, smoking-specific cognitions, and nicotine dependence, and their association with readiness to quit smoking.

To conclude with, *Chapter 14* provides a summary and general discussion of the present thesis, in which all findings are elaborated on from an overarching perspective. In addition to the limitations of the present thesis, implications for theory, practice and future research will be discussed.
References


Chapter 2

Adolescent smoking continuation: Reduction and progression in smoking after experimentation and recent onset
Abstract

In the present study, the role of cognitive concepts derived from the Theory of Planned Behavior in adolescent smoking reduction, continuation, and progression was investigated. These concepts include pro-smoking attitudes, perceived social norms regarding smoking, and self-efficacy to resist smoking. Logistic regression analyses were performed on data from 397 Dutch adolescents aged 11-15 years, who had at least once tried smoking. Attitudes, perceived social norms, and self-efficacy, including significant interactions between these three concepts, explained up to 41% of variance in smoking behavior cross-sectionally. Longitudinally, an interaction between pro-smoking attitudes and low self-efficacy increased the chance of reduction in smoking, and all three cognitions inclusive of two interactions between pro-smoking perceived social norms and low self-efficacy or positive attitudes towards smoking predicted progression of smoking. Cognitions may play relatively small roles in adolescent smoking reduction, but do seem to be relevant in progression in smoking after experimentation or recent onset. Interactions between positive attitudes towards smoking and prosmoking perceived social norms provide cumulative risks for adolescents to increase their levels of smoking, whereas interactions between less favorable attitudes and high self-efficacy to resist smoking may provide a protective effect for adolescents to reduce or to quit their smoking.
Introduction

Despite the fact that the highly hazardous consequences of smoking have become common knowledge, representative figures demonstrate that there is still a large proportion of adolescent smokers. Prevalence rates in the Netherlands show that 23.6% of 10-19 year old students smoke at least once a month, and 46.3% have ever experimented with smoking (Dutch Foundation for National Health and Smoking (STIVORO), 2004). Also, most experimentation of smoking occurs among Dutch adolescents between 12 and 14 years (Dutch Foundation for National Health and Smoking (DEFACTO), 2002). These prevalence rates are in accordance with the general figures in most European countries, where country-specific prevalences of smoking during the last 30 days range between 22% and 56%, and where 50% to 80% of 15-16 year old students have ever tried smoking (Hibell et al., 2003).

At present, ample studies have been conducted to examine which factors constitute the motivation of young people to initiate smoking. One of the most frequently studied theoretical frameworks of smoking initiation involves the Theory of Planned Behavior (TPB) (e.g. De Vries et al., 1995; Godin et al., 1992; Hanson, 1997; Harakeh et al., 2004). The TPB aims to predict motivational influences on deliberate behavior, such as experimentation and initiation of smoking, through consideration of attitudes, normative beliefs, and self-efficacy (Ajzen, 1991). Despite the fact that the motivational processes of the TPB have been proved to be related to initiation of regular smoking, little is known about the motivational processes that are involved in continuation of smoking after experimentation with or recent initiation of smoking. It is crucial, however, to determine why some adolescents do not continue to smoke after experimentation or recent initiation whereas other adolescents do. Of those who do continue to smoke, it is useful to know which factors can predict either reduction or progression in their levels of smoking.

The few studies that consider smoking continuation have mainly focused on adult populations and on demographics, such as education (Droomers et al., 2002), on tobacco availability (Pokorny et al., 2003), on nicotine dependency and amount of cigarettes smoked at baseline (Nordstrom et al., 2000; Pierce et al., 1996), and on parental smoking (Bauman et al., 2001; Fergusson et al., 1995). Also, smoking behavior of friends has been found to predict progression from experimental smoking to regular smoking (Pierce et al., 1996). Cognitive predictors of smoking continuation, such as attitudes, self-efficacy and perceived social norms, however, have hardly been taken into account so far, neither among adolescents, nor among adults. However, since the concepts of the Theory of Planned Behavior have been abundantly and successfully linked to other stages of smoking before, such as intention to
smoke (De Vries et al., 1995; Godin et al., 1992; Kremers et al., 2004), and initiation of smoking (Harakeh et al., 2004), the TPB may provide an appropriate framework within which to study continuation of smoking after experimentation or recent onset.

**Attitudes, perceived social norms, and self-efficacy.**

Applied to smoking behavior, pro-smoking attitudes reflect a positive and favorable view on smoking (Harakeh et al., 2004). When adolescents value smoking as advantageous, it is plausible that they will see no reasons to discontinue smoking. In fact, the experience of smoking may influence the attitudes towards smoking. When adolescents have positive experiences with smoking, it is possible that they will come to view smoking as more positive, which in turn may make them more susceptible to increase their levels of smoking. Furthermore, most studies have focused on peer smoking as a measure of peer influence, yet passive peer pressure through perceived normative beliefs appears to have been neglected (Perrine, & Aloise-Young, 2004). However, it is understood that adolescents are strongly susceptible to their friends’ attitudes and values (Berndt, 1996; Cohen, 1977). Therefore, it is likely that adolescents take their friends’ norms and approval of their behavior as a reference in making their decision to either quit, to continue, or to even increase their levels of smoking after experimentation or recent initiation. The effect of self-efficacy may also be applicable to smoking continuation in the sense that, when adolescents have experimented with or have recently taken up smoking, and expect that they will find it difficult to resist smoking in subsequent tempting situations, they are more likely to continue their recently acquired habit. Low self-efficacy may also make them more vulnerable to progression of smoking, whereas high self-efficacy to resist smoking may make adolescents more prone to smoking reduction.

In conclusion, previous studies have indicated that attitudes towards smoking, perceived social norms, and self-efficacy concerning smoking resistance may explain and predict smoking initiation and are likely to play a role in smoking continuation as well.

**The present study.**

Pro-smoking attitudes, perceived social norms which reflect friends’ approval of smoking, and low self-efficacy to resist smoking in tempting situations were hypothesized to be positively related to smoking behavior cross-sectionally. From a longitudinal perspective, pro-smoking attitudes, perceived social norms in favor of smoking, and low self-efficacy to resist smoking were expected to predict smoking continuation, and progression. Negative attitudes towards smoking, perceived social norms disapproving of smoking, and high self-efficacy to resist smoking were expected to be positively related to smoking reduction. Furthermore, Ajzen and Madden (1986) recommend that interactions between the cognitive
concepts be included in testing the theory. They propose that direct effects of attitudes, norms, and self-efficacy on behavior need not be additive in nature. Each of these predictors may be necessary, but not sufficient conditions for the formation of intentions to perform behavior. Regarding behavioral control, for example, one must also be inclined to perform the behavior for other motivations than merely believing that one could perform the behavior. This line of reasoning implies the possibility that perceived behavioral control affects behavior in interaction with attitudes and self-efficacy. Also, testing interactions may illuminate which combinations of predictors place young smokers in a high risk group of adolescents who are most likely to continue to smoke or even to progress their levels of smoking. Despite Ajzen and Madden’s valuable recommendation, no study has hitherto implemented this strategy with regard to adolescent smoking behavior. Accordingly, the present study is unique in including interactions between smoking attitudes, perceived social norms and self-efficacy to test if particular combinations of these concepts have cumulative effects, and will thus pose an intensified threat for starting smokers to continue or to increase their levels of smoking. These interactions were tested in a three-wave longitudinal study among 397 adolescents who had at least once tried smoking.

Method

Sample and procedure

During the 1999-2000 school year, 1969 first-grade students (footnote 1) from ten secondary schools across the Netherlands were recruited for a three-wave study which examined smoking behavior, drinking behavior, and delinquency. During November and December 2000, when the students were at the beginning of the first grade, the first wave (T1) had been conducted, the second wave (T2) took place six months later in May-June 2001, and the third and final wave (T3) in November-December 2001, when the students were at the beginning of the second grade. The parents or guardians had been informed about the aims of the study in advance and had been given the opportunity to respond if they had any objections to their child’s participation. A few parents contacted the research institute for additional information, yet none of the parents disapproved of their child taking part in the study. The students themselves agreed to participate as well, and incidental missings were solely due to truancy and sickness. Questionnaires had been administered during school hours in the presence of an instructed teacher. All students were assured of strict confidentiality, that any information given would not be revealed to any other person than the primary researchers. Students were notified that participation included them in a lottery through which CD-
vouchers could be won, to motivate them to complete the questionnaires conscientiously at all three measurements.

Of the eligible 1969 students, 1595 (81%) participated in all three measurements. Sample attrition over the several measurements was mainly due to students who changed school, dropped out, or who repeated the same curriculum for a second year. Also, two schools had not been able to administer the questionnaires during one of the three measurements. Previous attrition analyses on the present data have demonstrated that there were no substantial differences between the students who dropped out of the sample and those who were included (De Kemp et al., 2004). Of these 1595 respondents, only those respondents were included in the analyses who had reported that they had at least smoked once, thus constituting the final sample (N = 397).

At baseline, the average age of the respondents was 12.4 years (SD = .52; range: 11-15 years). At the second measurement most students were 13 years old (72.0%), and at the third measurement, most adolescents were aged 13 (51.6%), and 14 (45.6%). The sample comprised 215 (54.2%) boys and 182 girls. The vast majority of respondents (94.7%) were of Dutch descent. Types of education that were involved in the study were a) lower education (14.9%), b) middle education (35.5%), and c) pre-university education (38.8%). The remaining 2.3% included not otherwise specified types of education. With regard to domiciliary situation, 85.0% lived with both their parents, 12.2% lived in a single parent household, and 2.8% resided in other arrangements (e.g., with other family members, institutions, or foster homes).

**Measures**

**Smoking continuation.** A frequently used self-report instrument to measure smoking status was employed (cf. Engels et al., 2004; Kremers et al., 2001; Harakeh et al., 2004). Smoking status was assessed through one item asking the respondents which statement applied best to them. Percentages will be given for the first, second, and third measurement respectively. 1) “I have tried smoking once, but I no longer smoke” (68.6%; 63.4%; 53.1%), 2) “I try smoking once in a while” (15.1%; 13.1%; 14.5%), 3) “I smoke less than once a month” (2.5%; 2.5%; 7.1%), 4) “I do not smoke weekly, but at least once a month” (2.5%; 4.5%; 3.0%), 5) “I do not smoke daily, but at least once a week” (6.8%; 7.6%; 6.1%), and 6) “I smoke at least once a day” (4.5%; 8.8%; 16.2%). Thus, the preponderance of students at baseline concerned adolescents who had at least tried smoking once but who no longer smoked (68.6%), a percentage which had decreased to 63.4% at T2, and to 53.1% at T3. Moreover, considering its skewed distribution, the outcome variable in the cross-sectional analyses ‘smoking status’ had been dichotomised at all three measurements. A score of ‘1’
thus included respondents who reported that they had tried smoking once, but who had not continued smoking, whereas score ‘2’ included the respondents who at that time reported to smoke, regardless of frequency. To explore possible effects of the cognitions on smoking continuation, a distinction had been made between reduction in smoking, and progression in smoking. To this end, the original smoking status variable with 6 categories of smoking frequency had been recoded into 3 categories: ‘1’ represented those who had tried smoking but who no longer smoked, ‘2’ represented the ‘occasional smokers’, who smoked once in a while or at least once a month, and ‘3’ represented the weekly and daily smokers. This was performed for all three measurements. Reduction was established when a respondent showed that frequency of smoking had decreased, for instance, when he or she had reported to smoke weekly or daily at the first measurement, and reported to be smoking once in a while or once a month at the second measurement. Progression was similarly defined, with the change in smoking frequency indicating an increase in smoking frequency. The reduction and progression variables were computed as dichotomous variables of which ‘1’ represented the group with those respondents who had maintained the same level of smoking frequency, and of which ‘2’ represented the group of either reducing or progressing respondents. The respondents who reported to have tried smoking once, but who at baseline had already quit experimenting with smoking were excluded from the reference group in the longitudinal ‘reduction’ analyses, since reduction in smoking could not be accomplished within this group. Thus, the reference group in the reduction analyses contained only respondents who at baseline had been occasional or regular smokers, and who had maintained this level of smoking at T2 and/or at T3. Similarly, the regular smokers at baseline were excluded from the reference group in the longitudinal ‘progression’ analyses, as progression in smoking could not be reached within this group as well. Thus, 6 longitudinal logistical regression analyses were performed: continuation of the same smoking frequency level versus smoking reduction or smoking progression between T1 and T2 (six month interval), between T1 and T3 (one year interval), and between T2 and T3 (six month interval).

Attitudes towards smoking. Attitudes towards smoking reflect to which extent adolescents appraise or have a positive regard for smoking. Attitudes towards daily smoking were measured on a bipolar scale of which the seven items represented negative and positive attitudes (Harakeh et al., 2004). The negative words were: ‘unpleasant’, ‘harmful’, ‘useless’, ‘boring’, ‘hazardous’, ‘unhealthy’, and ‘bad’. The positive words on the bipolar scale were respectively: ‘pleasant’, ‘innocuous’, ‘useful’, ‘exciting’, ‘harmless’, ‘healthy’, and ‘good’. On a scale of 1 to 7, respondents could rate their preference regarding each of the attitudes.
High scores imply strong pro-smoking attitudes. Internal consistencies for T1, T2, and T3 respectively were .83, .85, and .86, as assessed through Cronbach’s alpha.

**Perceived social norms.** To examine to which degree adolescents subjectively feel that their best friends and friends in general either approve or disapprove of the respondent’s smoking, the respondents were asked to indicate to which extent they thought that a.) their best friend, and b.) their friends would approve that he or she smoked or would smoke (Harakeh et al., 2004). Response choices ranged from 1 ‘certainly not’ to 5 ‘certainly yes’. The mean of the two items was used in the analyses. High scores imply strong approval. The Pearson correlation between the two items was .70.

**Self-efficacy to resist smoking.** A self-efficacy instrument was employed to explore the expected self-efficacy not to smoke in smoking-specific and tempting situations (De Vries et al., 1988; Engels et al., 1999). A few examples of the 6 items are: “For me, not to smoke, while my friends are smoking is…”, “For me, to think of a reason to refuse a cigarette is…”, and “For me, becoming a non-smoker is…”. The expected difficulty not to smoke in the described situations ranged from 1 ‘very hard’ to 6 ‘very easy’. High scores imply high self-efficacy to refrain from smoking. Internal consistencies for T1, T2, and T3 respectively were .83, .86, and .89, as assessed through Cronbach’s alpha.

**Results**

To test the relatedness and predictive power of attitudes, perceived social norms, and self-efficacy in relation to concurrent smoking, and to smoking reduction or progression, both Pearson and Spearman correlations and logistic regression analyses were conducted cross-sectionally as well as longitudinally.

**Descriptive analyses**

Table I lists the cross-sectional and longitudinal Pearson and Spearman correlations between the cognitive factors and smoking for all three measurements. Both cross-sectionally and longitudinally, attitudes were moderately correlated with perceived social norms, with correlations ranging between .10, and .32, and more strongly correlated with self-efficacy, with correlations between -.24, and -.51. Perceived social norms and self-efficacy were moderately correlated as well, with correlations between -.13, and -.28. Furthermore, from a cross-sectional and longitudinal perspective, all cognitive determinants were significantly correlated with smoking at all three measurements, with correlations ranging between .14, and -.46. Cross-sectionally, the cognitive determinants and smoking seemed to be increasingly correlated in the course of the year. Lastly, the longitudinal correlations between the cognitive determinants at T1, and smoking at the subsequent measurements T2 and T3, generally
showed a decreasing trend. Thus, the longer the interval between the waves, the weaker became the correlations between cognitive determinants and smoking.

**Cross-sectional analyses**

Table II presents the cross-sectional findings for attitudes, perceived social norms and self-efficacy in relation to adolescent smoking. Age, gender, and ethnicity were included in the analyses as control variables. The enter-method was used in the logistic regression analyses, and both Table II and Table III represent the findings per step. Neither one of the external variables age, gender, ethnicity, and educational attainment level appeared to be associated with adolescent smoking. Furthermore, the odds’ ratios proved to be significant at all three measurements for attitudes, and for self-efficacy. This indicates that holding pro-smoking attitudes and anticipating low self-efficacy to resist smoking increase the odds of young adolescents’ smoking. Perceived social norms only appeared to be significantly related to smoking at T2, which shows that adolescents are more likely to smoke at T2 when they perceive the perceived social norms to be in favor of their smoking habit. To conclude, Nagelkerke’s explained variance from T1 to T3 increased from 22% to 41%. Apparently, over an interval of a year, the TPB derived variables are increasingly powerful to explain largely more than one third of the variance in smoking behavior. These results thus support the idea that smoking attitudes, perceived social norms, and non-smoking self-efficacy are related to smoking behavior in a sample of early adolescents who had reported life time smoking.

**Longitudinal analyses**

Table III shows the longitudinal associations between the cognitive factors and reduction in smoking. The background variables did not seem to be relevant, neither in reduction nor progression in smoking, with exception of educational attainment at T1. A high educational attainment level served a protective function in that adolescents who received high secondary education were the most likely to have reduced or to have quit smoking at T2, relative to the first measurement. Although cognitive factors were generally significantly related to smoking cross-sectionally, smoking reduction did not appear to be affected by the included cognitions. Concerning progression in smoking (Table IV), the cognitive concepts seemed to play a more important role. When adolescents who had experimented with smoking, or who had recently taken up smoking, perceived the social norm regarding smoking to be in favor of smoking at the first measurement, they were significantly more likely to have increased their levels of smoking six months later (T2) than to have continued to experiment or to have maintained the same smoking level. Positive attitudes towards
smoking, as well as low self-efficacy to resist smoking at the first measurement were predictive of progression in smoking one year later (T3) (Footnote 2).

Interaction analyses

Three two-way and one three-way interaction terms between the cognitive factors had been computed as the products of the centered main effects variables (Aiken & West, 1991). Interactions between attitudes and perceived social norms were significantly related to adolescent smoking cross-sectionally at T1, and T3. Thus, when adolescent experimenters or starting smokers hold positive attitudes towards smoking in conjunction with a perception of high perceived social approval of their smoking, they are at elevated risk to smoke (see Figure 1a and Figure 1b). The cross-sectional three-way interaction at T3 also demonstrated that adolescents who concurrently experienced pro-smoking attitudes, pro-smoking perceived social norms, and who additionally experienced low self-efficacy to resist smoking, were twice as likely to smoke, than adolescents who were not influenced by all three cognitions simultaneously (see Figure 1c). Longitudinally, the interaction between negative attitudes towards smoking and high self-efficacy to resist smoking at T1 significantly predicted reduction in smoking six months later (see Table III, and Figure 2a). This implies that adolescents who consider smoking to be unfavorable and who concurrently feel capable of resisting smoking, are more likely to reduce their smoking levels. That is, compared to adolescents who either view smoking as unfavorable, but who have low self-efficacy to refrain from smoking, or compared to adolescents who anticipate to be capable of refraining from smoking, but who concurrently retain or develop a positive regard for smoking. Also, an interaction between positive attitudes and pro-smoking perceived social norms at T1 was significantly related to progression in smoking at T3 (see Table IV, and Figure 2b). Apparently, adolescents who view smoking as advantageous, and who at the same time perceive the perceived social norms to be in support of their smoking habit, are more likely to increase their levels of smoking after experimentation or recent initiation. That is, compared to adolescents who either have pro-smoking attitudes but who do not experience social approval, or adolescents who do experience social approval, but who themselves do not endorse positive attitudes towards smoking. Also of influence on progression, yet after six months, was an interaction between pro-smoking perceived social norms and low self-efficacy to resist smoking (see Figure 2c).

Discussion

The present study aimed to identify the influence of cognitive concepts derived from the Theory of Planned Behavior on adolescent smoking continuation in terms of reduction and
progression in levels of smoking. As hypothesized, pro-smoking attitudes, perceived social norms endorsing smoking, and low self-efficacy to resist smoking were related to smoking behavior cross-sectionally, which is in line with previous studies (De Vries et al., 1995; Harakeh et al., 2004). Moreover, interactions between attitudes and norms were found to be related to adolescent smoking at T1 and T3. Also, adolescents who concurrently held positive attitudes towards smoking, who scored low on self-efficacy to resist smoking, and who perceived the social norms to be in favor of their smoking, were twice as likely to be smoking at T3. Cross-sectionally, the explained variance appeared to increase from T1 to T3. From a statistical viewpoint, this is plausible since there is increasing variance on smoking status as adolescents are older. Moreover, adolescence is known to be the period in which (meta)cognitions are developed, and in which the ability to self-reflect is enhanced (Finkenauer et al., 2002; O’Mahony, 1989). As cognitive skills are more developed, they are more likely to be applied in adolescent decision making.

Judging from the longitudinal results, the predictive validity of the cognitive concepts appeared to be very limited in terms of reduction of smoking. However, in the present study, the application of concepts derived from the Theory of Planned Behavior has proven successful in predicting progression in smoking. It is therefore interesting and important to explore alternative explanations as to why these cognitions did not predict reduction of smoking among adolescents, whereas they do seem to play a role in progression in smoking.

Perhaps, reduction in smoking does not involve a typical cognitive process. The group of reducing adolescents mainly consisted of occasional smokers at baseline who had quit smoking after six or twelve months. It is conceivable that when adolescents smoke only once in a while, it does not require an active rational decision to quit the occasional smoking. It may also be the case that other factors are relevant in smoking reduction than in smoking progression. It is possible that the need to experiment with smoking is fulfilled after a few months, and adolescents may no longer feel the need to continue their smoking. However, this contention does not hold for all experimenters, as the reducers’ reference group in the analyses had maintained the same level of smoking at baseline one year later. Considering the intervention opportunities in this specific smoking trajectory, it is important for future research to examine which factors, other than cognitions, stimulate some adolescents to reduce or to quit smoking after experimentation or recent onset, whereas others maintain the same levels of smoking.

Alternatively, a combination of cognitions may be more significant in explaining reduction in smoking than each of the cognitions individually. The present results evidence of
a considerable negative impact of the interaction between pro-smoking attitudes and low self-efficacy to resist smoking at baseline on reduction in smoking six months later (T2). This means that adolescents who score high on positive attitudes towards smoking and who concurrently score low on self-efficacy to resist smoking are the least likely to reduce their smoking. Intervention programs aimed to make experimenters or recent smokers quit or reduce their smoking should therefore target the smoking-related attitudes and self-efficacy simultaneously rather than separately. Educational attainment level should also be accounted for, as the present data demonstrate that adolescents who received high secondary education were the most likely to have reduced or quit smoking after six months. Students at a lower educational attainment level may require relatively more attention in encouraging reduction of smoking.

Regarding progression in smoking, the involved smoking-related cognitions seem to play a marginal yet significant role. Perceived social norms emerged as a significant predictor of smoking progression among students after six months of the first grade. Over the course of one year (T1-T3), both positive attitudes towards smoking, and low self-efficacy to resist smoking displayed marginal effects on progression on smoking. The fact that perceived social norms at the beginning of the first grade (T1) appeared to be relevant for progression in smoking six months later (T2), and that similar effects had not been found for attitudes and self-efficacy, might indicate that when adolescents enter secondary school, they may adhere to the prevailing norms regarding smoking in the friendship group rather than that they contemplate why they should stop, continue, or increase their smoking. Adolescents may also be most vulnerable and susceptible to the prevailing perceived social norms when they enter secondary school, since this is a distinct period in which new friendships are manifested. Aloise-Young and colleagues (1994), for example, have suggested that teenagers may regard smoking as a way to enter desired friendship groups. When adolescents consider smoking as a way of making new friends, they may be vulnerable to passive peer pressure (Perrine, & Aloise-Young, 2004). This may especially apply to the first six months after entering a new social and educational environment. We found perceived social norms at T1 to significantly predict smoking continuation at T2, but not at T3. It is possible that in the first course of the second grade, adolescents have already established a more stable friendship group. The need to comply in order to make friends may be lessened at that time, or friends’ perceived social norms may have become the adolescents’ own norms for smoking. Still, the influence of positive attitudes towards smoking, and low self-efficacy to resist smoking may not be disregarded as these cognitions at baseline resulted in progression in levels of smoking one
year later (T3). As such, all the cognitions derived from the Theory of Planned Behavior could provide risk for young adolescents to increase their levels of smoking after experimentation or recent onset. This was also reflected by the negative impact the concurrent combination of pro-smoking perceived social norms with low self-efficacy at T1, and the combination of positive attitudes with a pro-smoking perceived social norm at T1 appeared to have on smoking progression at T2, and T3 respectively. All in all, both in stimulating teenagers to reduce their levels of smoking after experimentation or recent onset, and in discouraging teenagers to increase their levels of smoking, prevention and intervention programmes could find useful targets in the smoking-related cognitions presented in the present study.

Turning to the limitations of the present study, the study may be considered limited in that self-reports have been used to measure smoking status. Although there has been debate in the past as to whether or not self-reports of substance use may be viewed as reliable instruments, Barnea and colleagues (1987) have reported that self-reports of substance use in the adolescent population are stable, and that questionnaires provide highly reliable data. Respondents were also assured of strict confidentiality of their reports, which should enhance reliability as well (Velicer, Prochaska, Rossi, & Snow, 1992). Moreover, the sample is restricted in the age range, including respondents between 12 and 15 years old, with a mean age of 12.4 years at the first measurement. Generalizability with regard to older adolescents is therefore limited, especially since development of cognitions may be contingent on maturity level (Finkenauer et al., 2002). However, at T3, most of the adolescents were in the ages of 13 and 14. Besides, the cognitions may not be complex to such a degree that they are likely to be largely underdeveloped in this particular age range. Moreover, continuation of smoking after experimentation is distinctly different from the initiation phase. Thus, when samples with young adolescents, such as the present sample, would be solely used to explore initiation of smoking, and only samples with older adolescents would be used to explore continuation of smoking, we would fail to capture the very early phase in which teenagers, who have experimented with smoking, or who have only recently taken up smoking, decide to turn smoking into a habit or decide to refrain from smoking.

Despite these limitations, the present study has several important assets. Firstly, to our knowledge, this study is the first to implement interactions between attitudes, perceived social norms, and self-efficacy in examining smoking behavior, more specifically, in examining smoking reduction, continuation, and progression after experimentation or recent onset. Interactions between attitudes, perceived social norms, and self-efficacy have not been
implemented and tested so far, while interactions may give more insight into combinations of factors and may identify high risk profiles. The present findings demonstrate that these interactions certainly may not be neglected. For instance, the present cross-sectional findings point to significant relatedness between smoking-specific cognitions and adolescent smoking. In the longitudinal analyses of reduction in smoking, however, attitudes towards smoking and self-efficacy at baseline showed no main effects on smoking reduction at T2, yet they appeared to be relevant when they were combined as interacting variables. It is thus possible that attitudes, and self-efficacy exert an influence on smoking reduction, but only under particular conditions. In addition, the longitudinal design of the study enables us to make inferences about the direction of the associations.

In sum, attitudes, perceived social norms, and self-efficacy are not associated with adolescent smoking reduction, yet do predict progression in smoking among adolescents who have been experimenting with or who have recently taken up smoking. Prevention programs which focus on a cognitive level on youth who have only just experimented with smoking, may be effective in preventing progression in smoking. However, intervention on cognitions may still be useful when adolescents have progressed in their smoking (see Footnote 2). Since perceived social norms do seem to have harmful effects, the present findings also endorse previous recommendations that prevention efforts should teach teenagers to resist peer pressure (Flay et al., 1983; Leventhal & Cleary, 1980). It is emphasized, however, that there is a possibility that adolescents come to a point where perceived social norms are internalized, regardless of further active peer pressure. In such cases, it should be aimed to make adolescents aware of their own cognitive dispositions and to address these cognitions. To conclude, adolescents who conjunctly hold both pro-smoking attitudes and experience either perceived social norms in favor of their smoking, or low self-efficacy to resist smoking should be identified as risk groups.
Footnotes

1. Please note that the term ‘grade’ has dissimilar meanings across countries. In the Netherlands, students usually leave elementary school when they are aged 12, varying between 11 and 14, and thereupon continue their educational careers as first graders in secondary school, of which the first and second year will be referred to as ‘first and second grade’.

2. The reviewers of this paper suggested to control for concurrent cognitions in the longitudinal analyses, to determine whether prior cognitions predict smoking behavior above and beyond concurrent cognitions. If the effects of the prior cognitions would not be diminished if concurrent cognitions were controlled for, this would indicate that once adolescents have taken up smoking, it is too late to intervene on cognition. We found that the effects of prior cognitions diminished if the concurrent cognitions were controlled for in all longitudinal analyses. This suggests that interventions on cognitions may still be effective once teenagers have initiated smoking, even if they have increased their smoking rates.
Table I. *Pearson and Spearman Correlations between Model Variables.*

<table>
<thead>
<tr>
<th>Measures</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitudes T1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitudes T2</td>
<td></td>
<td>.34**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitudes T3</td>
<td></td>
<td></td>
<td>.25**</td>
<td>.39**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social norms T1</td>
<td>.20**</td>
<td>.17**</td>
<td>.14**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social norms T2</td>
<td>.10</td>
<td>.26**</td>
<td>.16**</td>
<td>.52**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social norms T3</td>
<td>.10</td>
<td>.24**</td>
<td>.32**</td>
<td>.40**</td>
<td>.42**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-efficacy T1</td>
<td>-.43**</td>
<td>-.24**</td>
<td>-.24**</td>
<td>-.28**</td>
<td>-.13**</td>
<td>-.18**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-efficacy T2</td>
<td>-.26**</td>
<td>-.42**</td>
<td>-.32**</td>
<td>-.17**</td>
<td>-.19**</td>
<td>-.16**</td>
<td>.56**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-efficacy T3</td>
<td>-.27**</td>
<td>-.35**</td>
<td>-.51**</td>
<td>-.14**</td>
<td>-.14**</td>
<td>-.25**</td>
<td>.42**</td>
<td>.58**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking status T1</td>
<td>.27**</td>
<td>.28**</td>
<td>.22**</td>
<td>.12*</td>
<td>.11*</td>
<td>.15**</td>
<td>-.29**</td>
<td>-.23**</td>
<td>-.23**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking status T2</td>
<td>.29**</td>
<td>.45**</td>
<td>.32**</td>
<td>.18**</td>
<td>.25**</td>
<td>.18**</td>
<td>-.28**</td>
<td>-.38**</td>
<td>-.35**</td>
<td>.40**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking status T3</td>
<td>.21**</td>
<td>.33**</td>
<td>.49**</td>
<td>.20**</td>
<td>.20**</td>
<td>.31**</td>
<td>-.17**</td>
<td>-.26**</td>
<td>-.44**</td>
<td>.32**</td>
<td>.46**</td>
<td></td>
</tr>
</tbody>
</table>

*Note.*  *p < 0.05, **p < 0.01, ***p < 0.001. Spearman correlations were calculated for the correlations with smoking status variables.*
Table II. Cross-Sectional Associations between Attitudes, Perceived social norms and Self-Efficacy, and Adolescent Smoking Behavior.

<table>
<thead>
<tr>
<th></th>
<th>Smoking T1</th>
<th></th>
<th>Smoking T2</th>
<th></th>
<th>Smoking T3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
</tr>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>1.18</td>
<td>.77 – 1.81</td>
<td>1.30</td>
<td>.87 – 1.96</td>
<td>.77</td>
<td>.77 – 1.76</td>
</tr>
<tr>
<td>Gender</td>
<td>.86</td>
<td>.55 – 1.33</td>
<td>1.07</td>
<td>.70 – 1.62</td>
<td>.65</td>
<td>.65 – 1.48</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>1.00</td>
<td>.94 – 1.07</td>
<td>.98</td>
<td>.92 – 1.04</td>
<td>.93</td>
<td>.86 – 1.00</td>
</tr>
<tr>
<td>Education</td>
<td>.85</td>
<td>.66 – 1.11</td>
<td>.84</td>
<td>.66 – 1.08</td>
<td>.87</td>
<td>.68 – 1.11</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitudes (A)</td>
<td>1.37**</td>
<td>1.11 – 1.68</td>
<td>1.67***</td>
<td>1.35 – 2.08</td>
<td>1.86***</td>
<td>1.47 – 2.37</td>
</tr>
<tr>
<td>Social norms (N)</td>
<td>1.25</td>
<td>.99 – 1.57</td>
<td>1.53***</td>
<td>1.22 – 1.92</td>
<td>1.21</td>
<td>.97 – 1.51</td>
</tr>
<tr>
<td>Self-efficacy (S)</td>
<td>.57***</td>
<td>.44 – .74</td>
<td>.56***</td>
<td>.44 - .72</td>
<td>.56***</td>
<td>.43 – .75</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AxN</td>
<td>1.36*</td>
<td>1.04 – 1.79</td>
<td>1.20</td>
<td>.90 – 1.60</td>
<td>.64*</td>
<td>.45 – .91</td>
</tr>
<tr>
<td>AxS</td>
<td>1.08</td>
<td>.84 – 1.39</td>
<td>.85</td>
<td>.64 – 1.13</td>
<td>1.06</td>
<td>.76 – 1.48</td>
</tr>
<tr>
<td>NxS</td>
<td>1.16</td>
<td>.88 – 1.54</td>
<td>1.27</td>
<td>.97 – 1.68</td>
<td>.73</td>
<td>.51 – 1.03</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AxNxS</td>
<td>1.23</td>
<td>.93 – 1.62</td>
<td>1.22</td>
<td>.89 – 1.68</td>
<td>2.07***</td>
<td>1.41 – 3.03</td>
</tr>
<tr>
<td><strong>Nagelkerke R^2</strong></td>
<td></td>
<td>.22</td>
<td></td>
<td>.35</td>
<td>.41</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* The figures in this table represent the results per step. N = Number of adolescents.

* p < 0.05, ** p < 0.01, *** p < 0.001.
Table III. Longitudinal Associations and Interactions between Attitudes, Perceived Social Norms and Self-Efficacy, and Reduction in Smoking.

<table>
<thead>
<tr>
<th></th>
<th>Reduction in Smoking T1–T2</th>
<th>Reduction in Smoking T1–T3</th>
<th>Reduction in Smoking T2–T3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 100</td>
<td>N = 95</td>
<td>N = 95</td>
</tr>
<tr>
<td><strong>OR</strong></td>
<td><strong>95% CI</strong></td>
<td><strong>95% CI</strong></td>
<td><strong>95% CI</strong></td>
</tr>
<tr>
<td><strong>Step 1</strong> Age</td>
<td>.61</td>
<td>.26 – 1.42</td>
<td>.50</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td>1.44</td>
<td>.62 – 3.34</td>
<td>2.01</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td>1.01</td>
<td>.88 – 1.14</td>
<td>1.08</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td>1.86*</td>
<td>1.15 – 3.00</td>
<td>1.53</td>
</tr>
<tr>
<td><strong>Step 2</strong> Attitudes (A)</td>
<td>.706</td>
<td>.44 – 1.11</td>
<td>1.18</td>
</tr>
<tr>
<td><strong>Social norms (N)</strong></td>
<td>.77</td>
<td>.51 – 1.16</td>
<td>.93</td>
</tr>
<tr>
<td><strong>Self-efficacy (S)</strong></td>
<td>.84</td>
<td>.51 – 1.38</td>
<td>.69</td>
</tr>
<tr>
<td><strong>Step 3</strong> AxN</td>
<td>.69</td>
<td>.34 – 1.40</td>
<td>.86</td>
</tr>
<tr>
<td><strong>AxS</strong></td>
<td>.39**</td>
<td>.21 – .74</td>
<td>.65</td>
</tr>
<tr>
<td><strong>NxS</strong></td>
<td>.93</td>
<td>.49 – 1.74</td>
<td>1.23</td>
</tr>
<tr>
<td><strong>Step 4</strong> AxNxS</td>
<td>.54</td>
<td>.27 – 1.04</td>
<td>.88</td>
</tr>
</tbody>
</table>

**Nagelkerke R²**          | .36                         | .24                        | .17                        |

**Note.** The figures in this table represent the results per step. *N* = Number of adolescents. *p < 0.05, **p < 0.01, ***p < 0.001. The independent variables are from the first measurement of the various intervals as indicated above, e.g., from the second measurement when reduction in smoking was analyzed for the T2-T3 interval.
Table IV. Longitudinal Associations and Interactions between Attitudes, Perceived Social Norms and Self-Efficacy, and Progression in Smoking.

<table>
<thead>
<tr>
<th>Progression in Smoking T1– T2</th>
<th>Progression in Smoking T1– T3</th>
<th>Progression in Smoking T2 – T3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$N = 305$</td>
<td>$N = 304$</td>
<td>$N = 293$</td>
</tr>
<tr>
<td>OR 95% CI OR 95% CI OR 95% CI</td>
<td>OR 95% CI OR 95% CI OR 95% CI</td>
<td>OR 95% CI OR 95% CI OR 95% CI</td>
</tr>
</tbody>
</table>

**Step 1**

- **Age**: OR = 1.12, 95% CI = 0.67 – 1.87
- **Gender**: OR = 1.42, 95% CI = 0.84 – 2.37
- **Ethnicity**: OR = 1.00, 95% CI = 0.92 – 1.08
- **Education**: OR = 1.07, 95% CI = 0.78 – 1.47

**Step 2**

- **Attitudes (A)**: OR = 1.05, 95% CI = 0.82 – 1.35
- **Social norms (N)**: OR = 1.51**, 95% CI = 1.15 – 2.00
- **Self–efficacy (S)**: OR = 0.76, 95% CI = 0.57 – 1.02

**Step 3**

- **AxN**: OR = 1.08, 95% CI = 0.80 – 1.46
- **AxS**: OR = 1.21, 95% CI = 0.91 – 1.61
- **NxS**: OR = 1.42**, 95% CI = 1.01 – 2.00

**Step 4**

- **AxNxS**: OR = 1.02, 95% CI = 0.72 – 1.46

**Nagelkerke $R^2$**: 0.12, 0.15, 0.08

**Note.** The figures in this table represent the results per step. $N =$ Number of adolescents. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The independent variables are from the first measurement of the various intervals as indicated above, e.g., from the second measurement when progression in smoking was analyzed for the T2-T3 interval.
Figure 1. Profile plots of the cross-sectional relation of the two-way interaction between attitudes and norms at T1 with smoking at T1 (a), the cross-sectional relation of the two-way interaction between attitudes and norms at T3 with smoking at T3 (b), and the cross-sectional relation of the three-way interaction between attitudes, norms, and self-efficacy at T3 with smoking at T3 (c).
c.)

![Graph showing Attitudes T3-Norms T3 with Smoking T3 on the y-axis and low-low, low-high, high-low, high-high on the x-axis. The graph includes lines for high and low levels of self-efficacy T3.]

Note. ‘High’ indicates scores one whole standard deviation above the mean score, ‘low’ indicates scores one whole standard deviation below the mean score.
Figure 2. Profile plots of the longitudinal effect of the two-way interaction between attitudes and self-efficacy at T1 on smoking reduction at T2 (a), the longitudinal effect of the two-way interaction between attitudes and perceived social norms at T1 on smoking progression at T3 (b), and the longitudinal effect of the two-way interaction between self-efficacy and perceived social norms at T1 on smoking progression at T2 (c).

Note. ‘High’ indicates scores one whole standard deviation above the mean score, ‘low’ indicates scores one whole standard deviation below the mean score.
References


Chapter 3

The role of smoking cessation-specific parenting in adolescent smoking-specific cognitions and readiness to quit
Abstract

Background. An instrument assessing smoking cessation-specific parenting was developed and tested in relation to a) the pros of smoking and quitting and self-efficacy to resist smoking, and b) adolescent readiness to quit. Methods. Cross-sectional survey data from 998 Dutch regularly smoking adolescents were used to perform structural equation analyses. Results. Adolescents who perceived relatively few advantages of smoking and many benefits of quitting reported a high readiness to quit. Self-efficacy was not related to readiness to quit. Smoking cessation-specific parenting was both directly related to a high readiness to quit, and indirectly through the perceived pros of quitting. Also, if one or both parents were smokers, adolescents reported to experience less smoking cessation-specific parenting, and a lower readiness to quit. However, in general, differences in paths were not found between adolescents with two non-smoking parents and adolescents with one or two smoking parents. Conclusions. Given that anti-smoking socialization has not yet been operationalized in terms of smoking cessation-specific parenting, the present results will warrant further research into smoking cessation-specific parenting in relation to adolescent smoking cessation. Further, parental smoking should not demotivate parents to engage in smoking cessation-specific parenting as its relations with smoking cognitions and readiness to quit were highly similar in both the group with two non-smoking parents and the group with one or two smoking parents.
Introduction

The predictors of adolescent initiation and continuation of smoking have been widely studied (for an overview see Mayhew, Flay & Mott, 2000). However, as adolescent smoking cessation involves a relatively new research domain, predictors of adolescents’ motivation to quit smoking are less well-defined. In the context of adolescent smoking onset, the roles of parental smoking and parenting practices have increasingly been focused upon in the past decade (see Darling & Cumsille, 2003). Regarding smoking cessation, however, the influence of parenting and parental smoking on adolescent smoking cessation has received less attention. The present paper will deal with the readiness of adolescents to quit smoking, which has been found to predict smoking cessation among adults (Lichtenstein, Lando & Nothwehr, 1994; Osler & Prescot, 1998). More specifically, the smoking-cessation specific parenting and parental smoking roles in adolescent readiness to quit will be explored.

There is some preliminary evidence that parental smoking has a negative impact on adolescent smoking cessation efforts (Hansen, Collins, Anderson Johnson, & Graham, 1985). Apparently, adolescents are not encouraged to quit smoking or to maintain cessation if their parents are smokers. Not only the actual smoking of parents has adverse effects on adolescent smoking cessation, but also it is very likely that the way parents engage in anti-smoking socialization is of influence as well. Anti-smoking socialization refers to parenting practices such as punishment, house rules, and communication about smoking with the intention of discouraging children from smoking. Previous studies have demonstrated that children are less inclined to initiate smoking, and actually show lower rates of smoking and smoking onset, if parents engage in anti-smoking socialization (e.g., Chassin, Presson, Todd, Rose & Sherman, 1998; Huver, Engels, & De Vries, 2005; Jackson & Henriksen, 1997), even if the parents are smokers themselves (Henriksen & Jackson, 1998). Thus, there is increasing evidence that parenting practices and adolescent smoking are related, yet less is known about how anti-smoking parenting practices vary as a function of parental smoking experiences (for exceptions see Henriksen & Jackson, 1998). Even less evidence is available regarding anti-smoking socialization in the context of adolescent smoking cessation, and a smoking cessation-specific parenting instrument has not yet been developed and tested. This is necessary because general anti-smoking socialization does not deal with adolescent smoking cessation specifically. For the present study, we have developed and tested such a smoking cessation-specific parenting measure and tested whether this is related to adolescent readiness to quit.
Besides the direct impact parents may have on adolescent readiness to quit, parents may also influence adolescent smoking cessation indirectly. Parental smoking and anti-smoking parenting practices were found to be related to adolescents’ smoking-specific cognitions (Engels & Willemsen, 2004; Otten, Harakeh, Vermulst, Engels & Van Den Eijnden, 2006). Smoking-specific cognitions, in turn, have been found to mediate the relation between parental smoking and initiation of smoking (Harakeh, Scholte, Vermulst, De Vries & Engels, 2004; Huver et al., 2005). Considering these findings, we expect that smoking-specific cognitions mediate the associations between both parental smoking and parenting practices on the one hand, and smoking cessation on the other. In the present paper, we focus on the smoking-specific cognitions derived from the Social Cognitive Theory (SCT) of Bandura (1986), which posits that the anticipated positive and negative outcome expectations of a certain behaviour determine the enactment of that behaviour. According to the SCT, other important determinants of behaviour include perceived self-efficacy, and intentions. Studies which have used the SCT as a theoretical framework to explain readiness to quit have predominantly used samples with adults (e.g. Dijkstra & De Vries, 2000). The literature on adults has quite consistently demonstrated an association between the pros of smoking, the pros of quitting, and self-efficacy to resist smoking on the one hand, and motivation to quit on the other (Dijkstra, Bakker & De Vries, 1997; Prochaska & DiClemente, 1984; Prochaska, Velicer, Guadagnoli, & Rossi, 1991). Regarding adolescent smoking cessation, however, this theory has hardly been applied. Studies that did use adolescent samples mainly focused on aspects of the SCT, but did not capture the whole model including outcome expectations, self-efficacy, and intentions as a whole. The Transtheoretical model of Prochaska and DiClemente (1984) can be considered to be strongly inspired by Bandura’s SCT, yet only a few studies tested this model in adolescent samples (see Pallonen, 1998; Pallonen, Prochaska, Velicer, Prokhorov, & Smith, 1998). There are a considerable number of reasons to concentrate research on adolescent age groups, as adolescents seem to undertake more ill-considered quit attempts, they seem to relapse more often than adults, and seem to move more between stages of readiness to quit than adults (Pallonen, Murray, Schmid, Pirie, & Luepker, 1990). This study extends the scarce literature on smoking-specific cognitions in relation to adolescent readiness to quit by testing the concepts of Bandura’s SCT. In addition, the present study explored the roles of parents in these cognitions and adolescents’ readiness to quit. We hypothesized that low scores on pros of smoking, high scores on pros of quitting, high self-efficacy to resist smoking, smoking abstinence of parents, and engagement in smoking cessation-specific parenting would be related to a high readiness to quit. We further expected
that smoking cessation-specific parenting and parental smoking would also be indirectly related to readiness to quit through the smoking-specific cognitions. Lastly, we hypothesized that model paths would differ between the two groups, that is the group in which both parents were non-smokers versus the group in which one or both parents were smokers. However, since this study was the first to explore smoking cessation-specific parenting, no directions of the differences were specified beforehand. These hypotheses were tested in a large nationwide sample of Dutch adolescents.

Method

Participants and Procedure

The data of the present study pertain to the third wave of a larger longitudinal study that started in November 2004, focusing on psychological processes in relation to tobacco use among Dutch adolescents (for a more detailed description see Van De Ven, Van Den Eijnden, & Engels, 2006). Fifty-five schools had been approached to participate, of which 33 schools agreed to cooperate. The questionnaires were administered during school hours, in the presence of an instructed teacher. To assure confidentiality, each student received an unmarked envelope in which they had to return the completed questionnaires. Of the 12,532 eligible students, 10,265 students (81.9%) completed the questionnaire consistently. Sickness, truancy, leaving school, and repeating class were noted by teachers as the primary causes for non-response.

All adolescents had to report whether they thought that their parents knew that they were smokers on a scale from 1 (certainly not) to 4 (certainly yes). Only those adolescents who reported that they thought that both parents knew they were smokers were selected (footnote 1). This selection resulted in a sample of 998 respondents, consisting of 512 boys (50.9%) and 486 girls, with ages distributed as follows: 14 (17.4%), 15 (43.2%), 16 (30.3%), 17 (8.9%), and 18 years (0.2%), ($M = 15.29, SD = 1.07$). All students received regular education; 54.8% received lower vocational training, 23.6% received intermediate vocational training, 16.3% received high school education, and the remaining 5.3% received pre-university education. Most respondents were daily smokers (91.3%) and the remaining 8.7% reported smoking weekly.

Measures

Readiness to quit. This measure had been derived from the original stages of change measure by Prochaska et al. (1991) and was similar to the stages of change derived scales as used by Dijkstra, Bakker, and De Vries (1997). On a scale from 1 to 9, respondents could rate their readiness to quit: 1 (within 10 days) (3.4%), 2 (within 1 month), (9.1%) 3 (within 6
Smoking cessation-specific parenting. Smoking cessation-specific parenting refers to parenting practices aimed at motivating and pressurising adolescents to quit smoking. The scale originally consisted of 12 items, which aimed at tapping parental support, rule setting, communication, and pressure, all attuned to adolescent smoking cessation. Exploratory and confirmatory factor analyses extracted and confirmed one factor on which 8 of the 12 items showed high loadings (Table 1). Exploratory factor analysis was performed on 10 random first halves of the sample, and the confirmative factor analysis (CFA) was performed on 10 random samples of the other halves. The factor loadings and fit indices provided in Table 1 depict the mean values over the 10 samples. The modification indices of the CFA indicated that some of the error terms had to be correlated. Following these indications did not result in any differences in factor loadings. The mean fit was acceptable ($\chi^2 (17) = 72.06$, RMSEA = .081, CFI = .958). The content validity of the items was judged to be satisfactory, and appeared to be highly internally consistent (Cronbach’s alpha = .83) (footnote 1).

Parental smoking. Standard items were used to measure fathers and mothers’ smoking status. Response choices were: 1 (no, my father/my mother does not smoke), 2 (yes, but less than 1 cigarette per day), 3 (yes, 1-5 cigarettes per day), 4 (yes, 6-10 cigarettes per day), 5 (yes, 11-20 cigarettes per day), 6 (yes, 21-30 cigarettes per day), 7 (yes, more than 31 cigarettes per day). Scores on maternal and paternal smoking had been dichotomised into ‘non-smokers’ (response choice 1), and ‘smokers’ (response choices 2-7), and were used as separate indicators for the latent variable parental smoking. Previous research showed that adolescents are highly accurate in their reports on parental smoking (e.g., Harakeh, Engels, De Vries, & Scholte, 2006).

Pros of smoking and pros of quitting. Pros of smoking involved the perceived positive aspects of smoking, and pros of quitting involved the perceived advantages of smoking cessation as constructed by De Vries and Backbier (1994), and validated in other studies (cf. Dijkstra et al., 1997). Response choices of both scales ranged from 1 (totally disagree) to 4 (totally agree). Example items of the 9 pros of smoking were: “Smoking helps to relax”, and “Smoking helps to concentrate”. Alpha was .83. The scale for pros of quitting consisted of 14 items, with items such as “To quit smoking decreases the risk for lung cancer”, and “To quit smoking will get me in better shape”. Alpha was .90.
**Self-efficacy to resist smoking.** Self-efficacy represented the adolescents’ perceived ability to resist smoking in tempting situations (Velicer, DiClemente, Rossi, & Prochaska, 1990). To the question “Suppose you have quit smoking. How easy or difficult would it be for you not to smoke in the following situations?”, respondents could answer on a scale from 1 (very easy) to 5 (very difficult). Exemplary situations of the 8 situations given are: “When things are not going your way and when you are frustrated”, and “When your friends offer you a cigarette”. Alpha was .86.

**Strategy for analyses**

To explore whether the power of exertion of smoking cessation-specific parenting varied by parents’ own smoking, *t*-tests were computed. Next, Pearson correlations between variables were examined within both the group with two non-smoking parents, and the group with one or two smoking parents. To test whether it was necessary to control for the background variables age, gender, and educational level, these were also depicted in the correlation matrix. Further, the additional value of smoking cessation-specific parenting above the cognitive factors and parental smoking was tested, by performing a stepwise procedure in the structural equation analysis, with help of AMOS 5.0 (Arbuckle, 2003). Subsequently, direct and indirect relationships between variables were tested with structural equation modelling. Lastly, multi-group analyses were carried out to test differences in model paths between the group with two non-smoking parents, and the group with one or two smoking parents. For a more detailed description of the statistical procedures, please see Jöreskog and Sörbom (1996). For ease of presentation, the observed variables are not depicted in Figures 1 and 2. Subsets of scale items, also denoted as parcels, were used as indicators for the latent variables smoking cessation-specific parenting, the pros of smoking and quitting, and self-efficacy (Bandolos & Finney, 2001). The lower and higher factor loadings of each scale were equally divided between the two parcels for each latent construct as recommended by Nasser and Takahashi (2003) (Footnote 2).

**Results**

**Descriptive analyses**

T-tests were performed for the cognitive factors and for smoking cessation-specific parenting, to test differences between adolescents with parents who did not smoke versus adolescents with one or two smoking parents (Table 2). Adolescents with two non-smoking parents scored equally on the pros of smoking, but higher on the pros of quitting (*t* (996) = 3.76, *p* < .001), and higher on self-efficacy to resist smoking (*t* (996) = 3.18, *p* < .01), compared to adolescents with one or two smoking parents. In addition, adolescents with two
non-smoking parents reported higher exertion of smoking cessation-specific parenting ($t(996) = 10.54, p < .001$).

Of the background variables, only educational level showed a low, yet significant positive correlation with readiness to quit, implying that the more highly educated students had more readiness to quit. Controlling for educational level in the structural equation analyses did not change the results, and educational level has therefore not been included in the models as depicted in Figure 1 and 2. The Pearson correlations between model variables appeared to be highly similar for both adolescents with two non-smoking parents and adolescents with one or two smoking parents (Table 3). Self-efficacy and its associations with smoking cessation-specific parenting and readiness to quit were the exceptions. These two relations were only significant among adolescents with one or two smoking parents. Further, for both groups, the pros of smoking were not related to the pros of quitting, but seemed to be strongly inversely associated with self-efficacy. Thus, if adolescents regard smoking as highly advantageous, they are more likely to report lower self-efficacy to resist smoking. This did not apply to the pros of quitting, which seemed unrelated to self-efficacy to resist smoking. Perceiving relatively many advantages of quitting and few advantages of smoking was associated with higher readiness to quit. Lastly, strong smoking cessation-specific parenting was associated with perceiving more pros of quitting, and a high readiness to quit.

**Self-efficacy, pros of smoking and quitting, parental smoking, and smoking cessation-specific parenting.** The additional value of smoking cessation-specific parenting above the cognitive factors and parental smoking was tested, by performing a stepwise procedure in the structural equation analysis, with help of AMOS 5.0 (Arbuckle, 2003). This model evidenced a very good fit with a RMSEA of .029 and CFI of .994 ($\chi^2(40) = 72.86, p < .001$). Self-efficacy did not appear to be related to readiness to quit, whereas pros of smoking and quitting were related, together accounting for 13% of explained variance. Apparently, perceiving many advantages of smoking is associated with a low readiness to quit, and perceiving many benefits of smoking cessation is related to a high readiness to quit. Parental smoking added 6% explained variance through its negative association with readiness to quit: adolescents were less ready to quit smoking if one or two parents in the family smoked, than if neither of the parents smoked. Above the aforementioned factors, smoking cessation-specific parenting additionally explained 1% of the variance in readiness to quit, demonstrating that engagement in smoking cessation-specific parenting was also directly related to high readiness to quit. In summary, smoking cessation-specific parenting bears the
potential to explain adolescent readiness to quit above and beyond smoking-specific cognitions and parental smoking.

**Direct and indirect relations.** A structural equation model was tested to examine the role of smoking cessation-specific parenting from a perspective in which this type of parenting, as well as parental smoking, were theoretically presumed to precede the smoking-specific cognitions (Figure 1). The model showed an excellent fit with a RMSEA of .029, and a CFI of .994.

Both intensive engagement in smoking cessation-specific parenting and smoking abstinence by both parents were related to a high readiness to quit smoking. Engagement in smoking cessation-specific parenting was also significantly related to the pros of quitting. Considering that the pros of quitting were significantly related to readiness to quit, smoking cessation-specific parenting seems to play a role in adolescent readiness to quit, both directly and indirectly, through the pros of quitting. A similar indirect relation did not hold for the perception of many pros of smoking which, despite their association with low readiness to quit, did not appear to be related to smoking cessation-specific parenting. Furthermore, engagement in smoking cessation-specific parenting was not associated with high self-efficacy to resist smoking. However, self-efficacy to resist smoking appeared to be low if one or both parents smoked. Lastly, parental smoking was found to be unrelated to both the pros of smoking and quitting. Summarizing, intensive engagement in smoking cessation-specific parenting was directly associated with high readiness to quit, and indirectly via the pros of quitting. Moreover, smoking abstinence by both parents was related to a higher adolescent readiness to quit, and a higher adolescent self-efficacy to resist smoking.

**Multi-group analyses.** Differences in structural parameters between adolescents with two non-smoking parents (group 1), and adolescents with one or two smoking parents (group 2) were tested with multi-group analyses, in which step-wise chi-square difference testing was applied (Jöreskog & Sörbom, 1996). The model showed an excellent fit with RMSEA = .031, and CFI = .990 (Figure 2). We found no significant differences between lambdas (factor loadings) nor between betas ($\Delta \chi^2 (5) = 6.60, p > .05; \Delta \chi^2 (3) = 0.88, p > .05$ respectively). The gammas showed marked differences between the two groups ($\Delta \chi^2 (4) = 11.85, p < .05$), which seemed due to a structural difference in the path between smoking cessation-specific parenting and self-efficacy. This path was stronger in the group of adolescents whose parents (one or both) were smokers ($\Delta \chi^2 (1) = 9.38, p < .01; \beta_{\text{group1}} = -.02; \beta_{\text{group2}} = .21$). This implies that smoking cessation-specific parenting applied by smoking parents plays a more important
role in adolescent self-efficacy to resist smoking than does smoking cessation-specific parenting applied by two non-smoking parents.

Discussion

The present study showed that parental smoking, smoking cessation-specific parenting, and the pros of smoking and quitting were significantly related to adolescent readiness to quit. Smoking cessation-specific parenting was also indirectly related to readiness to quit through the pros of quitting. In general, no evident differences in model paths were found between adolescents with two non-smoking parents and adolescents with one or two smoking parents.

Social Cognitive Theory. First of all, this is one of the first studies to critically test Bandura’s Social Cognitive Theory (Bandura, 1986) in the context of adolescent readiness to quit smoking within a large nationwide sample. We found that adolescents who perceived relatively few pros of smoking and many pros of quitting were more likely to have a high readiness to quit than adolescents who perceived smoking to be highly advantageous and quitting to be less attractive. Moreover, the pros of smoking seemed less strongly related to readiness to quit than the pros of quitting, which confirms previous findings of Prochaska (1994). These findings indicate that people’s perceptions of the advantages of smoking are less relevant for the intention to quit than the perceptions of the advantages of quitting. Self-efficacy, however, was not directly related to readiness to quit, which contradicts our expectations as well as findings from previous studies among adults (e.g., Prochaska & DiClemente, 1984; Prochaska et al., 1991) and adolescents (Pallonen, 1998; Pallonen et al., 1998). This may be due to the high negative correlation of self-efficacy with the pros of smoking. It may be that self-efficacy is not directly, but indirectly related to readiness to quit through the pros of smoking. As such, it is possible that a low self-efficacy enhances the perception of the advantages of smoking, which in turn will affect one’s readiness to quit.

Smoking cessation-specific parenting. Further, smoking cessation-specific parenting appeared to be both directly related to adolescent readiness to quit, and indirectly through the adolescent’s perception of the pros of quitting, as these cognitions were related to readiness to quit. Apparently, if parents engage in smoking cessation-specific parenting, adolescents are more likely to view smoking cessation as beneficial, which in turn will motivate them to quit smoking. However, due to the cross-sectional nature of our data, we cannot make inferences about causality. Thus, alternatively, it may occur that when parents notice that their children perceive many advantages of smoking cessation, they feel urged to support their children in their readiness to quit by practising more smoking cessation-specific parenting. Similarly, an
increased readiness to quit may have incited an increase in the adolescent’s perception of pros of quitting, which may consequently stimulate parents to enhance their engagement in smoking cessation-specific parenting.

**Parental smoking.** Turning to parental smoking, we found that adolescents reported to be less ready to quit smoking if one or both parents were smokers than adolescents whose parents did not smoke. Moreover, it appeared that adolescents with one or two smoking parents perceived the exertion of smoking cessation-specific parenting to be lower than adolescents with two non-smoking parents. A plausible and previously postulated explanation could be that smoking parents feel they have no legitimate authority, or feel hypocritical to prohibit behaviour from their children which they themselves have engaged in (cf. Andersen, Leroux, Marek, Peterson, Kealey, Bricker, & Sarason, 2002). Nevertheless, perceived parental authority may be an important issue in exploring smoking cessation-specific parenting, as it is possible that this type of parenting is only effective in influencing adolescent readiness to quit if adolescents acknowledge their parents’ authority as legitimate. Lastly, if one or both parents were smokers, adolescents reported fewer pros of quitting and lower self-efficacy than adolescents with two non-smoking parents. In sum, these findings seem to indicate that parental smoking and cessation-specific parenting skills can be viewed as distal factors of the SCT model in relation to adolescent readiness to quit smoking.

In general, beside the direct harmful effects of parental smoking, parental smoking can also be considered harmful as children from smoking parents reported less smoking cessation-specific parenting, fewer pros of quitting, lower self-efficacy, and a lower readiness to quit. However, according to our multi-group analyses, the relations between smoking cessation-specific parenting and the pros of smoking and quitting, and the relations between smoking cessation-specific parenting and readiness to quit were equally significant regardless of parental smoking. This implies that it is certainly advisable for smoking parents to quit, however, if they do smoke they still have resources to interfere with their children’s smoking-specific cognitions and readiness to quit (cf. Henriksen & Jackson, 1998).

**Practical implications.** The present results endorse adolescent smoking cessation programs that are based on the Social Cognitive Theory, such as the Not On Tobacco Programme (Horn, Dino, Kalsekar & Mody, 2005), which has already been evaluated as relatively successful. Moreover, in giving an overview on health promotion by social-cognitive means, Bandura (2004) states that interventions are most effective when applied in several settings simultaneously. However, most adolescent cessation programs are provided within schools and community settings (Sussman, 2002). The present findings on the relations
of smoking cessation-specific parenting and parental smoking with the smoking-specific cognitions seem to confirm Bandura’s recommendation, and it may be fruitful to expand interventions to the family situation.

Limitations. When we interpret the results we must bear the following shortcomings of our study in mind. As mentioned earlier, the cross-sectional design of the study does not allow inferences about causality. The use of adolescent reports only may also provide bias in the actual exertion of smoking cessation-specific parenting. However, the subjective experience of adolescents may be more important to their development than parents’ actual behaviour (Steinberg, Lamborn, Dornbusch & Darling, 1992). Nevertheless, a full-family design in which all family members provide reports would ideally complement the picture on smoking cessation-specific parenting. In addition, it is impossible to disentangle the influence of smoking cessation-specific parenting as exerted by the parents individually, as this construct had not been reported for the two parents separately. Contradictory smoking cessation messages towards the child of the two parents individually, and possible adverse effects thereof, cannot be explored presently either. We therefore strongly recommend that our measure of smoking cessation-specific parenting also be completed by parents in future research, and by fathers and mothers separately in two-parent families. Also, we are aware and emphasize that the present operationalization of smoking cessation-specific parenting does not exhaustively capture all aspects of parenting behaviour directed at adolescent smoking cessation. However, a first step in exploring smoking cessation-specific parenting has now successfully been undertaken. The present findings encourage future studies on smoking cessation-specific parenting to further illuminate its influence on adolescent smoking cessation.
Footnotes

1. The smoking cessation-specific parenting scale indicates an expected rather than experienced construct if parents are not aware of their children’s smoking. Accordingly, only parents of whom the respondents perceived that they were aware of their smoking were included in the analyses, as we found this sample theoretically the most legitimate one in which to examine smoking cessation-specific parenting. We also tested the structural model with inclusion of the 274 adolescents, who reported that their parents did not know they were smokers. This did not result in robust differences in path coefficients or model fit.

2. Alternative compositions of the parcels were tested to explore the robustness of the results. The path coefficients retained the same level of significance, and the amount of explained variance differed with a maximum of 1% compared to the analyses with the presently used parcel compositions.
Tables and figures

Table 1. *Factor Loadings on the Smoking Cessation-Specific Parenting Dimension.*

<table>
<thead>
<tr>
<th></th>
<th>Exploratory</th>
<th>Confirmatory</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>My parents often tell me to quit smoking</td>
<td>.648</td>
</tr>
<tr>
<td>2.</td>
<td>My parents force me to quit smoking</td>
<td>.754</td>
</tr>
<tr>
<td>3.</td>
<td>My parents set restrictions to how much and how often I am allowed to smoke</td>
<td>.547</td>
</tr>
<tr>
<td>4.</td>
<td>My parents often warn me about the harmful effects of smoking</td>
<td>.683</td>
</tr>
<tr>
<td>5.</td>
<td>My parents do not allow me to smoke at home</td>
<td>.633</td>
</tr>
<tr>
<td>6.</td>
<td>My parents exert pressure on me to quit smoking</td>
<td>.819</td>
</tr>
<tr>
<td>7.</td>
<td>My parents talk to me about the benefits of smoking cessation</td>
<td>.587</td>
</tr>
<tr>
<td>8.</td>
<td>My parents do not allow me to smoke anywhere</td>
<td>.744</td>
</tr>
</tbody>
</table>

*Note.* N = 998; $\chi^2 (17) = 72.06; \text{RMSEA} = .081; \text{CFI} = .958.
Table 2. Comparison of the Cognitive Factors, and Smoking Cessation-Specific Parenting for the Group with two Non-Smoking Parents versus the Group with One or Two Smoking Parents.

<table>
<thead>
<tr>
<th></th>
<th>Two non-smoking parents N = 294</th>
<th>One or two smoking parents N = 704</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Pros of smoking</td>
<td>2.63</td>
<td>.60</td>
</tr>
<tr>
<td>Pros of quitting</td>
<td>2.97</td>
<td>.61</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>2.99</td>
<td>.95</td>
</tr>
<tr>
<td>Smoking cessation-specific parenting</td>
<td>2.78</td>
<td>.87</td>
</tr>
</tbody>
</table>
Table 3. *Pearson and Spearman Correlations between Model Variables*

<table>
<thead>
<tr>
<th>Measures</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Age</td>
<td>-</td>
<td>-.10**</td>
<td>.00</td>
<td>.04</td>
<td>-.11**</td>
<td>.05</td>
<td>-.14**</td>
<td>.01</td>
</tr>
<tr>
<td>2 Gender</td>
<td>-.07</td>
<td>-</td>
<td>.00</td>
<td>-.26**</td>
<td>.16**</td>
<td>.06</td>
<td>-.11**</td>
<td>.03</td>
</tr>
<tr>
<td>3 Educational level</td>
<td>.06</td>
<td>.07</td>
<td>-</td>
<td>-.01</td>
<td>.05</td>
<td>.07</td>
<td>.09*</td>
<td>.10**</td>
</tr>
<tr>
<td>4 Self-efficacy</td>
<td>.08</td>
<td>-.32**</td>
<td>.09</td>
<td>-</td>
<td>-.49**</td>
<td>-.01</td>
<td>.18**</td>
<td>.15**</td>
</tr>
<tr>
<td>5 Pros of smoking</td>
<td>.06</td>
<td>.11</td>
<td>.00</td>
<td>-.48**</td>
<td>-</td>
<td>.06</td>
<td>-.04</td>
<td>-.16**</td>
</tr>
<tr>
<td>6 Pros of quitting</td>
<td>.00</td>
<td>.09</td>
<td>.06</td>
<td>-.05</td>
<td>.06</td>
<td>-</td>
<td>.23**</td>
<td>.28**</td>
</tr>
<tr>
<td>7 Smoking cessation-specific parenting</td>
<td>.01</td>
<td>.06</td>
<td>.10</td>
<td>-.03</td>
<td>-.03</td>
<td>.22**</td>
<td>-</td>
<td>.25**</td>
</tr>
<tr>
<td>8 Readiness to quit</td>
<td>.01</td>
<td>.07</td>
<td>.03</td>
<td>.05</td>
<td>-.12**</td>
<td>.31**</td>
<td>.25**</td>
<td>-</td>
</tr>
</tbody>
</table>

*Note.* Data for the adolescents with two non-smoking parents are below the diagonal; data for the adolescents with one or two smoking parents are above the diagonal. *p < .05; **p < .01.
Figure 1. Standardized coefficients of the structural equation model for testing indirect relationships between smoking cessation-specific parenting, parental smoking, smoking-specific cognitions, and adolescent readiness to quit.

Note. N = 998, χ²(40) = 72.86, p < .001, RMSEA = .029, CFI = .994. * p < .05; ** p < .01; *** p < .001.
Figure 2. *Standardized coefficients of the structural equation model for testing multigroup differences between adolescents whose parents both do not smoke (group 1), and adolescents of whom one or two parents smoke (group 2).*

Note. The coefficients given first are those who pertain to group 1, the coefficients between parentheses pertain to group 2. Parental smoking was omitted from the model as this variable differentiated the two groups. N = 998, $\chi^2(52) = 90.98$, $p < .001$, RMSEA = .027, CFI = .992.
References


Chapter 4

Longitudinal test of smoking cessation-specific parenting on adolescent smoking cessation
Abstract

Relatively little is known about if and through which mechanisms parents influence adolescents’ smoking cessation. The present study used Social Cognitive Theory as a theoretical framework to test whether parental smoking and smoking cessation-specific parenting (SCSP) predicted readiness to quit smoking and actual smoking cessation one year later. Both direct paths between parent factors and outcomes, and indirect paths via adolescents’ smoking-specific cognitions (pros of smoking and quitting, and self-efficacy) were examined in a sample of 530 adolescents in the ages of 13 to 18 who smoked daily and weekly at baseline. The main findings show that although parental smoking and SCSP were significantly associated with cognitions (cross-sectionally), neither the parent factors nor cognitions predicted readiness to quit smoking or actual cessation one year later. Baseline SCSP did predict readiness to quit one year later. Participants’ baseline level of nicotine dependence moderated the associations between the parent variables and the smoking-specific cognitions, but not the associations between parents variables, cognitions, and outcomes. Parents may be more influential in shaping adolescents’ beliefs and readiness to quit than in facilitating actual cessation.
Introduction

Despite all the policy and prevention efforts in most Western countries to prevent adolescents from taking up smoking, many adolescents start to experiment with cigarettes and subsequently progress to advanced stages of smoking. The precursors of smoking initiation have received ample attention in the literature, however, less is known about the mechanisms underlying successful smoking cessation among adolescents. Many adolescent smokers report that they want to quit smoking (Grimshaw, Stanton, Blackburn, Andrews, Grimshaw et al., 2003), and also frequently undertake quit attempts (Pallonen, Murray, Schmid, Pirie, & Luepker, 1990; Presti, Ary, & Lichtenstein, 1992). Still, few of them actually succeed in quitting (Stanton, 1995). Up to 95% to 99% of all unaided quit attempts among adults end in relapses (Jarvis, 2003; Sussman, 2002), with the vast majority relapsing during the first few days and weeks of quitting (Doherty, Kinnunen, Militello, & Garvey, 1995). So far, there is no convincing evidence that the programs aimed to help adolescents to quit smoking are effective (see review by Grimshaw & Stanton, 2009). Insight into the processes underlying adolescent smoking cessation is essential to tailor effective psychosocial or pharmacological treatments to this particular age group (Curry, Mermelstein, & Sporer, 2009).

Social Cognitive Theory (SCT) aims to offer a framework to understand how people acquire and maintain certain health behaviors. Applied to smoking, SCT poses that outcome expectations (i.e., pros and cons of smoking and quitting), self-efficacy, and intentions are important determinants of smoking behavior, including efforts to quit smoking (Bandura, 1986). There is a substantial body of literature on adult smoking cessation showing the predictive value of this model (e.g., De Vries & Backbier, 1994; Dijkstra, Bakker, & De Vries, 1997), and the effectiveness of intervention programmes based on its requisites show promise (Dijkstra, Conijn, & De Vries, 2006; Ramelson, Friedman, & Ockene, 1999; see also review by McDonald, Colwell, Backinger, Husten & Maule, 2003). Research using this particular model in adolescent samples is growing. In a cross-sectional study involving 998 juvenile smokers, adolescent smokers who endorsed the pros of smoking were less ready to quit, while those who endorsed the pros of quitting were more ready to quit (Van Zundert, Van de Ven, Engels, Otten, & Van den Eijnden, 2007). Self-efficacy to refrain from smoking was not related to readiness to quit in this study. In a US sample of youths, positive and negative smoking outcome expectancies were associated with the readiness to quit as well (Lewis-Esquerre, Rodrique, & Kahler, 2005).
Longitudinal studies on the value of the SCT framework in adolescent smoking cessation showed mixed results. In two longitudinal samples on 622 adolescents, Wahl, Turner, Mermelstein, and Flay (2005) showed the predictive value of outcome expectancies on smoking escalation and cessation (see also Solomon, Bunn, Pirie, Worden, & Flynn, 2006). In contrast, a study among 215 regular adolescent smokers showed that pros of smoking and self-efficacy were not related to smoking cessation three years later (Engels, De Vries, Knibbe, & Drop, 1998). Using a different methodology (i.e., a diary study following adolescent smokers after quitting) showed that pros of smoking and self-efficacy were significantly related to smoking cessation in 149 adolescents who embarked on a quit attempt and achieved at least 24 hours of abstinence (Van Zundert, Engels, & Nijhof, 2009). A study on the same data in which adolescent smokers were monitored daily after quitting revealed that dynamic day-to-day variations in self-efficacy predict successful cessation (Van Zundert, Ferguson, Shiffman, & Engels, resubmitted). Moreover, a smoking cessation intervention trial involving motivational interviewing and cognitive-behavioral techniques among teens resulted in an increase in the perceived self-efficacy to quit smoking (Patten, Decker, Dornelas, Barbagallo, Rock et al., 2008). In sum, findings from longitudinal and intervention research generally provided support for the importance of self-efficacy in predicting smoking cessation whereas mixed results are found for the predictive value of outcomes expectancies.

Further, in line with the Transtheoretical model (TTM: Prochaska & DiClemente, 1983), it is likely that the mechanisms underlying smoking cessation differ by phase. The TTM describes a temporal dimension containing five stages of readiness to change: precontemplation, contemplation, preparation, action, and maintenance. The first three stages are pre-action stages and concern the readiness to quit. The latter two stages concern deliberate actions to change behavior and to maintain this new behavior. Outcome expectancies might be more relevant in the pre-action stages, affecting people’s motivation to quit, while self-efficacy is expected to be important in affecting whether people can actually succeed in an attempt (for empirical evidence of this proposition, see Dijkstra, Tromp & Conijn, 2003). On the basis of these assumptions, one might suggest that outcome expectancies are more influential in affecting young people’s readiness to quit while self-efficacy predicts whether people are actually able to refrain from smoking after quitting.

In addition to individual factors such as the SCT-derived cognitions and readiness to quit smoking, the successfulness of quit attempts is likely to depend on adolescents’ immediate social environment as well. Research has shown that when parents are daily
smokers, children are less ready to quit and also less successful in their attempts to quit (Kleinjan, Engels, Van Leeuwe, Brug, Van Zundert et al., 2009). Others have shown that when parents quit smoking, their children are not only less likely to initiate smoking (as compared to children of parents who continue to smoke) (Bricker, Leroux, Peterson, Kealey, Sarason et al. 2003; Den Exter Blokland et al., 2004), but are also more likely to quit (Bricker, Rajan, Andersen, & Peterson, 2005). Further, when parents actively encourage their child in their wish to quit, this might facilitate not only the readiness to quit but also successful smoking cessation (McGee, Williams, & Reeder, 2008; Sargent & Dalton, 2001). In order to tap the above-mentioned parental active efforts aimed at adolescents’ smoking cessation, we developed an instrument measuring smoking cessation-specific parenting (SCSP: Van Zundert et al., 2007). Cross-sectional analyses already showed that SCSP was related to higher readiness to quit in juvenile regular smokers. These findings are in line with cross-sectional studies showing that a higher readiness to quit is related to parents’ expressed desire that their child does not smoke (Castrucci & Gerlach, 2005), and parents’ restrictive smoking policies (Ditre, Coraggio, & Herzog, 2008).

Parental smoking and smoking cessation-specific parenting might not only directly affect adolescents’ readiness to quit and actual smoking cessation, but also indirectly through their impact on smoking-specific cognitions. When parents inform, motivate and pressurise their offspring to quit smoking, this might shape children’s expected outcomes from smoking and quitting, and strengthen them in their belief that they actually can refrain from smoking. Parental smoking and anti-smoking parenting practices have been found to relate prospectively to adolescents’ attitudes on smoking and to self-efficacy (Huver, Engels, & De Vries, 2005; Otten, Harakeh, Vermulst, Engels, & Van den Eijnden, 2007). Concerning readiness to quit, a cross-sectional study provided preliminary evidence that pros of quitting and smoking, and self-efficacy partly mediate the link between parental smoking and smoking cessation-specific parenting on the one hand, and adolescents’ readiness to quit on the other (Van Zundert et al., 2007).

Prospective research is warranted to study processes of smoking cessation, as no conclusions regarding the predictive value of predictor variables can be drawn from cross-sectional data. The current study employs a prospective design to test the impact of parental smoking, smoking cessation-specific parenting, and smoking-specific cognitions, on readiness to quit and successful smoking cessation among adolescents. Data were used from 545 13-18 year-old daily and weekly smokers who were interviewed at baseline and 12 months later. We
hypothesized that parents’ smoking and engagement in smoking cessation-specific parenting would be directly related to readiness to quit and smoking cessation, and also indirectly related to readiness to quit and smoking cessation through their associations to pros of smoking, pros of quitting and high self-efficacy. We expected self-efficacy to be more strongly linked to successful quitting than pros of smoking and pros of quitting.

Method

Procedure and Sample

The data of the present study pertain to the third and fourth wave of a larger longitudinal study that started in January 2003, focusing on psychological and environmental processes in relation to tobacco use among Dutch adolescents. Schools in four regions of the Netherlands were randomly selected and approached to take part following random selection from the phone book. Participation in other studies was the main reason for school boards to refuse cooperation. In November 2004, at the time of the third wave, a total of 25 secondary schools were included (T1). Data were collected among 6,750 respondents aged 13-18 (M = 14.8, SD = .88). In 2005, at the time of the fourth wave, 4,940 respondents participated again (T2; response rate 73.2%). Teachers noted sickness, truancy, leaving school, and repeating class as the primary causes for non-response (Otten et al., 2007). The medical ethical committee (CMO Arnhem-Nijmegen) provided approval for conducting the study.

Respondents completed questionnaires in the presence of their instructed teacher during school hours in grades nine and ten at T1, and in grades ten and eleven at T2. Students were informed that the data would be processed anonymously, i.e., respondent numbers replaced their names. To assure confidentiality, each pupil received an unmarked envelope in which they had to return the completed questionnaires. In addition, students were informed that participation was not obligatory. The questionnaire consisted of two sections: one for respondents who indicated that they had smoked at least once in the past month, and one for respondents who had not smoked during the past month.

Of the 530 respondents included at T1 and T2, 54.7% was female. A total of 38.4% received preparatory vocational training, 16.7% junior general secondary training, 30.9% senior general secondary education, 13.4% received university preparatory training, and 0.6% reported some other form of education. The mean age at T1 was 14.99 (SD = 0.83). At T1, 78.6% smoked daily, and 21.4% smoked weekly. The distribution of how many cigarettes participants smoked per day was as follows: less than 1 (15.3%), 1-5 cigarettes (30.2%), 6-10
cigarettes (27.4%), 11-20 cigarettes (23.4%), 21-30 cigarettes (3.0%), and 31 or more cigarettes per day (0.7%)

**Measures**

*Smoking cessation-specific parenting T1.* Smoking cessation-specific parenting refers to parenting practices aimed at motivating and pressurising adolescents to quit smoking. This scale has been demonstrated to have good factorial validity and high internal consistency (Van Zundert et al., 2007). Examples of items are: “My parents exert pressure on me to quit smoking”, and “My parents often warn me about the harmful effects of smoking.” These items could be answered on a 5-point Likert scale ranging from 1 (not true at all) to 5 (very true). Cronbach’s alpha was .85.

*Parental smoking T1.* Standard items were used to measure fathers’ and mothers’ smoking status (e.g., Kleinjan et al., 2009). Both parents’ smoking was recoded into one observed variable with the following categories: 1 (both parents do not smoke), 2 (one parent smokes, the other parent does not smoke), and 3 (both parents smoke). Adolescents’ proxy reports on parental smoking are considered to be valid indicators of parents’ lifetime and current smoking status (e.g., Harakeh, Engels, De Vries, & Scholte, 2006).

*Smoking-specific cognitions T1.* The smoking-specific cognitions included the pros of smoking, pros of quitting (De Vries, & Backbier, 1994; Dijkstra et al., 1997; Van Zundert et al., 2007), and self-efficacy to resist smoking (Velicer, DiClemente, Rossi, & Prochaska, 1990; Van Zundert et al., 2007). Pros of smoking involved 10 items measuring the perceived positive aspects of smoking, such as “Smoking helps to relax”, and “Smoking helps to concentrate.” Alpha was .84. Pros of quitting were measured through 14 items about the perceived advantages of smoking cessation, such as “To quit smoking decreases the risk for lung cancer”, and “To quit smoking will get me in better shape.” Alpha was .90. Both scales had response choices ranging from 1 (totally disagree) to 4 (totally agree), and were constructed by De Vries and Backbier (1994), and validated in other studies (Dijkstra et al., 1997). Self-efficacy represented the perceived difficulty to resist smoking in tempting situations on a scale from 1 (very easy) to 5 (very difficult). Exemplary situations of the 8 situations given are: “When things are not going your way and when you are frustrated”, and “When your friends offer you a cigarette.” Alpha was .86.

*Nicotine dependence T1.* We used a measure of nicotine dependence that is specifically attuned to adolescents and that has good psychometric properties (Kleinjan, Van den Eijnden, Van Leeuwe, Brug, Otten et al., 2007). This composition was derived from the
modified Fagerström Tolerance Questionnaire (mFTQ) (Prokhorov, Pallonen, Fava, Ding, & Niaura, 1996), and Hooked on Nicotine Checklist (HONC) (DiFranza, Rigotti, McNeill, Ockene, Savageau, St Cyr, & Coleman, 2000). The total 11 items include aspects of emotional and physical symptoms of dependence (e.g., irritation, anger, restlessness, etc., when abstaining or smoking less), and behavioral symptoms of nicotine dependence (e.g., intensity of smoking). Alpha was .85.

Outcome variables. The measure for readiness to quit was derived from the original stages of change measure by Prochaska, Velicer, Guadagnoli, and Rossi (1991), and was similar to stages of change derived scales as used in other studies (Dijkstra et al., 1997; Kleinjan et al., 2007; Van Zundert et al., 2007). On a scale from 1 to 9, respondents could rate their readiness to quit: 1 (within 10 days), 2 (within 1 month), 3 (within 6 months), 4 (within 1 year), 5 (within 5 years), 6 (within 10 years), 7 (in the future, but not within 10 years), 8 (I intend to keep smoking, but to cut down), 9 (I intend to keep smoking and not to cut down). The items were recoded so that a high score on this scale represented a high readiness to quit. It should be stressed that although we use the term readiness to quit, this also refers to the term motivation to quit that other researchers often use. To restrict the skewness of the distribution, the answering possibilities were recategorized as follows: ‘1’ (anchors 8 and 9), ‘2’ (anchors 5 through 7), ‘3’ (anchors 3 and 4), and ‘4’ (anchors 1 and 2). We found this distribution the most suitable one with regard to both content and normality (cf. Van Zundert, Engels, Kleinjan, & Van Den Eijnden, 2008). On T2, participants were also asked whether they had quit smoking or not. Thus, the variable for smoking cessation was dichotomous.

Strategy for Analyses

To test the effect of SCSP and parental smoking on outcomes both directly and indirectly via the smoking-specific cognitions, we tested two separate structural equation models. The first model included readiness to quit at T2 as outcome, and the second model included smoking cessation at T2. These models were analyzed using the software package MPLUS 5.1 (Muthén and Muthén, 1998–2006). MPLUS was used because of its ability to handle nonnormality and ordinal variables without reliance on large samples (Kaplan, 2000), and because it allows for testing models with binary outcome variables. To examine hypothesized relations among (or with) ordinal and nominal variables, MPLUS uses the weighted least squares (WLS) approach and thus was used in the readiness to quit model. For more details on the WLS approach in relation to model estimation, see Flora and Curran (2004). Since ‘smoking cessation’ was a binary dependent variable, parameters in this second
model were estimated using the maximum likelihood estimator with robust standard errors (MLR). All indicators showed loadings above .73 on the latent variables.

Subsets of scale items, also denoted as parcels, were used as indicators for the latent variables smoking cessation-specific parenting, the pros of smoking and quitting, and self-efficacy (Bandalos & Finney, 2001). The lower and higher factor loadings of each scale were equally divided between the two parcels for each latent construct as recommended by Nasser and Takahashi (2003). For ease of presentation, the observed variables are not depicted in Figures 1-3. The default procedure to deal with missing values in MPLUS 5.1 is the Full Information Maximum Likelihood (FIML), which uses all the available information without imputing missing values. Because only those who completed the outcome variables on T2 were included, missings were restricted to the endogenous variables where missings were random and small in number (highest percentage of missings on a variable was 2.6%).

We conducted some additional analyses as well. To test whether level of nicotine dependence moderated the pathways in both structural models, we applied multi-group testing which is based on chi-square difference testing between the original model and an identical model with (some) constrained parameters (Jöreskog & Sörbom, 1996). Since the chi-square value cannot be used for standard chi-square difference tests when using the MLR estimator, the Satorra-Bentler scaled chi-squared difference test was applied when calculating the model for smoking cessation (Satorra, 2000). Based on a median split, respondents were assigned to either the low or high category of nicotine dependence.

To evaluate the fit of the several models, we used two commonly used fit measures: (a) root-mean-square error of approximation (RMSEA) and (b) comparative fit index (CFI). RMSEA is used for assessing approximate fit, preferably with values less than or equal to .05, but values between .05 and .08 are indicative of fair fit. CFI values above .95 are preferred but to show comparative fit should not be lower than .90 (Kline, 1998, p. 131). Chi-square values, degrees of freedom, and p-values are reported but are less suitable to assess the fit of structural models (Mueller, 1996, pp. 82–84). For the structural models, no additional constraints (e.g., correlated error terms of indicators) were necessary to achieve model identification.

Results

Descriptive analyses

At T2, the least motivated group was largest in size, and the most motivated ones comprised the smallest group; readiness to quit was distributed as follows: 1 (37.4%), 2
(31.6%), 3 (22.1%), and 4 (8.8%). At T2, 11.1% of the participants reported to have quit smoking.

**Model for motivation to quit at T2**

SCSP was positively associated with pros of quitting and self-efficacy, and negatively related to pros of smoking (Figure 1). Parental smoking was not associated with pros of smoking and quitting, but was significantly and negatively associated with self-efficacy. The cognitions, in turn, were not significantly related to readiness to quit one year later, and neither was parental smoking. SCSP, however, was significantly and positively related to readiness to quit at T2. (Footnote 1)

**Model for smoking cessation at T2**

Neither the parental smoking and SCSP, nor the smoking-specific cognitions predicted smoking cessation one year later (Figure 2).

**Multi-group analyses: high versus low nicotine dependence.**

We conducted multi-group analyses for both models. No significant differences were detected that were related to the two main outcome variables, indicating that the associations between the parenting variables and cognitions were not differentially related to readiness to quit and smoking cessation at T2 according to participants’ level of nicotine dependence. Various pathways between the parent variables and the smoking-specific cognitions, however, were different across groups (Figure 3, Footnote 2). The association between parental smoking and the pros of quitting was stronger among those who had low levels of nicotine dependence ($\Delta \chi^2 (1) = 3.98, p < .05; \beta_{low} = .11; \beta_{high} = .38$). Smoking cessation-specific parenting was more strongly related to both the pros of smoking (negative association) and pros of quitting among those with high levels of dependence (pros of smoking: $\Delta \chi^2 (1) = 4.51, p < .05; \beta_{low} = .01; \beta_{high} = -.28$; pros of quitting: $\Delta \chi^2 (1) = 6.06, p < .05; \beta_{low} = .11; \beta_{high} = .38$).

**Discussion**

A longitudinal test of the Social Cognitive Theory failed to provide support for its assumptions when it concerns adolescent smoking cessation. Further, albeit that parental smoking and smoking cessation-specific parenting were related to the cognitive components of the model, they did not predict whether or not adolescents successfully quit smoking. Smoking cessation-specific parenting did affect readiness to quit over time.

Outcome expectancies (the pros of smoking and quitting) and self-efficacy were not related to readiness to quit or actual smoking cessation over a period of 12 months. This is in line with a previous prospective cohort study on Dutch adolescents (Engels et al., 1998), but
in contrast with prospective findings of studies involving US adolescents (Rose, Chassin, Presson, & Sherman 1996; Wahl et al., 2005), and those from a diary study among Dutch adolescents who embarked on a serious quit attempt (Van Zundert, Nijhof, & Engels, 2009). There are several reasons that might explain the differences in findings. First, Wahl and colleagues (2005) examined adolescents engaged in a smoking cessation intervention, and perhaps this is a self-selected group of adolescents that cannot be easily compared with samples of unaided quitters. In addition, Wahl and colleagues focused on the entire spectrum of cigarette smokers, whereas the present study included only regularly smoking adolescents. Irregular smokers have a more fluctuating smoking pattern and may respond differently to smoking interventions compared to regular smokers (Hollis, Polen, Whitlock, Lichtenstein, Mullooly et al., 2005). When testing the usefulness of cognitive and behavioral constructs in guiding intervention development, it could thus be argued that only regular smokers should be included. Rose et al. (1996) focused on an older sample (young adults) and indeed found effects of reasons for quitting on smoking cessation but not for personally relevant health and psychological beliefs (which are similar to our measurement of pros and cons of smoking). A second explanation is related to differences in designs. Perhaps adolescents – as they have rather limited experience with undertaking a quit attempt and the associated difficulties like withdrawal symptoms and craving – might not be accurate in judging their efficacy to refrain from smoking. Once they embark on a quit attempt, and experience the challenges of refraining from smoking, adolescents might be better able to judge their capacities to deal with tempting situations.

In cross-sectional analyses on the same data, pros of smoking and quitting were related to readiness to quit (Van Zundert et al., 2007). However, the current longitudinal analyses do not show that smoking cognitions are related to readiness to quit over time. This might imply that a) other factors, such as friends’ support and peer smoking (Kleinjan et al., 2009) overrule the impact of pros and cons of smoking over time, or b) that pros and cons of smoking, especially in teens with little experience with quitting, are flexible and are easily influenced by external factors or individual experiences. The latter might also be applicable for readiness to quit. Hughes, Keely, Fagerstrom, and Callas (2005) found that plans to stop smoking are unstable over short periods of time and that for many smokers, a measure of plans to quit represents only short-term intentions. Moreover, as adolescents frequently engage in often short-lived quit attempts (Pallonen et al., 1990), these experiences might shape not only their readiness to quit in the future but also their perceptions on the advantages
and disadvantages of smoking and quitting. Hence, our findings fit well with longitudinal empirical testing of another social-cognitive model, namely the Transtheoretical Model (TTM: Prochaska & DiClemente, 1984). The TTM aims to explain and predict stages of change in smoking. Two large European prospective studies on adolescent smokers did not find support for the impact of the affective-cognitive components (i.e., processes of change and decisional balance) on readiness to quit and successful smoking cessation (Guo, Aveyard, Fielding, & Sutton., 2009; Kleinjan, Brug, Van den Eijnden, Vermulst, Van Zundert et al., 2008). In sum, we have two main interpretations of our findings: 1) social-cognitive factors are not predictive of readiness to quit and smoking cessation in young people, and 2) a critical test of the theory should be conducted using data sets that include the day-to-day variations and effects of social-cognitive factors on behavior.

Parental smoking was related to self-efficacy levels directly, but was neither related to readiness to quit nor to smoking cessation over time. Although the impact of parental smoking on smoking acquisition is well established (e.g., Bricker, Otten, Liu, & Peterson, 2009; Otten et al., 2007), only a few studies tested the impact of parental smoking on successful quitting of their offspring. One of these studies did not find an effect of parental smoking either (Rose et al., 1996), while two other studies showed that only when parents quit early in the life of their children, children are more likely to quit themselves (Bricker et al., 2005; Bricker et al., 2009). It might be possible that other social agents are more pivotal in the process of smoking cessation as most teens spend a lot of time with their friends and peer group members and also smoke together (Bauman & Ennett, 1996). Qualitative research on teens who quit smoking demonstrates that friends’ smoking and support are significant factors in maintaining cessation (Dalum, Schaalma, Nielsen, & Kok, 2008). Additionally, longitudinal research underscores that peer smoking is related to the level of nicotine dependence (e.g., Brook, Saar, Zhang, & Brook, 2009; Kandel et al., 2007), and peer smoking is also related to successful smoking cessation (Rose et al., 1996). Thus, considering peer and parental smoking, we propose further research to focus on peers rather than parental smoking in the process of adolescent smoking cessation.

In contrast with cross-sectional analyses (Van Zundert et al., 2006), we did not find support for a profound role of smoking cessation-specific parenting in successful smoking cessation in the current prospective analyses. Although parents’ pressuring actions seem to be cross-sectionally related to smoking-specific cognitions and readiness to quit, eventually their actions did not affect whether their offspring successfully quit smoking or not. That smoking
cessation-specific parenting does not predict successful quitting was also demonstrated in a diary study in which adolescents were followed intensively after achieving 24 hours of abstinence (Van Zundert & Engels, 2009). This study showed that lapses and relapse were not affected by baseline parenting practices. However, our findings build on previous work in the field on juvenile smoking cessation (Castrucci & Gerlach, 2005; Ditre et al., 2008; McGee et al., 2008) by demonstrating that parenting affects motivation to quit over time. As cross-sectional research always leaves open the possibility that associations are in the opposite direction (for example, when parents notice that their children perceive many advantages of smoking cessation, they might feel urged to support their children in their readiness to quit by practising more smoking cessation-specific parenting), our findings provide convincing evidence for parental actions actually affecting readiness to quit over time.

As noted, we have two interpretations of our findings. First, parents might be more influential in shaping adolescents beliefs and confidence to quit, preparing them to undertake a quit attempt than in helping them while they actually quit. Whether a quit attempt is successful might depend more on various contextual factors, such as being in contexts where other people smoke and in the case of alcohol consumption, or on individual differences in the dynamics in withdrawal symptoms and craving after having quit (Van Zundert, Boogerd, Vermulst, & Engels, 2009). These experiences might overrule parental efforts to help their child to quit. Second, perhaps parents are adapting their responses in terms of supporting and advising their child – or even altering their own smoking behavior throughout the course of the quit attempt, for example, by refraining from smoking in the environment of their teenage child. In addition, parents might also help their children to deal with ‘confronting situations’, for example when going out in bars where people smoke, or when they feel distressed and crave (or long) for a cigarette. Perhaps adolescent smokers, with mostly limited quitting experience, cannot really foresee how their parents respond in these various situations, implying that adolescents’ perceptions of parenting before they plan a quit attempt might be less accurate. This argues for more fine-grained analyses in which adolescents (and their parents) are followed before and during a quit attempt.

Despite the strengths of the study such as its large sample size, longitudinal design, and theory-driven analyses, some limitations have to be mentioned. To begin with, the findings are based on self-reports. Adolescent reports may have some bias in the actual exertion of smoking cessation-specific parenting. Although the subjective experience of adolescents might be more important to their behavior than parents’ actual behavior
(Steinberg, Lamborn, Dornbusch & Darling, 1992), for theoretical as well as prevention purposes it is needed to replicate the models including parent data. Second, we only gathered data about parenting practices at baseline. Insight into changes in parental actions and responses during a quit attempt is necessary to draw more definite conclusions. Third, self-reports on smoking cessation were not substantiated with biochemical verification. However, Stanton, Lowe, and Gillespie (1996) found that information obtained from adolescents on smoking and quitting was reliable and had high internal consistency and validity. Although in population studies among adolescents generally no carbon monoxide measurements and cotinine analyses are used (Christenhusz, De Jongh, Van der Valk, Pieterse, Seydel, & Van der Palen, 2007; Gorber, Schofield-Hurwitz, Hardt, Levasseur, & Tremblay, 2009), for theory-testing it will become increasingly important.
Footnotes

1. Since prior cross-sectional analyses on these data showed that SCSP was significantly related to readiness to quit (Van Zundert et al., 2007), we tested whether the effect of SCSP at T1 on readiness to quit at T2 would remain significant when controlling for readiness to quit on T1. The model fit remained excellent ($\chi^2(36) = 68.38, p < .001$, RMSEA = .045, and CFI = .986). Despite that readiness to quit on T1 significantly predicted readiness to quit on T2 ($\beta = .24, p < .001$), the association between SCSP at T1 on readiness to quit on T2 remained significant ($\beta = .18, p < .01$).

2. Because the model for readiness to quit and the model for smoking cessation resemble each other regarding the interrelatedness of the endogenous variables, the multi-group differences in those pathways were identical for the two models. Therefore, the standardized coefficients per group are only reported for the smoking cessation model (Figure 3).
Figure 1. *Standardized coefficients of the structural equation model for readiness to quit on T2.*

Note. $N = 446$, $\chi^2(31) = 58.84$, $p < .01$, RMSEA = .045, CFI = .987. * $p < .05$; ** $p < .01$; *** $p < .001$. 
Figure 2. Standardized coefficients of the structural equation model for smoking cessation on T2.

Note. N = 530, $\chi^2(31) = 55.55$, $p < .01$, RMSEA = .039, CFI = .990. * $p < .05$; ** $p < .01$; *** $p < .001$. 
Figure 3. *Standardized coefficients of multi-group model for smoking cessation on T2 based on groups low versus high on nicotine dependence.*

Note.  N = 526, $\chi^2(72) = 106.33$, $p < .01$, RMSEA = .043, CFI = .985. * $p < .05$; ** $p < .01$; *** $p < .001$. 
References


Chapter 5

Parental factors in adolescents’ smoking relapse
Abstract

The present study examined the role of parents in smoking relapse among adolescents who embarked on a serious quit attempt. Participants were 135 daily smoking adolescents aged 15-20 who participated in an Ecological Momentary Assessment (EMA) study. Daily questions about their quitting experiences were administered during four weeks. Longitudinal logistic regression analyses were applied to test whether parental smoking, expected parental support, parental norms about cessation, and smoking cessation-specific parenting at baseline predicted the first lapse into smoking as well as mild and heavy relapse during the four-week period, and abstinence at follow-up two months later. Neither parental smoking nor hardly any of the parenting variables explained successful smoking cessation among adolescents, except for expected parental support. Despite that parents have been found influential in the development of adolescent smoking, our findings suggest that parents’ influence is limited when it concerns actual smoking cessation and relapse.
Introduction

Whereas onset, escalation and continuation of smoking have been the primary focus of adolescent smoking research for years, there has been a shift in attention to adolescent smoking cessation over the past decade. Such a shift has proven critical as adolescents seem largely unable to quit smoking [1], while the prevalence of regular smoking in youths remains high. Having difficulty to quit smoking particularly applies to daily smoking adolescents, who have been shown to have successful unaided smoking cessation rates ranging from no more than 5.3% [2] to 12.3% [3]. Success rates are somewhat higher among adolescents who have received some kind of intervention, such as 17% in a teen school-based clinic cessation program [4], and between 6.5% and 17.7% with nicotine replacement aids [5]. Although cessation rates vary across countries and age groups, and are contingent on both the specific outcome measure used and duration of follow-up [6], youth cessation rates are discouragingly low, demanding more intensive research on determinants of relapse among adolescents.

Since the area of research on adolescent smoking relapse is almost completely uncovered, it may be effective to relate smoking cessation to factors that have been established as significant determinants in earlier adolescent smoking trajectories. In research on adolescent smoking, parental influences have extensively been examined and have consistently been found to play a significant role in the development of adolescent smoking. Several aspects of parenting, such as emotional support and anti-smoking socialization, as well as parents’ own smoking behavior have been shown to be related to both the acquisition and continuation of adolescent smoking [7-19] but their relation with adolescent smoking cessation and relapse has hardly received any attention so far. In the present study, the associations between parental factors and adolescent smoking relapse were examined.

Regarding parental factors in adolescent smoking, smoking behavior of parents themselves has received ample attention. Numerous studies demonstrate that parental smoking predicts adolescents’ acquisition and continuation of smoking, with exposure, availability and role-modeling being the most often proposed explanatory mechanisms [7-13]. Having established the adverse effects of parental smoking, one might expect that parental smoking discourages children to undertake quit attempts, or to frustrate success in smoking cessation. Despite that two studies support this notion and tell something about the likelihood that adolescents have quit at some point in the past when parents were supportive [20-21], they did not inform whether parental smoking can actually determine the successfulness of adolescents’ attempts to quit smoking or that it can prevent relapse.
In addition to parents’ own smoking behavior, their parenting skills and attitudes, such as parental support (both general and smoking-specific support) and parental disapproval of or norm against smoking, appear to be relevant to the onset and escalation of adolescent smoking as well [16-22]. However, these processes are distinctly different from smoking cessation and relapse. Again, there have been few studies that explored parenting practices such as support and anti-smoking norms in the context of adolescent smoking cessation and relapse. One exception is a study by Chassin and colleagues [22], who found that adolescents who had quit smoking reported higher levels of parental support than did continuing smokers, although this only counted for younger adolescents. We posit that adolescents may be more prone to try to maintain abstinence during a quit attempt when they are aware of their parents’ norm that they should quit smoking. In addition, parents’ engagement in smoking cessation-specific parenting skills (such as exertion of pressure to quit, communicating the advantages of smoking cessation, and limiting the opportunities to smoke around the house [23]), might make adolescents feel more prepared to start their quit attempt, thereby also decreasing the odds of relapse.

In the present study, 135 daily smoking adolescents in the ages of 15 to 20 participated in an Ecological Momentary Assessment (EMA) study in which they embarked on a serious attempt to quit smoking. Participants answered daily questions about their quitting experiences three times a day over a period of four weeks. We hypothesized that parental smoking would predict time to the first lapse, and relapse into smoking as observed during the three weeks after the quit attempt, and at the 2-month follow-up. Parental support, a parental norm in favour of smoking cessation, and the engagement in smoking cessation-specific parenting was hypothesized to decrease the odds of a first lapse and relapse.

Method

Participants

The present sample consists of 135 daily smoking adolescents in the ages of 15 to 20 years. Being between 15 and 19 years of age, and smoking at least one cigarette per day were the main selection criteria. Exclusion criteria were participation in a smoking cessation program, and use of anti-depressants. Two participants who had turned 20 in the month prior to the study were allowed to participate. The sample originally comprised 176 adolescents who were enrolled in the study. This number was narrowed down to 149 by excluding 17 individuals who withdrew prior to the target quit day, 9 who had too many missing values to establish whether they had achieved 24 hr abstinence or not, and 1 participant who failed to reach 24 hr abstinence at least once during the study. Fourteen of those 149 participants had
not successfully returned their baseline questionnaire and were therefore excluded from the present analyses. The final sample thus consisted of 135 adolescents. Of those 135 participants, 120 (88.%) completed the 2-month follow-up. For attrition analyses on the same data, please consult [24].

The final sample of 135 adolescents consisted of 86 girls (63.7%), and 49 boys. Ages were distributed as follows: 15 (2.2%), 16 (31.1%), 17 (29.6%), 18 (16.3%), 19 (17.8%), and two persons had just turned 20 (1.5%) ($M = 17.21$, $SD = 1.18$). Participants resided across all four regions of the Netherlands, and all levels of educational attainment were represented: Lower vocational training (53.9%), higher vocational training (14.6%), pre-university education (13.8%), and college (17.7%). Most respondents lived at home with their parents (89.5%), whereas 7.6% lived in student housing, with his or her grandparents (0.7%), or with a romantic partner (2.2%). The average number of years that participants had been smoking daily was 2.95 ($SD=1.61$). At the time of enrollment in the study, smoking rate was distributed as follows: ‘1-5 cigarettes per day’ (11.9%), ‘6-10 cigarettes per day’ (34.3%), ‘11-20 cigarettes per day’ (47.0%), ‘21-30 cigarettes per day’ (3.7%), and ‘31 or more cigarettes per day’ (3.0%). The smoking rates for fathers and mothers were as follows: ‘not smoking’ (61.7% and 64.9% for fathers and mothers respectively), ‘smoking less than 1 cigarette per day’ (3.8% and 3.0%), ‘1-5 cigarettes per day’ (3.8% and 6.7%), ‘6-10 cigarettes per day’ (9.0% and 3.7%), ‘11-20 cigarettes per day’ (11.3% and 10.4%), ‘21-30 cigarettes per day’ (6.8% and 9.7%), and ‘31 or more cigarettes per day’ (3.8% and 1.5%).

Procedure

Participants were asked to complete a baseline questionnaire one week prior to entering the study part in which they were monitored daily for a total of four weeks (“diary period”). The first day of monitoring was always a Monday. Participants started the monitoring period with seven days of baseline monitoring, during which they were instructed to smoke ad lib. The eighth day was the assigned quit day for each participant. A quit attempt was considered as such when participants were abstinent for at least 24 consecutive hours, as was evidenced by 3 consecutive reports of non-smoking. Following the quit day, subjects were monitored for an additional three weeks. On each day of monitoring, participants were asked to complete the same internet-based questionnaire three times –in the morning (to be completed between 10am and noon), the afternoon (3pm – 5pm), and evening (8pm – 10pm). Each questionnaire was identical and asked participants questions on smoking since the previous questionnaire, motivation, self-efficacy, withdrawal symptoms, and situational stimuli (e.g., alcohol/coffee consumption, seeing others smoke). The questionnaires were in
Dutch (participants spoke Dutch) and took approximately three minutes to complete. Questionnaires were automatically time-stamped with the time that they were completed. Participants who failed to complete a questionnaire within the designated sampling window where sent a text message to remind them. If a participant did not have access to the internet during the sampling window, they were asked to complete a paper version of the questionnaire and to submit the paper version online as soon as they had access to internet again. Participants received 40 euros if they completed the full four weeks of the diary period, and 10 additional euros upon completion of the 2-month follow-up. All data were collected between October 2006 and March 2007. This study was approved with the Committee on Research Involving Human Subjects.

Measures

Parental smoking. Standard items were used to measure fathers’ and mothers’ smoking status. Response choices were: 1 (no, my father/mother does not smoke), 2 (yes, but less than 1 cigarette per day), 3 (yes, 1-5 cigarettes per day), 4 (yes, 6-10 cigarettes per day), 5 (yes, 11-20 cigarettes per day), 6 (yes, 21-30 cigarettes per day), 7 (yes, more than 31 cigarettes per day). Scores on maternal and paternal smoking had been dichotomised into ‘non-smokers’ (response choice 1), and ‘smokers’ (response choices 2-7), and were combined to form a measure of parental smoking, with ‘1’ being indicative of two non-smoking parents, ‘2’ indicating one non-smoking and one smoking parent, and ‘3’ two smoking parents. Previous research showed that adolescents are highly accurate in their reports on parental smoking [25].

Parental support. Expected parental support was measured through the question: “How much support in your quit attempt do you expect from your father/mother?” The two items were averaged into one score reflecting expected parental support. Item anchors ranged from 1 (no support at all) to 5 (a lot of support).

Parental norm regarding smoking cessation. Parental norm was operationalized as: “My father/mother thinks I should quit smoking”. Participants rated the extent to which they agreed with this statement on a scale from 1 (absolutely not true) to 4 (very true). A high score indicated that parents strongly held the norm that their child should quit smoking. The mean of the items for fathers and for mothers was used as a measure of parental norm towards their child’s smoking cessation.

Smoking cessation-specific parenting (SCSP). Smoking cessation-specific parenting refers to parenting practices aimed at motivating and pressuring adolescents to quit smoking, through rule setting, communication, and exertion of pressure specifically attuned to
adolescent smoking cessation [23]. This instrument has been shown to have a good reliability in a large sample of frequently smoking adolescents [23]. Example of the 8 items pertaining to the smoking cessation-specific parenting scale are “My parents do not allow me to smoke at home”, “My parents talk to me about the benefits of smoking cessation”, and “My parents exert pressure on me to quit smoking”. Item anchors ranged from 1 (absolutely not true) to 5 (very true). Cronbach’s alpha was .83.

**Outcome Variables**

For the purposes of the analyses presented in this paper, we were interested in five outcomes: First lapse, ‘mild’ and ‘heavy’ relapse within 3 weeks after the quit attempt, and smoking status at the 2-month follow-up. A participant’s first lapse day was defined by any report of smoking (even if only a puff), after having accomplished 24 hours of abstinence. The literature on adolescent smoking does not provide standard definitions of relapse that are suitable for adolescents specifically. Common definitions of relapse as applied to adult smokers might be too stringent in adolescent samples (e.g., smoking at least five cigarettes for three consecutive days; [26] ) given that adolescents have shorter histories of smoking. For the purposes of the present analyses, we defined relapse in two ways: 1) smoking at least one cigarette per day for three consecutive days (‘mild relapse’), and 2) smoking at least 5 cigarettes per day for three consecutive days (‘heavy relapse’). Smoking status at the 2-month follow-up was measured through the question: “Have you maintained abstinence since the end of the diary period?” Response choices were: ‘1’ “Yes, I am still a non-smoker”, ‘2’ “No, I am smoking again, but I smoke less now than before I entered the study”, and ‘3’ “No, I am smoking again at the same level as when I entered the study”. Scores were dichotomised into ‘non-smokers’ (response choice 1), and ‘smokers’ (response choices 2-3). All outcome variables were dichotomous with score ‘1’ representing non-smoking, and ‘2’ indicating the occurrence of smoking (first lapse, relapse, and current smoking at follow-up).

**Strategy for analyses**

First, we calculated the relative occurrence of the relapse variables, and computed correlations among independent variables. Next, we examined the associations between the baseline parenting variables and the various outcome variables by means of survival analyses, using a Cox proportional hazards regression model. Survival analysis is used to study the time between the entry to a study and a subsequent event (such as death, or in the present case ‘relapse’). A Cox regression model provides an estimate of the hazard (or risk) of the event for individuals on the basis of their individual characteristics (such as cognitions) thereby taking into account when the event occurred [27]. Since the follow-up was measured at a
fixed time point (2 months after the end of the diary period), we used logistic regressions instead of survival analysis to test effects on abstinence at follow-up. The survival analyses and logistic regression analysis are all multivariately testing the relative value of predictor variables. Lastly, sex, age and educational attainment did not significantly predict any of the outcome variables and were therefore not included in the model as possible confounding variables.

Results

The majority (70.4, n = 95 of 135) of the participants experienced at least one lapse during monitoring, and 58.5% (n = 79 of 135) also reported a second lapse. ‘Mild’ relapse defined as ‘any smoking on three consecutive days’ occurred for 46 participants (34.1%, n = 46 of 135). ‘Heavy’ relapse defined as ‘smoking at least 5 cigarettes on three consecutive days’ occurred for 27 participants (20.0%, n = 27 of 135). At follow-up, 29.6% of the initial sample of 135 adolescents were still abstinent, and 59.3% were smoking again (11.1% of the subjects did not participate in the follow-up).

Pearson and Spearman correlations were computed to examine the associations between all model variables (Table 1). Parents who were smokers themselves were less likely to engage in smoking cessation-specific parenting, and held a less strict norm regarding their child’s quitting than parents who did not smoke. Both fathers’ and mothers’ smoking status were not related to the amount of support their children expected them to provide. Smoking cessation-specific parenting was strongly positively related to parental norm, indicating that parents who were more strongly applying smoking cessation-specific parenting were also the ones who held the norm that their child should quit smoking. Smoking cessation-specific parenting was not associated with expected parental support, whereas parents who held a pro-quitting norm were expected to provide more parental support.

The findings of the survival analyses show that paternal and maternal smoking, smoking cessation-specific parenting, expected parental support and norm on smoking cessation were not related to any of the lapse and relapse measures (Table 2). We found a trend effect of smoking by fathers on abstinence at the 2-month follow-up (Table 3). Smoking by fathers seemed to function as a protective factor in that smoking by fathers was related to lower odds of adolescents’ smoking at the follow-up.

Discussion

The present study examined the impact of parental smoking, smoking cessation-specific parenting, parental norms towards quitting, and parental support on adolescent
smoking relapse after cessation. Although a trend was found for paternal smoking predicting successful quitting at follow-up, we mostly found no effects of the parent variables on relapse. We can propose several explanations for the lack of a substantial effect of parental smoking on adolescent relapse outcomes. Firstly, Darling and Cumsille [28] suggested that when focusing on proximal processes that operate at transitional points (undertaking a quit attempt), stable characteristics (such as parental smoking) can predict change only in the presence of a triggering event (such as the offer of a cigarette by a peer). If adolescents are constantly exposed to smoking at home while they attempt to quit, they are likely to be challenged more severely to maintain their abstinence. However, it may not directly be the exposure to their parents’ smoking that causes them to relapse, but the exposure is likely to weaken their resistance towards smoking-related cues or tempting situations, which in turn makes relapse more likely.

Alternatively, the influence of parental smoking may be contingent on individual characteristics of the adolescent, such as adolescents’ self-efficacy during and after the quit attempt. It is conceivable that parental smoking is only significant in further (re)lapsing when in conjunction with adolescents’ low self-efficacy to resist smoking. However, information about whether parents who were smokers also smoked in the company of their children who attempted to quit smoking or not and how often participants were around their smoking parents during the study was not included in the daily questionnaire, while this may make a difference for the self-efficacy and vulnerability of adolescents in cessation. We also do not know whether parents adjusted their smoking behavior during their child’s quit attempt or not, for example, by smoking outside the house instead of inside or even by quitting smoking themselves. Adolescents might be accustomed to their parents’ smoking and as such might be less influenced by it. However, it may be the change in parents’ smoking behavior rather than their baseline smoking status that affects adolescents who attempt to quit smoking. This might explain why smoking by fathers appeared to be a protective factor for smoking at follow-up; these fathers may have made an extra effort regarding their own smoking.

Perceived parental support at baseline did not predict any of the outcomes. It is possible that strong temptations to smoke (when drinking alcohol at a party or in a pub for example), and the experience of heavy withdrawal symptoms may cause relapse regardless of the amount of support parents may provide [29]. It must also be noted that we used a measure of expected parental support. Although adolescents are likely to be capable of forecasting their parents’ behavior, for example based on their experiences from the past, their expectations may not entirely be met. It is possible that those who had received less support
than they had expected were additionally prone to relapse, compared to those who had received the expected amount of support or even more. This, again, points to the need of examining the development of and change in parents’ attitudes and behaviors when their child is in the midst of the quitting process. To conclude with, there is hardly any literature available on which factors predict relapse among adolescents, and as such there is little empirical knowledge about what parents could focus on when they want to help their child in preventing relapse. One prior study showed that day-to-day variations in self-efficacy predict the first lapse and relapse into smoking among daily smoking adolescents who had achieved abstinence [30], and parents could be advised to monitor and help strengthen their child’s daily self-efficacy after quitting.

In the above, we have mainly proposed alternative explanations of why parental smoking and parenting practices may still be relevant despite the present findings. It is, however, of course possible that the influence of parents reaches only so far, and may be more important in guiding and facilitating the processes that precipitate actual quit attempts rather than determining the outcome of the trials. This might also explain why smoking cessation-specific parenting and parental norm about quitting did not predict the outcome of the quit attempts. It is conceivable that once an adolescent starts with his or her quit attempt, only individual characteristics remain critical to the outcome. Parents who exert pressure on their child to quit, and who have a strong pro-quitting norm, may be effective in stimulating their child to consider and undertake a quit attempt in the first place [23], but those particular efforts do not seem to facilitate progress in successful cessation.

**Limitations**

Important strengths of the present study are that it is the first prospective study on parent variables in relation to adolescent smoking relapse, and that day-to-day reports of smoking have allowed for the first lapse, and mild and heavy relapse to be distinguished from one another, and for the time to event to be known. However, the study has some limitations. The sample size may have prevented relations to emerge as statistically significant. However, the sample size is quite normative for a study using ecological momentary assessment data in which adolescents are monitored so intensively. Further, we had sufficient statistical power to show effects of baseline cognitive factors in another paper based on these data [31]. Second, reports by proxy were used to measure parents’ behavior and one could argue that such reports do not reflect the actual behavior of parents. However, not only do adolescents seem to be quite accurate in estimating parents’ substance use [24], the perception rather than actual (smoking) behavior of others seems more relevant to adolescents’ behavior regarding both
parents [32]. Lastly, we did not use biochemical verification to ensure that participants had achieved 24 hr abstinence. However, it was emphasized with the participants that failure to reach abstinence would not be condemned as we were interested in the natural process of adolescent smoking cessation. The observation that 27.5% of the participants did not show 24 hr abstinence on the target quit day suggests that participants did not feel obliged to falsify their actual quit day in case of initial ‘failure’. Moreover, several studies among adolescents have indicated that self-reports of smoking and quitting behaviour are valid and reliable [33].

**Future research**

Since the present study has been the first to examine the direct parental influence on adolescents’ smoking cessation attempts and relapse, more research is needed before we can draw definite conclusions. We conducted this pilot study to test whether baseline measurements of parental behaviors are affecting lapse, relapse and short-term prolonged cessation. We recommend that future studies on this topic include day-to-day information on the behaviors of parents during the period in which their adolescent offspring make an effort to quit smoking. As noted, we did not collect these data in the current study. As the process of quitting is a highly dynamic process [34], the interaction with parents automatically is as well. Ecological momentary assessment studies in which adolescents embark on a serious quit attempt, and which include daily reports of both parenting variables and possible moderators, would simultaneously meet the demand for more dynamic formulations of smoking cessation [34], as well as the need for placing familial influences in a context that interacts with individual characteristics of parents and children [35].
Table 1. *Pearson and Spearman Correlations between Model Variables.*

<table>
<thead>
<tr>
<th>Measures</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Smoking father</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Smoking mother</td>
<td>.27**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Smoking cessation-specific parenting</td>
<td>-.31***</td>
<td>-.34***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Parental norm about quitting</td>
<td>-.29**</td>
<td>-.24**</td>
<td>.45**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Expected parental support</td>
<td>-.07</td>
<td>.02</td>
<td>.08</td>
<td>.18*</td>
<td></td>
</tr>
</tbody>
</table>

*Note.*  * p < .05, ** p < .01, *** p < .001.
Table 2. *Survival Analyses for Outcome Variables during the Diary Period.*

<table>
<thead>
<tr>
<th></th>
<th>1st Lapse</th>
<th></th>
<th>Mild Relapse</th>
<th></th>
<th>Heavy Relapse</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HR</td>
<td>95% CI</td>
<td>HR</td>
<td>95% CI</td>
<td>HR</td>
<td>95% CI</td>
</tr>
<tr>
<td>Smoking father</td>
<td>.64</td>
<td>.39 - 1.06</td>
<td>.75</td>
<td>.36 - 1.56</td>
<td>.66</td>
<td>.25 - 1.77</td>
</tr>
<tr>
<td>Smoking mother</td>
<td>1.19</td>
<td>.72 - 1.98</td>
<td>.72</td>
<td>.35 - 1.52</td>
<td>.61</td>
<td>.21 - 1.73</td>
</tr>
<tr>
<td>Smoking cessation-specific parenting</td>
<td>1.11</td>
<td>.81 - 1.51</td>
<td>1.13</td>
<td>.75 - 1.71</td>
<td>1.30</td>
<td>.79 - 2.14</td>
</tr>
<tr>
<td>Parental norm</td>
<td>1.04</td>
<td>.72 - 1.50</td>
<td>1.03</td>
<td>.59 - 1.81</td>
<td>1.02</td>
<td>.47 - 2.21</td>
</tr>
<tr>
<td>Expected parental support</td>
<td>.88</td>
<td>.73 - 1.06</td>
<td>.96</td>
<td>.75 - 1.23</td>
<td>.92</td>
<td>.68 - 1.26</td>
</tr>
</tbody>
</table>
Table 3. *Logistic Regression Analyses for Relapse at the 2-Month Follow-Up.*

<table>
<thead>
<tr>
<th></th>
<th>N = 119</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
</tr>
<tr>
<td>Smoking father</td>
<td>.47†</td>
</tr>
<tr>
<td>Smoking mother</td>
<td>1.08</td>
</tr>
<tr>
<td>Smoking cessation-specific parenting</td>
<td>.92</td>
</tr>
<tr>
<td>Parental norm</td>
<td>1.28</td>
</tr>
<tr>
<td>Expected parental support</td>
<td>1.08</td>
</tr>
</tbody>
</table>

*Note.* † = .056
Parenting and Adolescent Smoking Relapse

References

Parenting and Adolescent Smoking Relapse


Chapter 6

Testing Social Cognitive Theory as a theoretical framework to predict smoking relapse among daily smoking adolescents
Abstract

Predictors of adolescent smoking relapse are largely unknown, since studies either focus on relapse among adults, or address (long-term) smoking cessation but not relapse. In the present study, Social Cognitive Theory (SCT) was used as a theoretical framework to examine the first and second lapses, as well as mild and heavy relapse into smoking among 135 daily smoking adolescents who embarked on a serious quit attempt. Baseline predictors were pros of smoking, pros of quitting, self-efficacy, and intensity of smoking. Using an ecological momentary assessment (EMA) study design, participants were monitored three times a day during four weeks. A follow-up was administered two months after the monitoring period. Perceiving many pros of smoking, reporting a low self-efficacy to quit, and high levels of baseline smoking significantly predicted relapse within three weeks after quitting. The effects of pros of smoking and self-efficacy on relapse, however, appeared to be accounted for by differences in intensity of smoking. Besides that pros of quitting showed a marginal effect on abstinence at the 2-month follow-up, no long-term effects were detected.
Introduction

Adolescents seem to undertake quit attempts frequently (Pallonen, Murray, Schmid, Pirie, & Luepker, 1990; Presti, Ary, & Lichtenstein, 1992), but only few adolescents succeed in quitting (Stanton, 1995). It is estimated that 95% to 99% of all unaided quit attempts among adults end in relapses (Jarvis, 2003), most of which occur in the first few days and weeks of quitting (Doherty, Kinnunen, Militello, & Garvey, 1995; Jarvis, 2003). Adolescent smokers even seem to relapse as much as or even more often than adults (Mermelstein, 2003; Pallonen et al., 1990; Presti et al., 1992; Stanton, McLelland, Elwood, Ferry, & Silva, 1996). Predictors of adolescent smoking relapse are largely unknown, since studies on smoking relapse are conducted almost invariably among adults. In addition, most studies, both among adults and adolescents, examine predictors of long-term smoking cessation, which only establishes distal relationships between predictors and outcomes over months and years. The present study focuses on incidental lapses and relapse among daily smoking adolescents who achieved at least 24 hr abstinence.

A wide variety of factors, such as physiological and biological as well as cognitive factors appear to determine whether individuals successfully quit smoking or not. The present study concentrates on the role of cognitive factors in adolescent smoking relapse. Social Cognitive Theory (SCT) explains how people acquire and maintain certain behavioural patterns, for example smoking. The cognitive factors outcome expectations, self-efficacy, and intentions are important determinants of behaviour according to SCT (Bandura, 1986). In the context of smoking, outcome expectations can be operationalized as pros and cons of smoking, and intentions as motivation or readiness to quit. Pros of smoking involve the perceptions of the advantages of smoking, and cons refer to the disadvantages of smoking. Prior research on the pros and cons of smoking also used measures of the pros of quitting next to the pros of smoking (De Vries & Backbier, 1994; Dijkstra, Bakker, & De Vries, 1997; Van Zundert, Van De Ven, Engels, Otten, & Van Den Eijnden, 2007). Self-efficacy is often defined as the ability to resist smoking in tempting situations, and intentions are frequently framed in terms of motivation or readiness to quit (Prochaska, Velicer, Guadagnoli, & Rossi, 1991; Van Zundert et al., 2007). As such, SCT offers a theoretical framework to examine smoking behavior.

Several studies have demonstrated that adult smokers’ perceptions of the pros and cons of smoking and quitting affect their quitting behaviour (De Vries & Backbier, 1994; Dijkstra, De Vries, & Bakker, 1996; Greening, 1997; Hansen, Collins, Johnson & Graham, 1985; Prochaska, DiClemente, & Norcross, 1992; Rose, Chassin, Presson, & Sherman, 1996). Individuals who report to attribute relatively few advantages to smoking and many benefits to
quitting are more likely to achieve smoking cessation. However, relatively little is known about the influence of the pros and cons on smoking relapse specifically. It is conceivable that adolescents who perceive smoking to be highly advantageous and quitting to have relatively few advantages are the ones who will relapse and revert to smoking after embarking on a quit attempt. Another predictor which seems to play an important role in smoking relapse is self-efficacy to resist smoking. Research has consistently shown that low self-efficacy is related to smoking relapse among adults (for an overview, see Gwaltney, Metrik, Kahler & Shiffman, in press). Among adolescents, self-efficacy has not yet been tested in association with relapse.

Lastly, motivation to quit has been found to be a precursor of smoking cessation among adolescents (Engels, Knibbe, De Vries & Drop, 1998; Lichtenstein, Lando, & Notwehr, 1994; Osler & Prescott, 1998). Conclusively, there are some indications from both the literature on smoking cessation and from adult studies that components of the SCT can predict relapse. However, most studies that used the SCT to explain smoking cessation and relapse have focused on aspects of the SCT rather than capturing the model including outcome expectations, self-efficacy, and intentions as a whole. Moreover, to our knowledge, SCT has not yet been used to predict relapse among adolescents. In the present study, we examined whether SCT derived smoking-specific cognitions predicted adolescents’ lapses and relapse after a serious quit attempt (Footnote 1).

Besides the influence of adolescents’ smoking-specific cognitions, the effect of intensity of smoking on relapse was taken into account. Intensity of smoking refers to the number of cigarettes smoked per day. Previous research has shown mixed results regarding the relation between intensity of smoking and smoking relapse. Some adult studies have found that heavy smokers are at greater risk for relapse during a quit attempt compared to light smokers (Curry, Thompson, Sexton, & Omenn, 1989; Senore et al., 1998). In contrast, other studies showed that the number of cigarettes smoked per day did not predict whether persons would succeed or fail during their attempts to quit smoking (Fiore et al., 1990; Kenford et al., 1994). Nicotine dependence is in part determined by intensity of smoking (Pierce & Gilpin, 1996), and there have been several studies that explored nicotine dependence in relation to adolescent smoking cessation (Engels et al., 1998; Horn, Fernandes, Dino, Massey, & Kalsekar, 2003), but not to relapse. Conclusively, the impact of baseline smoking on adolescent relapse has not yet been examined. Despite scarce evidence from previous research among adults and the contrasting findings above, we expected that a high intensity of smoking would predict the first lapses, as well as relapse into smoking within three weeks, and that
high baseline levels of smoking would lower the odds that quitters would be abstinent at the 2-month follow-up.

The purpose of the present study was to provide prospective information on the effects of SCT-derived smoking-specific cognitions and intensity of smoking on relapse among adolescent daily smokers. A number of 135 daily smoking adolescents in the ages of 15 to 20 participated in an Ecological Momentary Assessment (EMA) study in which they embarked on a serious attempt to quit smoking. Participants answered daily questions about their quitting experiences three times a day over a period of four weeks (1 week pre-cessation, and 3 weeks post-cessation). We hypothesized that high scores on pros of smoking, low scores on pros of quitting, low self-efficacy to resist smoking, and intensive tobacco use at baseline would predict the following five outcome variables: A first lapse, a second lapse, mild and heavy relapse into smoking as observed during the three weeks after the quit attempt, and current smoking at the 2-month follow-up.

Method

Participants

Participants were 135 daily smoking adolescents in the ages of 15 to 20 years, who were highly motivated to quit. Participants were recruited through advertisements and articles about the study that were published and displayed in newspapers, on websites, and in community centers. Being between 15 and 19 years of age, having a strong motivation to quit, and smoking at least one cigarette per day were the main selection criteria. Exclusion criteria were participation in a smoking cessation program, and use of anti-depressants. Two participants who had turned 20 in the month prior to the study were allowed to participate. The sample originally comprised 176 adolescents who were enrolled in the study. For the present analyses, we excluded 17 individuals who withdrew prior to the target quit day, 9 who had too many missing values to establish whether they had achieved 24 hr abstinence or not, 1 participant who failed to reach 24 hr abstinence at least once during the study, and 14 participants who had not successfully returned their baseline questionnaire. The final sample thus consisted of 135 adolescents. Of those 135 participants, 120 (88.%) completed the 2-month follow-up.

The final sample of 135 adolescents consisted of 86 girls (63.7%), and 49 boys. Ages were distributed as follows: 15 (2.2%), 16 (31.1%), 17 (29.6%), 18 (16.3%), 19 (17.8%), and two persons had just turned 20 (1.5%) ($M = 17.2, SD = 1.2$). Participants resided across all four regions of the Netherlands. All adolescents received regular education, and all levels of educational attainment were represented: Lower vocational training (53.9%), higher vocational
training (14.6%), pre-university education (13.8%), and college (17.7%). Most respondents lived at home with their parents (89.5%), whereas 7.6% lived in student housing, with his or her grandparents (0.7%), or with a romantic partner (2.2%). The average number of years that participants had been smoking daily was 2.9 (SD = 1.6). At the time of enrollment in the study, smoking rate was distributed as follows: 1-5 cigarettes per day (11.9%), 6-10 cigarettes per day (34.3%), 11-20 cigarettes per day (47.0%), 21-30 cigarettes per day (3.7%), and 31 or more cigarettes per day (3.0%). Although use of nicotine replacement was allowed, only 1 participant reported to have used nicotine patches.

Procedure

Participants were asked to complete a baseline questionnaire one week prior to starting the ‘diary period’ during which they were monitored daily for a total of four weeks. During the first week of monitoring, participants were instructed to smoke ad lib. The eighth day was the assigned quit day for each participant. A quit attempt was considered as such when participants were abstinent for at least 24 consecutive hours, as was evidenced by 3 consecutive reports of non-smoking. Following the assigned quit day, subjects were monitored for an additional three weeks. On each day of monitoring, participants were asked to complete the same internet-based questionnaire three times a day – in the morning (to be completed between 10am and 12pm), the afternoon (3pm – 5pm), and evening (8pm – 10pm). Each questionnaire was identical and contained questions on smoking behavior since the previous questionnaire. The questionnaires took approximately three minutes to complete. Participants who failed to complete a questionnaire within the designated interval were sent a text message to remind them. If participants found the internet to be inaccessible during a sampling interval, they were asked to complete a paper version of the questionnaire during the interval and to submit their report online as soon as they had access to internet again. A follow-up was administered two months after the end of the diary period. Participants received 40 euros if they completed the full four weeks of the diary period, and 10 additional euros upon completion of the 2-month follow-up. All data were collected between October 2006 and March 2007.

Measures

Pros of smoking and pros of quitting. Pros of smoking involved the perceptions of the advantages of smoking, and pros of quitting involved the perceptions of the advantages of smoking cessation as constructed by De Vries and Backbier (1994). These measures have been validated in other studies (cf. Dijkstra et al., 1997). Response categories of both scales ranged from 1 (totally disagree) to 4 (totally agree). Example items of the 10 pros of smoking were:
“Smoking helps to cope with stress”, and “Smoking helps to concentrate”. Cronbach’s alpha was .72. The scale for pros of quitting consisted of 13 items, with items such as “To quit smoking decreases the risk for lung cancer”, and “To quit smoking increases my health”. Cronbach’s alpha was .82.

**Self-efficacy to resist smoking.** Self-efficacy represented adolescents’ perceived ability to resist smoking in tempting situations and was measured using a scale that had been developed for adolescents specifically (Kremers, Mudde & De Vries, 2001). To the question “When you have quit smoking, how easy or difficult would it be for you not to smoke in the following situations?”, respondents could answer on a 5-point Likert scale ranging from 1 (very easy) to 5 (very difficult). Exemplary situations of the 18 situations given were: “When you are watching television”, and “When you feel angry”. Alpha was .83.

**Intensity of smoking.** Intensity of smoking refers to the number of cigarettes adolescents smoked per day at baseline. Response choices were: 1 (less than one cigarette per day), 2 (1-5 cigarettes per day), 3 (6-10 cigarettes per day), 4 (11-20 cigarettes per day), 5 (21-30 cigarettes per day), and 6 (31 or more cigarettes per day).

**Outcome variables**

The following variables were the five outcomes of interest: First lapse, second lapse, ‘mild’ and ‘heavy’ relapse within 3 weeks after the quit attempt, and smoking status at the 2-month follow-up. Whether a first lapse had occurred was established by any report of smoking (even if only a puff) after having accomplished 24 hours of abstinence. Similarly, the event of a second lapse was defined as any report of smoking after the first lapse. Relapse was defined in two ways: 1) smoking at least 1 cigarette per day for three consecutive days (‘mild relapse’), and 2) smoking at least 5 cigarettes per day for three consecutive days (‘heavy relapse’). Smoking status at the 2-month follow-up was measured through the question: “Have you maintained abstinence since the end of the diary period?” Response choices were: ‘1’ “Yes, I am still a non-smoker”, ‘2’ “No, I am smoking again, but I currently smoke less than when I entered the study”, and ‘3’ “No, I am smoking again at the same level as when I entered the study”. Scores were recoded and dichotomised into ‘abstinent’ (response choice 1), and ‘smoking’ (response choices 2-3). All outcome variables were dichotomous with score ‘1’ representing non-smoking, and ‘2’ indicating the occurrence of smoking (occurrence of first and second lapses, and relapse). All independent variables were measured through the baseline questionnaire.
Strategy for analyses

First we calculated the relative occurrence of the relapse variables, and computed correlations among independent variables. Next, we examined the predictive power of the SCT-derived cognitions and intensity of smoking on the various outcome variables by means of survival analyses, using a Cox proportional hazards regression model. Survival analysis is concerned with studying the time between the entry to a study and a subsequent event (such as death, or in the present case ‘relapse’). A Cox regression model provides an estimate of the hazard (or risk) of the event for individuals on the basis of their individual characteristics (such as cognitions) thereby taking into account when the event occurred. Since the follow-up was measured at a fixed time point (2 months after the end of the diary period), we used logistic regressions to test effects on abstinence at follow-up. Since the pros of smoking and self-efficacy were highly correlated and thus at risk to cause multicollinearity, we present both the univariate and the multivariate analyses. Lastly, sex and age did not significantly predict any of the outcome variables and were therefore not included in the model as possible confounding variables.

Results

Descriptive analyses

The majority of the participants experienced at least one lapse during monitoring (70.4%, n = 95 of 135), and 58.5% (n = 79 of 135) also reported a second lapse. ‘Mild’ relapse defined as ‘smoking at least 1 cigarette on three consecutive days’ occurred for 46 participants (34.1%, n = 46 of 135). ‘Heavy’ relapse defined as ‘smoking at least 5 cigarettes on three consecutive days’ occurred for 27 participants (20.0%, n = 27 of 135). At follow-up, 29.6% of the initial sample of 135 adolescents were still abstinent, and 59.3% were smoking again (11.1% of the subjects did not participate in the follow-up).

The mean scores and standard deviations for the independent variables were as follows: Pros of smoking (\(M = 2.71, SD = .47\)), pros of quitting (\(M = 3.45, SD = .44\)), self-efficacy (\(M = 2.48, SD = .61\)), and intensity of smoking (\(M = 3.53, SD = .87\)). Pearson correlations among the independent variables showed that the pros of quitting were not correlated with any of the other predictors. The pros of smoking were strongly negatively correlated with self-efficacy (\(r = -.54, p < .001\)), and also with intensity of smoking (\(r = -.20, p < .01\)), which indicates that those who perceived smoking to be advantageous were more likely to be heavy smokers and to have low self-efficacy to remain abstinent. Self-efficacy and intensity of smoking were positively correlated (\(r = -.21, p < .01\)), indicating that participants with higher levels of baseline smoking reported lower self-efficacy.
**Survival analyses**

The univariate analyses showed that neither one of the independent variables predicted time to first and second lapses, mild relapse, nor smoking at follow-up (Table 1). However, perceiving smoking as highly advantageous predicted time to heavy relapse (HR = 2.87, CI = 1.15 - 7.16, \( p < .01 \)) – each one-point increase in the pros of smoking increased the risk of suffering heavy relapse by almost 3 times. Lower levels of self-efficacy (HR = .46, CI = .24 - .89, \( p < .01 \)) as well as high levels of baseline smoking (HR = 1.84, CI = 1.25 - 2.71, \( p < .01 \)) were also predictive of heavy relapse. The multivariate analyses (Table 2) showed that the initially significant effects of pros of smoking and self-efficacy on heavy relapse diminished when intensity of smoking was accounted for (Footnote 2). Of the cognitions, only the pros of quitting showed a trendwise effect on abstinence at follow-up, indicating that endorsing many pros of quitting provided a protective effect on prolonged abstinence.

**Discussion**

In the present study, smoking-specific cognitions derived from the Social Cognitive Theory (Bandura, 1986) were hypothesized to predict the outcomes of a serious quit attempt of daily smoking adolescents. The main findings show that a strong endorsement of the pros of smoking, low self-efficacy to quit, and baseline smoking status significantly predicted relapse within three weeks after quitting. The first and second lapses as well as abstinence two months later appeared to be largely unaffected by baseline smoking status and smoking-specific cognitions.

The finding that pros of smoking and self-efficacy significantly predicted heavy relapse is in line with our own hypotheses as well as findings from prior research on adolescent smoking cessation (Hansen et al., 1985) and adult relapse (Gwaltney, Metrik, Kahler & Shiffman, in press). More specifically, this means that individual differences in smoking-specific cognitions that adolescents set out on their quit attempts with in part determine successful cessation. It therefore might be fruitful to target smoking-specific cognitions before adolescents begin their quit attempt. However, it is possible that the effects of pros of smoking and self-efficacy on heavy relapse can be attributed to smoking status. We found that inclusion of baseline smoking status attenuated the effects of the cognitions to non-significance, which is in line with recent findings suggesting that smoking status and nicotine dependence are potentially dominant over cognitive strategies in predicting smoking cessation (Kleinjan et al., 2007).

Furthermore, in contrast with our hypothesis, pros of quitting were not significantly related to any of the relapse variables, except for a marginal effect on abstinence at follow-up.
It is possible that the perceived pros of quitting are more relevant in an early stage of cessation – such as the trajectory that precedes smoking cessation and in forming intentions to quit (e.g., Van Zundert et al., 2007) – than in preventing relapse once abstinence is achieved. Perception of the pros of smoking, on the contrary, was associated with relapse, but not with abstinence at follow-up. This is in line with previous studies showing that pros of smoking are particularly related to the action stage of the stages of change and to relapse, and that cons of smoking are related to long-term abstinence (Dijkstra, Tromp & Conijn, 2003; Hansen et al., 1985; Pallonen, 1998). Compared to the pre-action phases, the pros of quitting have been found to be endorsed to a lesser extent among adults during the actual action phase (Dijkstra, De Vries & Bakker, 1996; Pallonen, 1998). Such a decline in acknowledging the benefits of cessation may be plausible in the light of the temptations and smoking cues that smokers who are attempting to quit encounter. It is possible that when quitters experience the negative effects of quitting (e.g., withdrawal symptoms), they are inclined to downplay the advantages of quitting. If such a change in perception indeed occurs, this would render baseline individual differences in the pros of quitting unable to explain the outcome of the attempt. Whether this postulate is valid needs to be tested by measuring the pros of smoking and quitting during the quit attempt.

Contrary to our hypotheses, pros of smoking, self-efficacy, and baseline smoking status did not predict abstinence at follow-up. In the case of self-efficacy this contradicts most studies among adults (e.g., Shiffman et al., 2000; Stuart, Borland, & McMurray, 1994). An explanation for this may be that self-efficacy changes in response to the experiences during the quit attempt. During a quit attempt, self-efficacy has been found to decrease in reaction to the event of a lapse, to a higher urge to smoke, and by negative affect (Gwaltney, Shiffman & Sayette, 2005, Shiffman et al., 1997; Shiffman et al., 2000). It is possible that self-efficacy changes in response to quitting experiences to such an extent that baseline self-efficacy becomes insignificant in predicting prolonged cessation. Studies among adults have demonstrated that self-efficacy is indeed a dynamic construct and that the day-to-day variations in self-efficacy play an important role in lapses and relapse (Shiffman et al., 2000; Stuart et al., 1994), but these results have hitherto not been replicated for adolescents. Future research is recommended to examine the dynamic effects of self-efficacy among adolescents to gain a more in-depth understanding of the interplay between smoking-specific cognitions and adolescent smoking cessation and relapse.

In the above, we have mainly discussed the results for heavy relapse and the 2-month follow-up. However, the null findings for the first and second lapse and mild relapse raise questions and are important to discuss as well. It is possible that the first few slips are
primarily caused by momentary states such as negative affect, or the experience of withdrawal symptoms, rather than that they are a consequence of with which attitude towards smoking and quitting adolescents set out on their cessation trials. Research among adults has shown that dynamic effects of smoking-specific cognitions such as self-efficacy and withdrawal symptoms can account for the first few lapses (Shiffman et al., 2000, Gwalney, Shiffman, Balabanis & Paty, 2005; Piasecki, Jorenby, Smith, Fiore & Baker, 2002). Most studies, however, do not distinguish the first lapse from a second lapse or full relapse, while the interval between a lapse and full relapse is distinctly different from the interval between quitting and the first lapse (Shiffman et al., 2000). Although experiencing a first lapse is very likely to instigate a second lapse, and to eventually lead to relapse (Piasecki, 2006), our results show that independent variables that predict relapse do not necessarily predict the first lapses. Especially since the first lapse is a powerful indicator for later relapse, it is important to gain a deeper understanding of which factors affect the first lapses among adolescents. In addition, it is interesting to notice that the results differ depending on which definition of relapse is used: ‘mild’ versus ‘heavy’ relapse. Since the literature on smoking relapse among adolescents is still relatively underdeveloped, it is important to acknowledge that percentages of relapse rates as well as effects of possible predictors greatly differ as a function of definition.

**Limitations.** Important strengths of the present study are that it is the first prospective study testing Social Cognitive Theory in relation to adolescent smoking relapse in a sample of daily smoking adolescents. In addition, daily reports of smoking have allowed for the first and second lapses and relapse to be distinguished from one another, and to take into account the time to the event. On the other hand, some aspects of this study may be considered as limitations, such as the relatively small sample size, the relative homogeneity of the sample, and the lack of biochemical verification of abstinence. To start with, one might posit that the sample size might cause lack of statistical power. Nonetheless, we did find some of the associations to be significant which would not have been possible if there had been a serious power problem. Second, to be able to have adolescents undertake a serious quit attempt, motivation to quit must be high. Accordingly, this was a selection criterion for participation. This high motivation to quit may have restricted the range of scores on the smoking-specific cognitions, as was visible in the relatively small standard deviations, and may have tempered the associations between the cognitions and the outcome variables. Lastly, we did not use biochemical verification to ensure that participants had achieved 24 hr abstinence. However, the fact that 27.5% of the participants did not show 24 hr abstinence on the target quit day suggests that participants felt free enough to honestly report whether or not they had smoked.
Moreover, several studies among adolescents have indicated that self-reports of smoking and quitting behaviour are valid and reliable (Dolcini, Adler & Ginsberg, 1996; Stanton et al., 1996).

**Recommendations.** Both the perception of the pros of smoking and self-efficacy appear to be affected and overruled by the intensity of smoking when it comes to heavy relapse. However, with the lapse of time after the quit attempt, the pros of quitting become more relevant again. This suggests that cessation interventions for adolescent smokers should have a dynamic character, and should intervene on different aspects at different stages of the cessation process. With the effect of baseline smoking status being strong and overruling the effects of cognitions on relapse, one might advocate to primarily target nicotine dependence when adolescents are in the action phase of the quit attempt. Prior research shows that withdrawal symptoms seem to be successfully reduced by using nicotine patches in adolescents (Smith et al., 1996), but the few studies on the effects of nicotine patch treatment on adolescent smoking cessation have revealed inconsistent findings. Hurt and colleagues (2000) found that use of nicotine patches did not improve cessation rates. In addition, Moolchan and colleagues (2005) showed that use of nicotine patches increased cessation rates, but the nicotine patch intervention was accompanied by cognitive-behavioral therapy. Our results suggest that an approach similar to the latter study would be fruitful, and that both nicotine dependence and cognitions should be targeted in cessation interventions and relapse prevention among adolescents. Lastly, given that our findings do not support the notion that Social Cognitive Theory nor baseline smoking status explain the first few lapses, future research is recommended to explore other possible predictors, such as withdrawal symptoms.
Footnotes

1. Since a strong intrinsic intention or motivation to quit smoking had been one of the primary criteria for participation, we expected extremely little variation on this variable and did not include this variable in the baseline questionnaire.

2. Since pros of smoking and self-efficacy were highly correlated, we also ran the multivariate model with either one of these two variables omitted. Findings showed that this did not change the findings; the effect of pros of smoking was still overruled by intensity of smoking, as was the effect of self-efficacy.
Tables and figures

Table 1. *Univariate Survival Analyses.*

<table>
<thead>
<tr>
<th></th>
<th>1st Lapse</th>
<th>2nd Lapse</th>
<th>Mild Relapse</th>
<th>Heavy Relapse</th>
<th>Smoking at follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HR</td>
<td>95% CI</td>
<td>HR</td>
<td>95% CI</td>
<td>HR</td>
</tr>
<tr>
<td>Pros of smoking</td>
<td>1.07</td>
<td>.67 - 1.63</td>
<td>1.22</td>
<td>.76 - 1.95</td>
<td>1.22</td>
</tr>
<tr>
<td>Pros of quitting</td>
<td>.77</td>
<td>.48 - 1.22</td>
<td>.99</td>
<td>.60 - 1.64</td>
<td>1.54</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>1.03</td>
<td>.74 - 1.43</td>
<td>.94</td>
<td>.65 - 1.35</td>
<td>.95</td>
</tr>
<tr>
<td>Intensity of smoking</td>
<td>.96</td>
<td>.76 - 1.22</td>
<td>1.03</td>
<td>.79 - 1.33</td>
<td>1.31</td>
</tr>
</tbody>
</table>

*Note.* *p* < 0.05, **p** < 0.01. HR = Hazard Ratio; OR = Odds Ratio.
### Table 2. Multivariate Survival Analyses.

<table>
<thead>
<tr>
<th></th>
<th>1st Lapse</th>
<th></th>
<th>2nd Lapse</th>
<th></th>
<th>Mild Relapse</th>
<th></th>
<th>Heavy Relapse</th>
<th></th>
<th>Smoking at follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HR</td>
<td>95% CI</td>
<td>HR</td>
<td>95% CI</td>
<td>HR</td>
<td>95% CI</td>
<td>HR</td>
<td>95% CI</td>
<td>OR</td>
</tr>
<tr>
<td>Pros of smoking</td>
<td>1.14</td>
<td>.70 - 1.63</td>
<td>1.22</td>
<td>.69 - 2.15</td>
<td>1.16</td>
<td>.56 - 2.35</td>
<td>1.36</td>
<td>.50 - 3.66</td>
<td>2.26</td>
</tr>
<tr>
<td>Pros of quitting</td>
<td>.77</td>
<td>.48 - 1.22</td>
<td>1.00</td>
<td>.60 - 1.66</td>
<td>1.68</td>
<td>.84 - 3.35</td>
<td>1.87</td>
<td>.72 - 4.84</td>
<td>.36†</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>1.49</td>
<td>.74 - 1.43</td>
<td>1.00</td>
<td>.65 - 1.54</td>
<td>1.11</td>
<td>.62 - 1.98</td>
<td>.66</td>
<td>.30 - 1.44</td>
<td>1.82</td>
</tr>
<tr>
<td>Intensity of smoking</td>
<td>.93</td>
<td>.76 - 1.22</td>
<td>1.00</td>
<td>.76 - 1.30</td>
<td>1.33</td>
<td>.94 - 1.86</td>
<td>1.69*</td>
<td>1.13 - 2.51</td>
<td>.97</td>
</tr>
</tbody>
</table>

*Note.† p = .051, * p < 0.05, ** p < 0.01. HR = Hazard Ratio; OR = Odds Ratio.*
References


Chapter 7

Dynamic effects of self-efficacy on smoking lapses and relapse among adolescents
Abstract

The present study examined whether dynamic day-to-day variations in self-efficacy (SE) predict success in quit attempts among daily smoking adolescents. A sample of 149 adolescents recorded their smoking and SE three times per day during one week prior to and three weeks after a quit attempt. SE was relatively high and moderately variable prior to the first lapse, but decreased and became more variable thereafter. Lower SE as measured at the lapse assessment significantly increased the risk that a second lapse and relapse would occur. Individual differences in baseline self-efficacy did not predict any of the treatment outcomes. The time-varying analyses, however, showed that lower SE on a given day predicted the first lapse, the second lapse, and relapse on the succeeding day. Daily concomitant smoking (any smoking on the preceding day) was not significantly related to relapse. The present results emphasize the importance of self-efficacy among adolescents in cessation, and highlight the need for dynamic formulations and assessments of adolescents’ self-efficacy and relapse.
Introduction

Relapse is the most probable outcome for the majority of adult smokers who attempt to quit (Piasecki, 2006; Kenford et al., 1994). Outcomes are similar among adolescents: An extensive review of sixty-six adolescent smoking intervention studies indicated that successful smoking rates do not exceed 19%, and are usually much lower (Sussman, 2002). Cessation rates are even lower among youth who smoke daily, with successful unaided smoking cessation rates ranging from no more than 5% (Stanton, McClelland, Elwood, Ferry & Silva, 1996) to 12% (Sargent, Mott & Stevens, 1998). These low rates of successful adolescent smoking cessation pose a major difficulty in the treatment of this highly addictive behavior. Intervention programs have not yet addressed the difficulties that adolescents encounter during cessation, as is reflected by figures demonstrating that taking part in a cessation program does not substantially increase the odds of successful adolescent smoking cessation (Garrison, Christakis, Ebel, Wiehe & Rivara, 2003).

Self-efficacy to obtain a goal behavior is a key cognitive concept in several major health behavior theories, such as the Social Cognitive Theory (Bandura, 1986), and the Theory of Planned Behavior (Ajzen, 1991), and in relapse models inspired by social learning (Marlatt & Gordon, 1985). These theories posit that one’s belief in their ability to successfully undertake a target behavior (e.g. smoking cessation) predicts the likelihood that the person will successfully achieve the target behavior. In the area of smoking cessation, there is some evidence to support this postulate: Self-efficacy seems to be an important predictor of smoking cessation in adults. A long line of studies among adults has demonstrated that those who feel highly confident that they are able to reach and sustain smoking cessation are more likely to succeed (for an overview, see Gwaltney, Metrick, Kahler & Shiffman, in press).

In contrast with such a large number of studies on adult self-efficacy and smoking cessation, the research on this association is limited for adolescent samples. To our knowledge, there are only three studies that have tested whether self-efficacy predicts smoking cessation among adolescents. Self-efficacy to resist smoking has been associated with having quit smoking two years later (Chang et al., 2006), three years later (Engels, Knibbe, De Vries & Drop, 1998), or as much as five years after self-efficacy was measured (Tucker, Ellickson, & Klein, 2002). It is notable that these studies do not examine success in a particular quit effort but instead only address long-term change. Moreover, these studies may be limited because they studied a
mixture of daily smokers and very low rate smokers (who smoked weekly, monthly, or who had only smoked once in the past year), for whom the process of quitting may be very different.

Perhaps a more significant limitation in the self-efficacy literature in general is that it only establishes distal relationships between self-efficacy and outcome over months and years, without revealing much about the process by which self-efficacy and smoking behavior interact. This is particularly troubling because self-efficacy (SE) is expected to affect behavior quite proximally (Baer, Holt & Lichtenstein, 1986; Shiffman et al., 2000), and because SE (Bandura, 1997; Gwaltney et al, 2001) and adolescent smoking (Colby, Tiffany, Shiffman, & Niaura, 2000) are both quite volatile. Moreover, the dynamic regulatory feedback model proposed by Niaura and colleagues (Niaura, 2000; Niaura et al., 1988) posits that self-efficacy is a central component of relapse that is reciprocally related to other major determinants of relapse such as urges, outcome expectations, smoking cues and coping efforts. Indeed, during a quit attempt, SE has been found to be negatively affected by a higher urge to smoke, and by negative affect among adults (Gwaltney, Shiffman & Sayette, 2005).

In addition, perceived SE is reactive to feedback on the outcome of one’s efforts, such as experiencing a lapse in smoking. Previous research in adult smokers has demonstrated that experiencing a lapse markedly reduces SE (Shiffman et al., 1997; Shiffman et al., 2000), which is known as the ‘abstinence violation effect’ (AVE). The AVE describes a mechanism whereby failure of an attempt to control one’s substance consumption (e.g., experiencing a lapse) propels a series of negative cognitive and affective reactions (among which decreased self-efficacy) that in turn can result in excessive use of the substance (e.g., relapse) (Marlatt & Gordon, 1985). According to Marlatt and Gordon (1985), the mechanism of decreases in self-efficacy that result in further smoking creates a downward spiral with self-efficacy as a continuing mediator with the eventual outcome being relapse. Whether the AVE applies to adolescent smoking cessation as well has not yet been tested, since prior studies on adolescent smoking cessation did not employ post-quit measures of self-efficacy and did not distinguish between incidental lapses and relapse.

This points to another limitation in the relapse literature in general: Very few studies have distinguished the first lapse from a second lapse or full relapse, most probably as a result of a robust consistency in the literature that most lapses end up in relapse anyway (Jarvis, 2003; Kenford et al., 1994). Instead of considering this strong association as an argument to neglect the
intervals between lapses and relapse, it actually highlights that the processes that mediate between a lapse and relapse are of major importance in understanding relapse. Moreover, the interval between a lapse and full relapse may in fact be distinctly different from the interval between quitting and the first lapse, and the mechanisms that are at play seem to change from one phase of the quitting process (before the lapse) to another (after the lapse) (Gwaltney et al., 2005). The use of nicotine replacement, for instance, appears to have a stronger treatment effect among individuals who have already lapsed in preventing them from progressing to full relapse than that it prevents quitters from lapsing (Shiffman, Scharf, Shadel, Gwaltney, Dang et al., 2006).

The preponderance of the aforementioned studies underscore that SE can be considered as a proximal precipitant of relapse that fluctuates over time in response to changing internal and external contexts, and that both self-efficacy and relapse are dynamic constructs. One might therefore expect that changes in SE should foreshadow lapses and relapse. Two studies using ecological momentary assessment among adults seem to confirm this postulate. Shiffman and colleagues (2000) found that daily SE ratings differentiated lapsers and nonlapsers. However, this effect seemed to be accounted for by stable individual differences in self-efficacy. In the study by Gwaltney and colleagues (2005), the effect of decreases in daily SE on lapses persisted when baseline self-efficacy measures and quit day SE ratings were controlled for. In both studies, however, a proximal effect of the preceding day’s SE on relapse the next day was found, which remained after baseline self-efficacy and concomitant post-quit smoking were accounted for. Thus, dynamics – variations over time in both smoking and its determinants – appear to be very important to the process of smoking cessation and relapse, and yet they have not been examined in adolescents so far.

One motivation to test smoking dynamics for adolescents separate from adults is based on the notion that adolescence is a developmental phase in which impulsivity, novelty seeking, and suboptimal decision making are considered to be normative traits (Chambers, Taylor & Potenza, 2003). Adolescents are also known to still be in the process of maturing and developing their ability of self-reflection and introspection (Beyth-Marmor & Fischhoff, 1997; Steinberg & Cauffman, 1996). Maturational changes in the brain are postulated to account for these transition traits, and are thought to predispose adolescence to being a critical period of addiction vulnerability in the first place (Chambers et al., 2003). Increased impulsivity in adolescents’
smoking behavior is also reflected in findings by Pallonen (1998), who showed that adolescents who are in the early stages of forming a motivation to quit smoking seem to move into action prematurely, and that adolescents tend to move back and forth between motivational stages more so than adults. Adolescents’ sensitivity to impulsive behavior and suboptimal decision making may cause them to deal differently with high-risk situations, and to respond differently to the day-to-day variations in self-efficacy. The present study is the first to examine whether dynamic changes in perceived self-efficacy to resist smoking can predict changes in smoking during a quit attempt among daily smoking adolescents.

In order to capture the day-to-day, or even moment-to-moment variation in cognitions and behavior, which is so essential to the process of relapse, repeated sampling is pivotal. Ecological momentary assessment (EMA) encompasses a variety of diary methods that repeatedly gather real-time data on momentary states of individuals who are in their “real-world” environments at the moment of assessment (Shiffman, 2005; Shiffman, Stone & Hufford, 2008). EMA studies acquire high temporal sensitivity to fluctuations in behavior by requiring subjects to report on their behavior at least once a day, and usually more frequently. The high frequency of reporting and the real-time nature of EMA designs minimize retrospection bias (Bolger, Davis & Rafaeli, 2003; Shiffman, 2005; Shiffman et al., 2008). EMA has been used to study adult smoking cessation (e.g., Shiffman, 2005), but has not yet been applied to adolescent smoking cessation (with the exception of a feasibility study by Gwaltney, Bartolomei, Colby, and Kahler, 2008).

The present study aimed to examine both between-person differences in self-efficacy, and dynamic, within-person variations in SE among 149 daily smoking adolescents who were quitting smoking. We assessed the variability of SE over time, and used daily SE measures to predict the first lapse, progression to the second lapse, and progression to relapse. We expected that lower ratings of self-efficacy at baseline, as well as daily decreases in SE, would predict each of these milestones. Individual differences in baseline self-efficacy and daily smoking after a lapse were controlled for (cf. Baer et al., 1986; Shiffman, Engberg, et al., 1997; Shiffman et al., 2000).

**Method**

*Overview*
The present study used EMA methods to monitor adolescents embarking on a quit attempt. Participants were monitored for one week prior to, and for three weeks after the designated quit day (four weeks in total). Their smoking and self-efficacy were reported three times a day via an internet-based survey.

Participants

Participants (n = 176) were Dutch adolescent daily smokers recruited for the study by means of community advertisements and newspaper articles. To qualify, candidates had to: be between 15 and 19 years of age; smoke at least one cigarette per day; and, not be currently enrolled in a cessation program. In addition, adolescents aged 15 needed to report having been a daily smoker for at least one consecutive year in order to be eligible for study enrollment. A total number of 272 interested candidates contacted the study site, and were sent a detailed description of the study. After reading the detailed description, 189 candidates were scheduled for a telephone screening, of which 176 were eventually enrolled (see Figure 1).

To be eligible for the analyses presented in this paper, subjects needed to: a) Achieve 24h abstinence at least once during the study; and, b) provide data on at least 80% of the 28 study days. A total of 84.6% (n = 149 of 176) participants met these criteria and were analyzed for this paper. Of the 27 participants who were excluded, 17 were removed because they dropped out of the study before achieving 24 hr of abstinence, nine provided data on less than 80% of all study days, and one participant was removed because of failure to reach abstinence at least once during the study. The final sample consisted of 149 adolescents. Figure 1 shows the flow and disposition of participants. Detailed participant characteristics are summarized in Table 1. Briefly, the average participant was female, white, 17 years old, and smoked 11 to 20 cigarettes per day. Written consent from the participants and their parents was not required. This study was approved with the Dutch Committee on Research Involving Human Subjects.

Procedures

Participants were asked to complete a baseline questionnaire that included items on general demographic characteristics, smoking history, nicotine dependence (multidimensional measure based on the mFTQ and HONC; Kleinjan, Van den Eijnden, Van Leeuwe, Otten, Brug & Engels, 2007), and smoking-specific cognitions (Van Zundert, Van de Ven, Engels, Otten & Van den Eijnden, 2007). Participants were monitored for a total of four weeks. The first day of monitoring was always a Monday. Participants started the monitoring period with seven days of
baseline monitoring, during which they were instructed to smoke ad lib. The eighth day was the assigned quit day for each participant. Following the quit day, subjects were monitored for an additional three weeks.

On each day of monitoring, participants were asked to complete three internet-based questionnaires – in the morning (to be completed between 10am and noon), the afternoon (3pm – 5pm), and evening (8 pm – 10pm). Each questionnaire was identical and asked participants questions about smoking since the previous questionnaire, motivation, self-efficacy, withdrawal symptoms, and situational stimuli (e.g., alcohol/coffee consumption, seeing others smoke). The questionnaires were in Dutch (participants spoke Dutch) and took approximately three minutes to complete. Questionnaires were automatically time-stamped with the time that they were completed on-line. Participants who failed to complete a questionnaire within the designated sampling window were sent a text message to remind them. If a participant did not have access to the internet during the sampling window, they were asked to complete a paper version of the questionnaire – which included a question on the date and time at the time of completion – and to transcribe the paper version online as soon as they had access to internet again. Analysis showed that 85.1% of all assessments were completed within the allotted time windows (Table 2). Of the assessments that were completed outside of the assessment windows (1497 of 10501, 14.3%), 99.6% were entered or reported to have been completed within three hours of the assessment window. Of all the assessments that were completed on a paper diary and later entered on the website, 60.5% was recorded on-line on the same day. All data were collected between October 2006 and March 2007.

Self-efficacy Measures

Daily measure of self-efficacy (SE). At each assessment, SE was assessed with the item “How confident are you that you can continue your quit attempt today?” (1 = ‘Not at all confident’, 5 = ‘Very confident’). Since the quit attempt had yet not been initiated during the first week of the study, participants could tick a box saying ‘I am in the first week of the study, so this question does not yet apply’.

Baseline self-efficacy questionnaire. Baseline self-efficacy was measured using a self-efficacy measure that was specifically designed for adolescents (Kremers, Mudde & De Vries, 2001). The instrument of 12 items originally showed high loadings on three subscales, and showed high internal consistency (Kremers et al., 2001). Respondents were asked: “When you
have quit, how difficult or easy do you expect it will be not to smoke in the following situations?”. Example items are ‘When you’re with friends who smoke’, ‘When you’re doing homework’, and ‘When you feel depressed’. Participants could answer on a 5-point Likert scale, ranging from 1 ‘Very easy’ to 5 ‘Very difficult’. A higher score represents high self-efficacy. The Cronbach’s alpha observed in this sample was .80, indicating a high degree of internal consistency.

**Outcomes: First lapse, second lapse, and relapse.**

For the purposes of the analyses presented in this paper, we were interested in three treatment outcomes: The first lapse, the second lapse, and relapse (e.g., Gwaltney et al., 2005; Shiffman et al., 2000; Shiffman et al., 2006). A participant’s first lapse day was defined by any report of smoking (even if only a puff), after having accomplished 24 hours of abstinence. Similarly, the second lapse day was defined by any report of smoking after the first lapse. The first and second lapse may coincide on the same day. The literature on adolescent smoking does not provide standard definitions of relapse that are suitable for adolescents specifically. Common definitions of relapse as applied to adult smokers may be too stringent in adolescent samples (e.g., smoking at least five cigarettes for three consecutive days; Shiffman et al., 1996) given that adolescents have shorter histories of smoking and may not smoke five cigarettes daily even before quitting. For the purposes of these analyses, we defined relapse as smoking at least one cigarette per day for three consecutive days. The first day of the relapse episode was counted as the relapse day.

**Analytic Plan**

The following analyses, modeled after those in Shiffman and colleagues (2000), used days as the primary unit of analysis – a study day was defined as the period between two consecutive morning reports. To test the impact of self-efficacy on risk of lapse and relapse, we used a series of proportional hazards regression survival analyses (Cox, 1972). Such analyses evaluate the risk of a target event (lapses or relapse) occurring per unit of time, while taking into account that some observations are censored because participants’ status after the study ended is unknown.

To assess the relationship between baseline questionnaire self-efficacy and progression to lapse and relapse, we used Cox proportional hazards survival analysis. We also used the self-efficacy report during the first lapse assessment as a static predictor of time to the second lapse.
Finally, in addition to static measures of self-efficacy, we calculated daily self-efficacy scores and used these values as time-varying covariates to test whether daily variations in self-efficacy predict the following day’s risk of lapsing or relapsing. To obtain daily measures of self-efficacy, we aggregated the three daily measures (or as many as were non-missing – 82.4% of daily measures were based on data from all three measures; only 3.6% of days had only one observation) of self-efficacy into a single, daily self-efficacy score. In the relapse analyses, we controlled for baseline self-efficacy as well as daily smoking which was used as a time-varying covariate. Of the final 149 participants, 14 participants failed to complete and/or to successfully return the baseline questionnaire. These 14 participants are excluded from the analyses in which we examine the effect of baseline self-efficacy on all outcome variables. Attrition analyses between those 14 subjects and those who were included in the analyses showed no differences in smoking rates during the first week of ad lib smoking, nor in relapse rates. All analyses were conducted using SAS Version 9.1.3.

**Results**

**Monitoring and Participant Disposition**

Participants completed an average of 25 ($SD = 4.5$) days of monitoring, during which they completed a total of 10501 assessments. Compliance with assessment taking was high – participants completed an average 88.3% of all possible assessments (taking into account that some dropped out of the study prematurely), and 87.2% of participants completed 75% or more of all possible assessments. On average, participants completed 70.5 ($SD = 14.9$) assessments each during the monitoring period. Most (83.9%) participants included in the present analyses remained enrolled in the study until the last day of the four week period. Of the remaining 16.1%, 4.0% dropped out within the first week after the target quit day, 4.7% in the second week after the target quit day, and 7.4% stopped completing assessments during the last week of the study. On average, participants remained in the study for 18.3 days ($SD = 4.4$) out of a possible 21 days after achieving 24 hr abstinence.

Participant disposition is shown in Figure 1. The majority of the participants reached 24 hr abstinence on the target quit day (72.5%, n = 108 of 149) or on the following day (13.4%, n = 20 of 149), an additional 13 participants (8.7%) quit on or after day 10. Although participants were instructed to smoke ad-lib during the first week of monitoring, eight participants (5.4%) quit smoking before the target quit day. The day that they reported non-smoking at three
consecutive assessments was counted as their actual quit day even if that was prior to the target quit day (thus, “quit day” was set as day zero). The self-efficacy question was completed only once participants started their quit attempt.

The majority of the participants (71.8%, n = 107 of 149) experienced at least one lapse during monitoring, typically, soon after achieving initial abstinence ($M = 4.0$ days; $SD = 3.37$; Range = 0-20 days), and 83.2% of these (n = 89 of 107) reported a second lapse. The average number of days between the first and second lapse was 2.2 ($SD = 3.11$; Range = 0 - 15); however roughly a third of the second lapses (31.5%; n = 28 of 89) occurred on the same day as the first lapse. Relapse occurred for 52 participants (34.9%, n = 52 of 149). For more than half of the subjects who lapsed (59.6%), the first lapse constituted the onset of a relapse. For the remaining 40.4%, the average number of days between the initial lapse day and relapse was 4.7 ($SD = 3.32$; Range = 1-12 days).

**Progression to a first lapse**

*Individual differences in baseline self-efficacy as a predictor of lapse risk.* We first tested whether the baseline questionnaire measure of self-efficacy predicted the risk of suffering a first lapse. Participants who reported a first lapse reported equal levels of baseline questionnaire self-efficacy compared to those who did not lapse (2.49 [$SD = .60$] vs 2.47 [$SD = .64$]). In a survival analysis, baseline self-efficacy scores did not predict time to first lapse (HR = 0.98, CI = 0.70 - 1.37, $p = .904$).

*Daily SE as a predictor of an initial lapse.* First, to examine the variability in SE between achieving abstinence and experiencing the first lapse, we calculated the overall coefficient of variation (which is the standard deviation, expressed as a percentage of the mean: [SD / M] * 100) across assessments. Participants reported moderately high SE during the quit-to-lapse interval ($M = 3.74$, $SD = 0.89$) on the 5-point scale. There seemed to be a modest amount of variability in overall SE during that interval; the average within-subject standard deviation for ASE was .92, the coefficient of variation was 24.6%. To test whether daily measures of SE predicted the risk of suffering a first lapse the following day, we entered daily measures of SE as time-varying covariates. Lower daily SE significantly predicted a first lapse on the subsequent day – for each 1-point decrease in daily SE, the risk of lapsing the following day increased by 48% (HR = 1.48, CI = 1.24 - 1.78, $p < .0001$). Controlling for baseline levels of self-efficacy showed that baseline self-efficacy did not account for this relation (adjusted HR = 1.56, CI = 1.28 – 1.88, $p < .0001$).
**Progression from first lapse to second lapse**

*SE reported at a first lapse as static predictor of second lapses.* The average self-efficacy score reported at the assessment during which participants reported their first lapse was 2.9 (on a five-point scale; $SD = 1.5$). SE scores at the first lapse were lower among participants who later reported suffering a second lapse (2.8 [$SD = 1.5$] vs 3.3 [$SD = 1.5$]), but this difference was not statistically significant ($t(101) = 1.21, p = .223$). In a survival analysis, lower SE scores at the first lapse assessment significantly predicted second lapses ($HR = 1.23, CI = 1.06 - 1.43, p = .006$) – for each 1-point decrease in SE at the first lapse, the risk of suffering a second lapse increased by 23%.

**Progression from first lapse to relapse**

*Individual differences in baseline and lapse day SE as static predictors of relapse risk.* Similar to the first lapse, baseline self-efficacy scores among those who relapsed did not differ from those who did not (2.47 [$SD = .62$] vs 2.49 [$SD = .61$]). Furthermore, baseline scores did not predict relapse risk in a survival analysis ($HR = 0.95, CI = 0.58 - 1.53, p = .822$). Lower SE scores at the first lapse assessment, however, significantly predicted relapse ($HR = 1.43, CI = 1.16 - 1.76, p = .0006$) – for each 1-point decrease in SE at the first lapse, the risk of relapse increased by 43%. Figure 2 shows this association as a survival curve, where one can see that by about one week after the lapse, subjects with low post-lapse SE are about twice as likely to have relapsed (50% vs 25%). Controlling for baseline SE did not substantively affect this relationship ($HR = 1.46, CI = 1.18 - 1.82, p = .0006$).

**Daily SE as a dynamic predictor of relapse.** Following the first lapse, overall SE declined ($M = 2.89, SD = .80$), and became more variable than it had been prior to the first lapse; the average standard deviation for SE over days was 1.30, the coefficient of variation was 45.0%. Daily variations in SE significantly predicted relapse ($HR = 1.33, CI = 1.04 - 1.70, p = .026$) – for each 1-point decrease in daily SE, the risk of relapsing the following day increased by 33%.

**Daily self-efficacy and concomitant smoking.** The occurrence of smoking between the first lapse and full relapse was quite variable. (On average, subjects smoked on 21% of the days in the interval between the first lapse and relapse. This figure of 21% is based on only 16 participants since most subjects relapsed on either the same day as the first lapse or on the adjacent day, leaving no days in between to calculate the rate of smoking between lapse and relapse). Any smoking on a given day was not related to relapse the following day ($HR = 1.44,$
We assessed whether the daily effect of SE would remain significant when both baseline self-efficacy and concomitant smoking (yes/no) as time-varying covariates were added to the model. Controlling for these variables decreased the effect of prior day’s SE and it became non-significant, though the HR decreased only slightly (adjusted HR = 1.29, CI = 0.99 - 1.68, p = .058).

Additional analyses. To test whether quitting experience enhances the predictive power of baseline reports of self-efficacy, we modeled the number of previous quit attempts as an independent covariate predicting (re)lapse, and as a moderator in the association between baseline self-efficacy and (re)lapse. We found no main effects of number of previous attempts on outcomes nor significant interactions with baseline self-efficacy.

Discussion

While the dynamics of self-efficacy and relapse are known to play an important role in adult smoking cessation, no study has hitherto examined dynamics among adolescent smokers who are trying to quit. The present study examined dynamics in self-efficacy (SE) and relapse among 149 adolescent daily smokers who embarked on a quit attempt. Findings show that within three weeks, the majority of the participants (71.8%) experienced at least one lapse, and a third relapsed. Whereas baseline self-efficacy did not predict any of the milestones, daily variations in SE predicted the first lapse, as well as progression from first lapse to relapse. Surprisingly, concomitant smoking did not predict outcomes on the next day.

To start with, the finding that individual differences in baseline self-efficacy did not predict abstinence is in contrast with prior studies among adolescents in which high self-efficacy predicted smoking cessation a few years later (Chang et al., 2006; Engels et al., 1998; Tucker et al., 2002). This discrepancy may well be due to the large difference in time intervals, but also to the fact that these other studies included large proportions of irregular and sporadic smokers. For sporadic smokers, refraining from smoking is presumably less of a challenge and self-efficacy may therefore automatically be high in those samples. In addition, only 19% of teenagers who report experimental smoking will continue their use (Tucker, Ellickson, & Klein, 2003), and ‘cessation’ is therefore a very probable outcome for these experimenters. As such, the relation between self-efficacy and smoking cessation as found in the above studies may be artificial. Alternatively, and more generally, the lack of predictive power of baseline self-efficacy in the present study might be explained by the timing of assessment. In their meta-analysis of 54
studies on the association between self-efficacy and smoking abstinence, Gwaltney and colleagues (in press) found that this association was substantially lower among studies using pre-quit self-efficacy measures, especially when post-quit smoking was controlled for. The authors postulated that a better understanding of the challenges as well as knowledge of the resources available to maintain abstinence are achieved more so after quitting than before, which may lead post-quit self-efficacy to comprise more accurate judgments and to yield larger effect sizes.

The present results on baseline self-efficacy did not mirror the preponderance of studies on self-efficacy and smoking abstinence among adults either (Gwaltney et al., in press). One reason that our results differ from those of studies on adult quitters could be that self-efficacy judgments are partly based on experience, and adolescents have less experience with quitting. However, in our analyses, the number of prior quit attempts did not affect SE judgments or their ability to predict outcomes. This could mean that lack of (or less) experience does not necessarily make adolescents poorer predictors of how capable they will be in resisting smoking after quitting. Further research is warranted to disentangle to what extent adolescents make use of their previous quitting experience in forming self-efficacy judgments as well as in undertaking the quit effort, and whether appropriate use of past experiences supports them in maintaining abstinence or not.

Whereas adolescents’ baseline self-efficacy did not predict treatment outcomes, the effects of daily variations in self-efficacy on the first lapse and relapse appeared to be quite robust. Drops in daily self-efficacy posed a substantial risk of lapsing after achieving abstinence and of relapsing after lapsing, which is in line with findings among adults (Gwaltney et al., 2005; Shiffman et al., 2000). These findings have an important implication for future research in that they support the notion that static measures of self-efficacy and smoking cessation provide insufficient information for understanding relapse among adolescents. In fact, self-efficacy dynamics seem to be even more important to adolescents than their individual differences in self-efficacy, which has important implications for intervention that we will discuss below.

Concurrent smoking has been found to be a strong predictor of further post-quit smoking and relapse in its own right, at least among adults (Gwaltney et al., in press; Piasecki, 2006; Shiffman et al., 2000). Shiffman and colleagues (2000) proposed that the act of smoking after quitting may reactivate the pharmacological and behavioral addictive processes that were at play
before quitting, thus reigniting psycho-physiological barriers to successful cessation.

Strikingly, the present results show that among adolescents, smoking on a given day did not predict relapse the next day. This implies that during cessation, as during ad libitum smoking, adolescents’ smoking can be intermittent rather than continuous. This implies that their smoking is not necessarily driven by a need to have nicotine continuously, which in turn implies that therapies like nicotine patches may not be suitable. The few studies available that have tested the effects of nicotine patches among adolescents have not distinguished between initial lapses and relapse, and have found that use of nicotine patches fails as an effective aid in tobacco use cessation (Hanson, Allen, Jensen, & Hatsukami, 2003; Hurt et al., 2000; Killen, Robinson, Ammerman et al., 2004; Moolchan, Robinson, Ernst et al., 2005). In the light of the notion that smoking might reactivate addictive processes, it is possible that when adolescents smoke after achieving abstinence it does not incite withdrawal symptoms nor prime further smoking to the same extent as in adults. Future research is recommended to test to what extent withdrawal symptoms are evoked by abstinence and post-abstinence smoking among adolescents, and whether daily variations in withdrawal symptoms can predict relapse outcomes.

Secondly, the finding that smoking did not predict relapse the next day whereas self-efficacy did implies that the effect of self-efficacy is not just a side effect of smoking, which could have been possible if smoking had been found to promote further smoking (cf. Baer et al., 1986). Given that the SE score at the first lapse was considerably lower than that during the quit-to-lapse interval, and given that daily SE predicted the second lapse and relapse, the theory behind the abstinence violation effect (AVE; Marlatt & Gordon, 1985) seems more plausible here. One hypothesized component of the AVE theory is that a lapse provokes self-blaming attributions that diminish expectancies for future efficacy to remain abstinent. The diminished self-efficacy in turn is thought to actuate further smoking, and our results indeed suggest so.

Summarizing, it appears that daily self-efficacy operates independently of concomitant smoking and that cognitive processes might even be more important than behavioral addictive processes in understanding relapse among adolescents.

One of the reasons to test dynamic self-efficacy in relation to abstinence among adolescents specifically was that adolescence is a developmental phase in which impulsivity, novelty seeking, and suboptimal decision making are considered to be normative traits (Chambers, Taylor & Potenza, 2003). These characteristics may cause adolescents to deal
differently with high-risk situations, and to respond differently to the day-to-day variations in self-efficacy. Given that the coefficients of variation (CV) (which allow comparison between scales with different response choice ranges) for daily self-efficacy between the quit-to-lapse, and lapse-to-relapse intervals appeared higher in the present study than in the study by Shiffman and colleagues (2000), there is some reason to believe that adolescents indeed experience more volatility in their daily self-efficacy. Although several methodological issues compel us to be tentative in drawing comparisons between the present study and the ones among adults (Gwaltney et al., 2005; Shiffman et al., 2000), it seems that relapse interventions that are designed for adults and that target self-efficacy may be suitable for adolescents as well. However, there may be differences in behavioral and psycho-physiological responses to cessation and post-quit smoking between adolescents and adults. More practically, considering that daily variations in SE affected the first lapse, intervention programs for adolescents might need to be active as soon as 24 hr abstinence is achieved. Interventions could implement cognitive strategies to help adolescents maintain higher and more stable levels of self-efficacy. In addition, the finding that changes in daily self-efficacy were relevant to both the first lapse and relapse demand that intervention is implemented immediately after quitting and to last for at least several weeks. Conclusively, while crucial information has been brought forward by the present study, important questions remain unanswered. For example, we do not know if and how adolescents’ daily self-efficacy responds to external stimuli (such as drinking coffee/alcohol, seeing others smoke) and affect-motivational states (Gwaltney et al., 2005). More fundamentally, we do not understand very well, either for adults or for adolescents, how self-efficacy judgments are formed, and further research into situational correlates of adolescents’ daily abstinence self-efficacy is needed.

The abovementioned results must be considered in light of the following limitations. First and foremost, roughly half of all assessments were entered on paper diaries, which bears the risk of back-filling or forward-filling where participants fill out a number of questionnaires at once. Studies in which compliance with paper-and-pencil-diaries has been tested have revealed high rates of falsification: in adult pain patients, Stone, Shiffman, Schwartz, Broderick, and Hufford (2002) found that subjects often hoarded the diaries and apparently completed them in batches days later, which raises critical questions about timely compliance. In the present study, while the timing of the paper diary reports cannot be ascertained exactly, examination of their
subsequent entries on-line did not reveal the sort of massive problems identified by Stone et al. The majority of paper diary records (60.5%) were subsequently entered on-line on the same day and, further, were not bunched together at the end of the day. It is less clear how timely the remaining 39.5% of these paper diaries were, but the pattern of same-day entries is somewhat reassuring. Nonetheless, it remains an important issue to be reminded of in interpreting the present results. In addition, 24 hr abstinence was not biochemically verified. However, it was emphasized with the participants that failure to achieve 24 hr abstinence on the target quit day (day 8) would not be regarded as ‘failure’ by the research team and that participants would not be discontinued if they did not achieve 24 hr abstinence on the target quit day. The observation that 27.5% of the participants did not show 24 hr abstinence on the target quit day (as indicated by at least three consecutive reports of non-smoking) suggests that participants felt the freedom to honestly report whether or not they had smoked for 24 hr. Lastly, a core component of ecological momentary assessment (EMA) is the intensive self-monitoring, which raises concern about reactivity, particularly when subjects want to change their behavior and are able to exert control over it, which is the case in smoking cessation. Despite continuing concerns about reactivity, the EMA literature shows little evidence of it (Shiffman et al., 2008). Nevertheless, it remains possible that the intensive self-monitoring has contributed to the degree of self-efficacy and rates of abstinence success as found in the present study.

In a review on adolescent smoking cessation in 2003, Mermelstein stated that the most basic questions about relapse among adolescent ex-smokers still needed to be answered; questions concerning the patterns, timing, and predictors of relapse. In 2008, Gwaltney, Bartolomei, Colby and Kahler reported that we still know very little about the natural history of quit efforts among adolescents, while such information is crucial to tailor psychosocial and pharmacological treatments to this particular group. Despite the abovementioned limitations, the present study has been the first to use EMA methods to examine smoking cessation and relapse among adolescents. The findings emphasize the role of both the concept of self-efficacy and the need to use dynamic formulations and assessments of self-efficacy and cessation outcomes among adolescents. Future research on adolescent relapse is encouraged to approach and assess other known determinants of relapse (e.g., withdrawal symptoms, outcome expectations, smoking cues and coping efforts) as dynamic constructs as well.
Tables and Figures

Table 1. *Demographic Characteristics and Smoking History of the Sample.*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean or %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>63.8%</td>
</tr>
<tr>
<td>Age</td>
<td>17.2 (1.2)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>96.3%</td>
</tr>
<tr>
<td>Other</td>
<td>3.7%</td>
</tr>
<tr>
<td>Cigarettes per day</td>
<td>11-20</td>
</tr>
<tr>
<td>Years smoked daily</td>
<td>2.9 (1.6)</td>
</tr>
<tr>
<td>Age smoking first puff</td>
<td>12.3 (1.9)</td>
</tr>
<tr>
<td>Age started daily smoking</td>
<td>14.3 (1.6)</td>
</tr>
<tr>
<td>Number of past serious quit attempts</td>
<td>1.9 (1.2)</td>
</tr>
<tr>
<td>Nicotine dependence (range 1-4)</td>
<td>2.63 (.49)</td>
</tr>
</tbody>
</table>

*Note.* Of the 149 participants included in the present sample, 14 participants did not provide demographic and smoking history data. Nicotine dependence was measured with a multidimensional scale including the mFTQ and the HONC (Kleinjan et al., 2007)
Table 2. Overview of Assessment Compliance.

<table>
<thead>
<tr>
<th>Assessment Type</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Assessments</td>
<td>10501 (100%)</td>
</tr>
<tr>
<td>Completed on the internet in real-time</td>
<td>4381 (41.7%)</td>
</tr>
<tr>
<td>Completed within the allotted assessment window</td>
<td>3516 (80.3%)</td>
</tr>
<tr>
<td>Completed within 3 hours outside the allotted assessment window</td>
<td>865 (19.7%)</td>
</tr>
<tr>
<td>Completed over 3 hours outside the allotted assessment window</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>Completed on paper and entered on the internet at a later time</td>
<td>5634 (53.7%)</td>
</tr>
<tr>
<td>Reported to be completed within the allotted assessment window</td>
<td>5002 (88.8%)</td>
</tr>
<tr>
<td>Reported to be completed within 3 hours outside the allotted assessment window</td>
<td>632 (11.1%)</td>
</tr>
<tr>
<td>Reported to be completed over 3 hours outside the allotted assessment window</td>
<td>5 (0.1%)</td>
</tr>
<tr>
<td>Entries with no clear indication of time of completion</td>
<td>486 (4.6%)</td>
</tr>
</tbody>
</table>
Figure 1. Disposition of candidates and participants.
Figure 2. The relationship between post-lapse self-efficacy (SE) and risk of progression to relapse. To construct discrete groups for the Kaplan-Meier curve, SE was dichotomized into low (<4) and high (≥4; 37% of subjects) SE groups.
References


Chapter 8

Contextual correlates of adolescents’ self-efficacy after smoking cessation
Abstract

Recent research has shown that daily changes in self-efficacy predict lapses and relapse into smoking after quitting among heavily smoking adolescents, but it is not known if and how momentary self-efficacy is associated with affect-motivational states and external contexts. In the present study, 134 daily smoking adolescents were monitored during one week prior to and three weeks after they began their quit attempt. Participants completed questions on smoking, self-efficacy, affect-motivational states (craving and negative affect), and external contexts (seeing others smoke, experiencing a stressful event, and alcohol and coffee consumption) three times a day in real-time. Affect-motivational states as well as all external contexts (except for coffee consumption) were associated with lower self-efficacy when participants were still abstinent, but also after they had lapsed. Associations between the situational contexts and self-efficacy did not largely depend on individual characteristics such as baseline self-efficacy and age. Among girls, however, the associations between self-efficacy and negative affect, seeing others smoke, and drinking alcohol were found to be weaker. These results show that adolescents’ self-efficacy during a quit attempt may be responsive to internal and external contexts, both before and after lapsing.
Introduction

If individuals are confident that they can acquire or maintain a specific behavior, they are more likely to succeed than those who lack such confidence. This confidence in oneself is often referred to as ‘self-efficacy’ and is one of the most important constituents of dominant psychological theories of behavior change such as Social Cognitive Theory (Bandura, 1986), and the Theory of Planned Behavior (Ajzen, 1991). Self-efficacy judgments also take on a central role in social learning models of smoking relapse (Marlatt & Gordon, 1985; Niaura et al., 1988). Traditionally, self-efficacy was considered to be an individual trait that remains relatively stable over time. This was reflected in the way self-efficacy was measured; using single time points to predict cessation and relapse across large time intervals. There is substantial evidence that differences in self-efficacy between persons indeed account for success in smoking cessation. A meta-analysis of 54 prospective studies among adults showed that people who set out on their quit attempts generally benefit from a high initial level of self-efficacy (Gwaltney, Metrik, Kahler, & Shiffman, 2009). Though less extensively investigated, individual differences in self-efficacy predict failure to quit and relapse among adolescents as well (Chang et al., 2006; Engels, Knibbe, De Vries & Drop, 1998; Tucker, Ellickson, & Klein, 2002; Van Zundert, Nijhof & Engels, 2009).

However, according to both self-efficacy theory (Bandura, 1977, 1997), and social learning models of relapse (Marlatt & Gordon, 1985; Niaura et al., 1988), individual self-efficacy should be reactive to contextual influences and thus should vary over time and across situations. Recent empirical research has shown that self-efficacy indeed changes from day to day and that these dynamic changes strongly predict lapses and relapse into smoking after cessation in both adults (Gwaltney et al., 2001; Gwaltney, Shiffman, Balabanis, & Paty, 2005; Shiffman et al., 2000), and adolescents (Van Zundert, Ferguson, Shiffman, & Engels, resubmitted). In addition, adults’ self-efficacy seems responsive to affect-motivational states (e.g., craving and negative affect), and external stimuli (e.g., seeing others smoke, drinking alcohol or coffee) (Gwaltney, Shiffman & Sayette, 2005). However, precursors and predictors of adolescent smoking relapse are largely unknown, since studies on smoking relapse are conducted almost exclusively among adults. However, one recent study among 15 to 19-year-olds identified daily self-efficacy after cessation to be an important predictor of lapse and relapse into smoking among adolescents (Van Zundert, Ferguson, Shiffman, & Engels, resubmitted). Given that empirical knowledge of the adolescent smoking relapse process is scarce, it is important to determine which factors are associated with the levels and variations in self-efficacy in this particular population. In the present study, it will be examined how
situational self-efficacy of adolescents varies with concurrent affect-motivational states, such as craving and negative affect, and across various external contexts, such as seeing others smoke, stress, and alcohol and coffee consumption.

The pathways through which self-efficacy might be affected by other situational factors are proposed in the dynamic regulatory feedback model of relapse (Niaura, 2000; Niaura et al., 1988). This model assumes that self-efficacy mediates the influence of all other relevant factors on relapse. More specifically, it is assumed that affect states and drug-related external stimuli (such as seeing others smoke) can elicit both cognitive and physiological reactions (such as outcome expectations and arousal) and urge (in this case, urge to smoke). The process of physiological and subjective reactions to presentations of drug-related stimuli is called cue-reactivity. The cluster of cognitive and physiological responses and urge is supposed to interact with cognitive-behavioral coping efforts and attributions such that when the cue responses are overwhelming, coping efforts are undermined and abstinence is jeopardized. Here, self-efficacy is thought to be the central component that inhibits urges and outcome expectations, and increases the likelihood of coping. The outcome of this process is thought to feed back to urges and outcome expectations that in turn reaffect self-efficacy, making self-efficacy ‘the final common pathway to lapsing’ (Gwaltney et al., 2005).

It is known that, among adults, urge to smoke is indeed inversely associated with momentary self-efficacy as found in both laboratory studies (Cooney, Gillespie, Baker, & Kaplan, 1987; Niaura, 2000; Niaura, Shadel, Britt, & Abrams, 2002), and in an ecological momentary assessment study (Gwaltney et al., 2005). Urge to smoke seems to be negatively associated with self-efficacy when individuals have achieved abstinence, but also after someone has lapsed. The same applies to negative affect; negative affect seems negatively associated with self-efficacy when individuals are temporarily deprived of nicotine (Rabois & Haaga, 2003), as well as during abstinence and after lapsing among adults who have quit smoking (Gwaltney et al., 2005). Although urge to smoke and negative affect are significantly correlated, their associations with self-efficacy seem independent of each other (Gwaltney et al., 2005). To date, it is unknown how urge to smoke and negative affect are associated with momentary self-efficacy to abstain among adolescents.

In addition to affect-motivational states, external contexts seem to interact with self-efficacy as well. Seeing other people smoke, for example, was modestly yet significantly related to lower self-efficacy in the study by Gwaltney and colleagues (2005). This association, however, disappeared when urge to smoke was controlled for. Preliminary findings from a pilot study among adolescents who quit smoking also suggested that seeing
others smoke was associated with lapsing (Gwaltney, Bartolomei, Colby, & Kahler, 2008), but it is not known whether seeing others smoke affects adolescents’ self-efficacy as well. Further, despite that alcohol and coffee consumption are related to smoking among adults (Shiffman et al., 2002), and despite that alcohol consumption is strongly related to lapsing after quitting in both adults and adolescents (Shiffman, Paty, Gnys, Kassel, & Hickcox, 1996; Van Zundert, Kuntsche, & Engels, submitted), both alcohol and coffee consumption do not seem to be related to self-efficacy among adults (Gwaltney et al., 2005). Lastly, although adolescents report to smoke for reasons of coping with stress (Kassel et al., 2003), there are no studies to date that have examined the role of experiencing a stressful event in adolescents’ quit attempts and self-efficacy after quitting. There are, however, reasons to believe that adolescents’ self-efficacy might respond differently to external stimuli than has been observed among adults.

First, little is known about cue-reactivity among adolescents, but there is some evidence that adolescents respond to smoking-related cues differently than adults. A study in which smoking-related cues were presented to young adult smokers (aged 19-24) in virtual reality revealed that participants responded strongly to these cues and, unlike what is commonly seen among older adults, did not return to a baseline level of craving following cue exposure (Traylor, Bordnick, & Carter, 2008). Another reason why external stimuli may be differently related to situational self-efficacy among adolescents specifically, is that impulsivity appears to be associated with increased responsivity to environmental smoking cues, at least among adults (Doran, Spring & McChargue, 2007). Given that adolescence is typically marked by increased impulsivity (Chambers, Taylor & Potenza, 2003), it is possible that external cues are associated to lower self-efficacy to the same or even greater extent as in adults.

The present study used data from an ecological momentary assessment (EMA) study in which 149 adolescent daily smokers embarked on a quit attempt and reported on their affect-motivational states and external contexts three times a day during one week prior to, and three weeks after achieving at least 24 hr abstinence. It was hypothesized that higher post-quit ratings of craving (Footnote 1) and negative affect, as well as seeing other people smoke, experiencing a stressful event, and consuming alcohol or coffee would be associated with lower self-efficacy to maintain abstinence, both before and after lapsing (if lapsing occurred). Because the associations between affect-motivational states, external stimuli, and self-efficacy may differ according to individual characteristics, we also examined whether between-person differences in age, sex, and baseline self-efficacy moderated the within-person associations. It
is possible, for example, that the hypothesized negative effect of increases in craving on situational self-efficacy is relatively stronger among those who reported low self-efficacy in general, that is, even before attempting to quit. Considering that negative affect is more common among females than males (Piccinelli & Wilkinson, 2000), the associations between negative affect and self-efficacy may vary as a function of sex as well.

Additionally, we examined interactions on the situational level. We tested whether the within-person associations were moderated by more general situational influences, such as the number of days since achieving abstinence and concomitant smoking. This was done because when aggregated across individuals, craving and negative affect seem to diminish over time after adolescents have quit smoking (Smith, Cavallo, McFetridge, Liss, & Krishnan-Sarin, 2008; Van Zundert, Boogerd, Vermulst, & Engels, 2009), and the decrease in craving has been found to be non-linear (Van Zundert et al., 2009). As craving and negative affect are waning over time, the possible negative effects on self-efficacy may become weaker as well. Moreover, since craving and negative affect are heightened under conditions of nicotine deprivation (Hughes, 2007), the associations between internal states and self-efficacy may be different under smoking circumstances compared to non-smoking occasions. The individual and situational moderators outlined above were tested in association with both the affect-motivational and external contexts.

Method

Participants

Participants (n = 176) were Dutch adolescent daily smokers recruited for the study by means of community advertisements and newspaper articles. To qualify, candidates had to: be between 15 and 19 years of age; smoke at least one cigarette per day; and, not be currently enrolled in a cessation program. Of the 176 participants who were eventually enrolled, a sample of 134 participants provided sufficient data for the present analyses (for more details on inclusion criteria and attrition, please consult other publications on these data; Van Zundert et al., 2009a, Van Zundert et al., 2009b). The majority of the sample was female (63.7%), and the mean age was 17.2 (SD = 1.2). All participants received regular education, and all levels of educational attainment were represented: Lower vocational training (53.9%), higher vocational training (14.6%), pre-university education (13.8%), and college (17.7%). Most participants lived at home with their parents (89.5%), whereas 7.6% lived in student housing, with his or her grandparents (0.7%), or with a romantic partner (2.2%). The average number of years that participants had been smoking daily was 2.9 (SD = 1.6). At the time of enrollment in the study, smoking rate was distributed as follows: 1-5 cigarettes per day.
(11.9%), 6-10 cigarettes per day (34.3%), 11-20 cigarettes per day (47.0%), 21-30 cigarettes per day (3.7%), and 31 or more cigarettes per day (3.0%). Written consent from the participants and their parents was not required. This study was approved with the Dutch Committee on Research Involving Human Subjects.

Procedure

Participants were asked to complete the baseline questionnaire that included the self-efficacy scale one week prior to the beginning of the EMA period during which they were monitored daily. Participants were monitored for a total of four weeks. The first day of monitoring was always a Monday. Participants started the monitoring period with seven days of baseline monitoring, during which they were instructed to smoke ad lib. The eighth day was the assigned quit day for each participant. Following the quit day, participants were monitored for three additional weeks. On each day of monitoring, participants were asked to complete three internet-based questionnaires – in the morning (to be completed between 10 a.m. and noon), the afternoon (3 p.m. – 5 p.m.), and evening (8 p.m. – 10 p.m.). Each questionnaire was identical and asked participants questions about smoking since the previous questionnaire, motivation, self-efficacy, withdrawal symptoms, and situational stimuli (e.g., alcohol/coffee consumption, seeing others smoke). The questionnaires took approximately three minutes to complete. Questionnaires were automatically time-stamped with the time that they were completed on-line. Participants who failed to complete a questionnaire within the designated sampling window were sent a text message on their cell phones to remind them. If a participant did not have access to the internet during the sampling window, they were asked to complete a paper version of the questionnaire – which included a question on the date and time at the time of completion – and to transcribe the paper version online as soon as they had access to internet again. Prior analyses on the timeliness of paper diary entries in this EMA study indicated that the majority of the paper diaries were entered online on the same day, and that they were not bunched together at the end of the day. Analyses excluding paper entries also revealed similar results as those obtained using both paper and real-time assessments (Van Zundert, Ferguson, Shiffman, & Engels, resubmitted). All data were collected between October 2006 and March 2007.

Measures

Daily measure of self-efficacy (situational self-efficacy). At each assessment, self-efficacy was assessed with the item “How confident are you that you can continue your quit attempt today?” (1 = ‘Not at all confident’ , 5 = ‘Very confident’). Since the quit attempt had
yet not been initiated during the first week of the study, participants could tick a box saying ‘I
am in the first week of the study, so this question does not yet apply’.

*Baseline self-efficacy questionnaire.* Baseline self-efficacy was measured using a self-
efficacy measure that was specifically designed for adolescents (Kremers, Mudde & De Vries,
2001). The instrument of 12 items originally showed high loadings on three subscales, and
showed high internal consistency (Kremers et al., 2001). Respondents were asked: “When
you have quit, how difficult or easy do you expect it will be to not to smoke in the following
situations?” Example items are ‘When you’re with friends who smoke’, ‘When you’re doing
homework’, and ‘When you feel depressed’. Participants could answer on a 5-point Likert
scale, ranging from 1 ‘Very easy’ to 5 ‘Very difficult’. A higher score represents high self-
efficacy. Cronbach’s alpha observed in this sample was .80.

*Sex.* Boys were assigned a value of 1 and girls a value of 2.

*Affect-motivational contexts (craving and negative affect).* Two items of the
Wisconsin Smoking Withdrawal Scale (WSWS) were used to determine adolescents’ daily
levels of craving, and 6 items of the WSWS assessed negative affect (Welsch, et al., 1999).
The WSWS has been found to show good construct validity with high reliabilities for these
two symptoms (West, Ussher, Evans, & Rashid, 2006), and the shortened version of ten items
has been successfully applied in prior EMA research on smoking relapse among adults
(McCarthy et al., 2006). The items could be answered on a Likert-scale ranging from 1
‘strongly disagree’ to 5 ‘strongly agree.’ In a prior study on the same data, the internal
consistencies of the craving and negative affect scales were found to be .88 (SD = .04) and .75
(SD = .04), respectively (as computed by calculating Cronbach’s alpha per assessment and
then taking the average alpha across all assessments) (Van Zundert, Boogerd, Vermulst, &
Engels, 2009).

*External contexts.* The external contexts were assessed through one-item questions.
“Seeing others smoke” was assessed through the question: “In the last 30 minutes, have you
seen any of the following people smoke?” Participants could choose between ‘nobody’, ‘girl-
or boyfriend’, ‘friends’, ‘best friend’, ‘someone else you know’, or ‘a stranger’. This item was
dichotomized such that ‘nobody’ was represented by the value 1, and all other categories were
assigned the value 2. “Stress” was tapped by the question “Has a stressful situation occurred
since the last recording?” (‘no’ = 1, ‘yes’ = 2). Participants were also asked to indicate
whether they had consumed alcohol or coffee in the past 30 minutes, by ticking the relevant
box in a list of possible drinks (‘no’ = 1, ‘yes’ = 2). Thus, all external contexts were
dichotomous variables of which a higher score indicated the presence of the relevant context.
The situational contexts that were used as moderators included concomitant smoking (smoking in the past 30 minutes; ‘no’ = 1, ‘yes’ = 2), and “days since quitting”, which represented the number of days since achieving abstinence up to the analyzed day. ‘Days since quitting’ was calculated by subtracting the actual quit day from the analyzed day. The value for this variable thus varied per day and per every three assessments and was therefore included on the situational level.

Strategy for analyses

The main purpose of the present study was to examine the within-person associations between affect-motivational and external contexts and adolescents’ self-efficacy after quitting. Before testing those associations, we calculated the (re)lapse rates, correlations between variables included in the model, and the associations between individual characteristics (baseline self-efficacy, age, and sex) and situational self-efficacy. Subsequently, modeled after Gwaltney and colleagues (2005), we investigated the within-person associations within two separate intervals: 1) the ‘abstinent interval’, which captures the period between each individual’s actual quit day to first lapse, or for those who did not lapse, to the end of the EMA period (n = 134; number of observations = 3,207), and 2) the ‘lapsed interval’, which refers to the period between the first lapse and relapse, or for those who lapsed but did not relapse, to the end of the EMA period (n = 94; number of observations = 2,948). The first lapse was defined as the first occurrence of smoking, even if only a puff, after achieving 24 hr abstinence. Relapse was defined as smoking at least 5 cigarettes per day for 3 consecutive days (e.g., Shiffman et al., 1996, 2000; Van Zundert, Nijhof, & Engels, 2009). Limiting the lapse interval to the time to relapse instead of to the end of the EMA period for those who relapsed was chosen because it is likely that reporting a relapse indicates resumed tobacco use, which might obscure the associations of interest. Altogether, participants missed 7.3% of the assessments in the abstinent interval, and 13.1% in the lapsed interval. Missings appeared to be random, that is, not systematically linked to time of day or study day, and were not imputed.

First, we tested whether affect-motivational and external contexts were univariately related to self-efficacy during the abstinent interval, after which we tested a multivariate model in which all affect-motivational and external contexts were included. We then examined whether the univariate associations were dependent on the situational variable ‘days since quitting’. We also tested whether the univariate within-person associations were moderated by the individual level factors baseline self-efficacy, sex and age (cross-level interactions). Next, we analyzed the lapsed interval. Again, the associations between affect-
motivational and external contexts and self-efficacy were examined both univariately and multivariately. Situational moderators of the univariate within-person associations included ‘days since quitting’, and concomitant smoking. As with the abstinent interval, we tested whether the individual characteristics baseline self-efficacy, sex, and age moderated the univariate within-person associations (cross-level interactions).

For the interaction terms involving two interval scales, the values were standardized before being multiplied. The interaction terms involving at least one dichotomous variable did not include standardized scores. For the purpose of the present analyses, we conducted multilevel regression analyses using the HLM program (Version 6.0; Raudenbush, Bryk, Cheong, Congdon, & du Toit, 2006), which allows for the estimation of within- and between-person effects in unbalanced diary data. Lastly, it should be noted that in multilevel modeling, the number of assessments (and not the number of participants) constitute the units of analysis. Thus, we had 3,207 data points for the analyses regarding the abstinent interval, and 2,948 data points for the analyses of the lapsed interval.

Results

Descriptive findings

Participants’ mean baseline level of self-efficacy (as measured through the baseline questionnaire) was 2.48 ($SD = .61$ [range 1-5]). Of the total sample of 134 students, 40 (29.9%) remained abstinent throughout the EMA period (to be called “abstainers” in this paper), 67 (50.0% of 134) experienced a first lapse but no further lapsing (“lapsers”), and 27 persons (20.1% of 134) experienced a relapse (“relapsers”). Pearson and Spearman correlations between independent variables were computed. Briefly, within both the abstinent and lapsed intervals, the external contexts were significantly but modestly interrelated, whereas craving and negative affect were relatively strongly correlated (Table 1). Craving and negative affect were significantly associated with external stimuli, but only modestly in the case of alcohol and coffee consumption. Craving was more strongly positively related to seeing others smoke and to stress than to the other external contexts. Negative affect was also moderately related to stress, but not to others’ smoking.

Individual level factors

Baseline questionnaire ratings of self-efficacy were not significantly associated with momentary self-efficacy during abstinence ($B = .18, SE = .14, T\text{-ratio} = 1.39, p = .196$), but they did predict momentary self-efficacy after lapsing ($B = .53, SE = .18, T\text{-ratio} = 2.85, p = .006$). Sex was not related to levels of momentary self-efficacy during abstinent and lapsed intervals ($B = .11, SE = .16, T\text{-ratio} = 0.67, p = .501$, and $B = -.01, SE = .27, T\text{-ratio} = 1.35, p$
Age, however, was positively associated with momentary self-efficacy (B = .13, SE = .06, T-ratio = 2.28, p = .024), indicating that older adolescents reported higher levels of self-efficacy while abstinent. This effect diminished after lapsing (B = .17, SE = .11, T-ratio = 2.13, p = .035).

Abstinent interval

Affect-motivational states. During abstinence, craving and negative affect were significantly inversely related to self-efficacy (Table 2). Because craving and negative affect were significantly interrelated and both associated with self-efficacy, they were also analyzed multivariately to test whether they might account for each other’s effects. Although the associations of both craving and negative affect with self-efficacy decreased somewhat compared to the univariate results, both associations remained significant (craving: B = -.22, SE = .03, T-ratio = -7.19, p = .000; negative affect: B = -.11, SE = .04, T-ratio = -2.60, p = .011) (Footnote 2).

External contexts. Of the external contexts, seeing others smoke, drinking alcohol, and experiencing a stressful event were all related to lower self-efficacy (Table 2). Drinking coffee was not significantly associated with self-efficacy. When all affect-motivational states and external contexts were included in a multivariate model, only the associations between craving and self-efficacy, and between stress and self-efficacy remained significant (Table 2).

Days since quitting. To test whether levels of self-efficacy would change over time, the number of days since quitting was included as independent variable on the situational level. Levels of self-efficacy seemed to slightly decrease as more days of non-smoking passed by (B = -.05, SE = .01, T-ratio = -3.28, p = .002) (Footnote 3).

Individual and situational moderators. The individual level factors baseline self-efficacy, sex, and age did not moderate the univariate associations between self-efficacy and the affect-motivational and external contexts (Table 3). One exception was the interaction between coffee consumption and baseline self-efficacy, which was positive, indicating that the negative association between coffee consumption and self-efficacy was stronger among those with high baseline self-efficacy levels (Table 3). In addition, all associations, except for the one involving alcohol consumption, were moderated by the number of days since abstinence was achieved (Table 3). The negative associations between craving and negative affect, and self-efficacy, appeared to become stronger as more days since achieving abstinence went by (Figure 1a-b). Experiencing a stressful event and seeing someone else smoke were also more strongly negatively related to self-efficacy as more days of abstinence
went by (Figure 1c-d). Conversely, the negative association between coffee consumption and self-efficacy seemed to decrease as more days since achieving abstinence went by (Figure 1e).

**Lapsed interval**

*Affect-motivational states.* After having experienced the first lapse into smoking, craving and negative affect were still significantly inversely related to self-efficacy (Table 4). Contrary to the abstinent interval where both craving and negative affect remained significantly related to self-efficacy when included in a multivariate analysis, the association between negative affect and self-efficacy decreased to non-significance ($B = -.09$, $SE = .05$, $T$-ratio = -1.79, $p = .077$), whereas the association between craving and self-efficacy remained significant ($B = -.34$, $SE = .04$, $T$-ratio = -9.24, $p = .000$).

*External contexts.* Identical to the results of the abstinent interval, the external contexts of seeing others smoke, drinking alcohol, and experiencing a stressful event were all related to lower self-efficacy after the first lapse into smoking (Table 4). Drinking coffee was again not significantly associated with self-efficacy. Including all affect-motivational states and external contexts in a multivariate model showed that most of the associations that were significant before remained significant (Table 4). The exception was the association between negative affect and self-efficacy, which diminished to non-significance.

*Individual and situational moderators.* The results for the cross-level interactions were highly similar to those in the abstinent interval: Baseline self-efficacy, age, and sex did not moderate the univariate associations between affect-motivational and external contexts and self-efficacy (results not reported given the high similarity to those reported in Table 3). Sex, however, did seem to determine the associations between self-efficacy and negative affect ($B$ of the interaction = -.35, $SE = .12$, $T$-ratio = -2.93, $p = .005$), others smoking ($B = -.26$, $SE = .12$, $T$-ratio = -2.16, $p = .033$), and alcohol consumption ($B = -.63$, $SE = .26$, $T$-ratio = -2.44, $p = .017$). Given that all three interactions were negative, the magnitude of these three associations was smaller for girls than for boys.

As for the interactions on the situational level, none of the within-person associations seemed to depend on the number of days that had passed since abstinence was achieved (Table 4). Further, having smoked in the past 30 minutes was strongly related to lower self-efficacy (Table 4). Concomitant smoking, however, did not seem to overrule the associations between self-efficacy and the other independent variables on the situational level when tested in a multivariate analyses including each factor along with concomitant smoking. One exception was that the association between self-efficacy and alcohol consumption decreased to a trend level when concomitant smoking was controlled for ($B = -.19$, $SE = .10$, $T$-ratio = -
1.89, \( p = .061 \)). When included as a moderating variable, concomitant smoking did not affect the associations between self-efficacy and situational factors, except for the association between craving and self-efficacy (Table 4). More specifically, this association appeared to be non-significant when including smoking assessments only (\( B = -.03, SE = .05, T\)-ratio = -0.69, \( p = .491 \)), but was significant when including nonsmoking assessments only (\( B = -.30, SE = .04, T\)-ratio = -8.82, \( p = .000 \)). Additionally, we found an interaction between concurrent smoking and number of days since quitting (Table 4). The association between concomitant smoking and decreased self-efficacy seemed to become stronger as more days since quitting went by (Figure 2).

**Discussion**

The present study examined individual predictors and situational correlates of self-efficacy among daily smoking adolescents who quit smoking. Affect-motivational states (craving and negative affect) as well as external contexts (seeing others smoke, stress, and alcohol consumption) were associated with lower self-efficacy when participants were still abstinent, but also after they had lapsed. Associations between the situational factors and self-efficacy did not largely depend on individual characteristics such as baseline self-efficacy and age. Among girls, however, the associations between self-efficacy and negative affect, seeing others smoke, and drinking alcohol were found to be weaker.

**Baseline self-efficacy versus situational self-efficacy**

Given that traditional research has mainly relied on static baseline ratings of self-efficacy to predict smoking relapse after quitting, it seems crucial to examine to what extent baseline ratings concur with situational self-efficacy ratings when smokers are in the midst of a quit attempt. Although baseline self-efficacy ratings were significantly related to situational self-efficacy after the first lapse, we were surprised to find that there was no such association while adolescents were still abstinent. Despite that the present sample had prior quitting experiences, it is possible that those experiences do not translate into a realistic prognosis of how teenagers will deal with real-life challenges to remain abstinent. Adolescents indeed have been found to be overly optimistic about quitting, while knowing little about how to go about quitting and effective methods to succeed (Stanton, 1995; Balch, 1998). Alternatively, as it has been demonstrated that smokers with low baseline self-efficacy may at times have higher momentary self-efficacy than those with high baseline self-efficacy, at least among adults (Gwaltney, Shiffman & Sayette, 2005), this might also explain the discrepancy between baseline and situational self-efficacy scores.
However, methodological issues may be at play here as well, precluding definite conclusions about the correlation between static baseline ratings of self-efficacy and momentary self-efficacy ratings. Although the self-efficacy scale used in this study was designed to assess expected self-efficacy to refrain from smoking across a variety of abstinence challenging situations specific to adolescents (Kremers, Mudde, & De Vries, 2001), this scale may not cover all dimensions of self-efficacy as a trait vulnerability. The effect of using one particular static measure of self-efficacy over the other is reflected in the additional analyses (Footnote 4) that showed modest though important differences in the correlations between baseline self-efficacy and situational self-efficacy ratings depending on the measure used. Future research is encouraged to include multidimensional self-efficacy questionnaires and to administer such questionnaires several times in the course of the quitting process in order to establish a better understanding between efficacy expectations before and after quitting and lapsing.

Affect-motivational states

Craving and negative affect appeared to be negatively related to self-efficacy, both before and after lapsing, which is in line with findings among adults (Gwaltney et al., 2005). Lapse status did not seem to moderate these associations (additional analysis; Footnote 3), indicating that those who would remain abstinent throughout the entire study continued to be challenged by these states just the same as those who later lapsed. Interestingly, the associations between affect-motivational states and self-efficacy in the abstinent interval were moderated by ‘days since quitting’ and thus became stronger over time, that is, until the end of the study for those who would remain abstinent, or until the first lapse for lapsers. Those who would later (re)lapse may in fact drive this effect, as additional analyses showed that this interaction effect was not present among abstainers only. Thus, for (re)lapers, the intensification of the link between either craving or negative affect and self-efficacy may forecast the proximity of a first lapse. This supports theories that state that the same level of discomfort may have a different impact at different times and across different contexts. “Catastrophe theory”, for example, poses that gradual continuous change in one variable may generate a ‘sudden’, catastrophic change in behavior, such as relapse (Hufford, Witkiewitz, Shields, Kodya, & Caruso, 2003). We did not find a moderating effect of days since quitting on the within-person associations after the first lapse, which indicates that the negative effects of several contexts on self-efficacy did not level off over time. This may have been due to intermittent smoking that occurred for many participants after the first lapse.
Further, both craving and negative affect were independently related to self-efficacy as long as participants were still abstinent, but this did not count for negative affect after participants had lapsed. The study in an adult population by Gwaltney and colleagues (2005) showed that craving and negative affect were independently associated with lower self-efficacy in both abstinent and lapsed intervals. Without aiming to make definite comparisons to adults, this may suggest that the association between negative affect and self-efficacy is less strong among adolescents, perhaps as a result of adolescents in general being subject to more variable and intense moods and more anxiety than children and adults (Buchanan et al., 1992). Adolescents may be more accustomed to (changes in) negative affect and therefore less discouraged in their quit attempt when confronted with it, that is, after lapsing. It is also possible that the association between negative affect and self-efficacy is mediated by craving after adolescents have lapsed. While still abstinent, however, negative affect is related to self-efficacy independently from craving. As two prior studies found that adolescents’ craving was high after quitting, but negative affect was not (Smith et al., 2008; Van Zundert, Boogerd et al., 2009), it is important to know that if adolescents do experience elevations in negative affect after quitting, self-efficacy is lower as well. For both craving and negative effect, however, the cross-sectional nature of our analyses do not allow to establish whether self-efficacy itself may precede changes in affect-motivational states and cause them to worsen. Losing hope of being able to maintain cessation might well instigate feelings of frustration, as well as craving to smoke at the thought of being able to smoke again (if one would break off the quit attempt and resume smoking).

**External contexts**

During both abstinent and lapsed intervals, seeing others smoke, experiencing a stressful event, and drinking alcohol were related to lower self-efficacy. Coffee consumption did not seem to play a significant role in self-efficacy before or after lapsing. Given that decreases in self-efficacy predict lapse and relapse among adolescents (Van Zundert et al., resubmitted), it seems that external stimuli may pose a significant threat to adolescents’ prolonged abstinence for at least three weeks after quitting and after the first lapse. As among adults (Gwaltney et al., 2005), seeing others smoke was significantly negatively associated with self-efficacy in both the abstinent and lapsed interval. This association disappeared in the multivariate analysis of the abstinent interval, however, presumably as a result of the interrelatedness with craving. The same applies to alcohol consumption which was no longer significantly related to self-efficacy in the multivariate analysis of the abstinent interval. These findings concur with the dynamic regulatory feedback model of drug relapse (Niaura et
al., 1989), in which contextual cues are supposed to precede urge to smoke, that in turn decreases self-efficacy, altogether provoking relapse. The fact that self-efficacy and the associated situational correlates were assessed simultaneously precludes conclusions about mediational effects over time, but such a chain of reactions may thus present itself among adolescents as well.

After the first lapse, however, both the contexts of consuming alcohol and seeing others smoke were related to self-efficacy independent of all other situational factors, which may indicate that after the occurrence of this important milestone, external contexts may become even more salient than before. In contrast, Gwaltney and colleagues (2005) found that the influence of seeing others smoke on adults’ self-efficacy was largely accounted for by changes in urge to smoke. This might suggest that the pathways between cue exposure and (re)lapse may differ between adolescents and adults in such a way that cues might directly prompt decreases in self-efficacy without the need for craving to rise to bring about this drop in self-efficacy. Seeing others smoke also remained related to lower self-efficacy when concomitant smoking was controlled for, indicating that seeing others smoke did not merely serve as an indirect proxy for smoking (as smoking often occurs in the company of others). For alcohol consumption, however, this may be the case, as the association between self-efficacy and alcohol consumption decreased to a trend level when concomitant smoking was controlled for.

It is known that just as adults, adolescents smoke for reasons of coping with stress (Kassel et al., 2003), but studies on the role of stress in adolescents’ quit attempts and self-efficacy after quitting are lacking. Other studies often operationalize ‘stress’ in terms of negative affect (Kassel et al., 2003), and the present study shows that both constructs are indeed interrelated, yet they may have differential effects on adolescents’ self-efficacy after quitting. Stress showed the strongest association with self-efficacy of all situational contexts (aside from concomitant smoking), and remained significantly associated with self-efficacy in the multivariate analyses of both the abstinent and lapsed intervals, whereas the association with negative affect disappeared. Among adults, when lapses are triggered by stress, people more quickly progress to relapse than when the lapse has been accompanied by eating or alcohol consumption (Shiffman, Hickcox et al., 1996). The present findings suggest that daily stressors may play a role in the adolescent relapse process as well and are recommended to be included in future studies.

Concomitant smoking
Of all independent situational variables, smoking was most strongly related to lower situational self-efficacy. This association became even stronger over time, possibly as a result of lapses accumulating, making relapse more and more likely. Concurrent smoking did not moderate the within-person associations, except for the one between craving and self-efficacy. If participants had just smoked, craving was no longer associated with self-efficacy. A possible explanation for this interaction effect is that the reported craving may in some instances have preceded smoking, while in other instances it may have been preceded, and perhaps altered, by the act of smoking. Also, although the assessment window for craving and smoking was short (the past 30 minutes), some retrospective bias might arise when participants base their craving report on the fact that they have just smoked, for example as a rationalization or justification of their behavior. Given that both variables were reported over the past 30 minutes, we cannot verify the temporal order in which they occurred. Alternatively, the effects of smoking on craving might differ per individual (which seems to be reflected in the moderate correlation between craving and smoking \( r = .22 \)). Smoking may satisfy craving for the one, but may incite more craving for the other. In addition, lapsing decreases self-efficacy among adults (Shiffman, Hickcox et al., 1997), and adolescents (Van Zundert et al., resubmitted). If lapsing indeed decreases self-efficacy, and simultaneously triggers different craving responses across individuals, the association between craving and self-efficacy understandably disappears.

**Individual differences**

Generally speaking, individual characteristics did not largely account for differences in within-person processes. High baseline levels of self-efficacy, for example, did not seem to buffer against the negative impact of internal states and external contexts. This is in contrast with findings among adults, where individual differences in pre-quit self-efficacy did moderate the association between urge to smoke and negative affect, but this interaction effect occurred only under circumstances of very high urge and negative affect, suggesting a three-way interaction (Gwaltney et al., 2005). The present study did not account for potential three-way interactions, which might explain the difference in results. However, it is also possible that for adolescents, urge and smoking cues are so overwhelming that they overrule any baseline confidence. The impact of situational contexts also did not appear to depend on participants’ age. Although a previous study indicated that the association between alcohol consumption and the first lapse is stronger for younger adolescents (Van Zundert, Kuntsche, & Engels, submitted), the present findings suggest that interventions targeting the situational
determinants of self-efficacy should be equally suitable for all adolescents in the age range of 15 to 19.

Lastly, we found that several within-person associations differed between boys and girls, at least after the first lapse had taken place. Both the experience of negative affect and smoking cues (seeing others smoke and alcohol consumption) were less strongly related to lower self-efficacy among girls. This may be plausible in the light of girls generally having higher levels of negative affect (Piccinelli & Wilkinson, 2000), and therefore may be less challenged by lower affect in their attempt to maintain abstinent than boys. Males indeed have been found to become more stressed and depressed as a result of their efforts to quit than females (Stanton, Lowe, & Gillespie, 1996). In addition, impulsive behavior is relatively more common among teenage boys than girls (Carlson, Tamm, & Gaub, 1997). Given that impulsivity appears to be associated with increased responsivity to smoking cues (Doran et al., 2007), this may explain the sex differences in smoking cue exposure after the first lapse.

The first lapse: before versus after

The present findings support prior claims that different processes might operate at different phases or milestones in the quitting process (Shiffman, Scharf et al., 2006). Whereas empirical research on adolescents smoking cessation has principally focused on final end point outcomes (such as continuous long-term abstinence), the present study demonstrates that the processes before the first lapse differ from those at play thereafter. This was not so evident in the univariate associations with self-efficacy – as they were highly similar in both the abstinent and lapsed interval, but mostly in the multivariate analyses and interactions with days since quitting. The situational contexts seemed to be more independently related to self-efficacy after the first lapse than before. Also, before lapsing, the number of days since quitting influenced the within-person associations, but seemed irrelevant to these associations after lapsing. Future research on adolescents’ quit attempts is encouraged to use study designs that allow for the various milestones (achieving abstinence, first lapse, and relapse) to be distinguished from one another.

Limitations

Several limitations of the present study require discussion. Firstly, two primary limitations are inherent to the particular EMA design used in this study: the use of paper diaries, and the possibility of reactivity effects. Paper-and-pencil-diaries might jeopardize validity of data as it allows for false entries by completing multiple assessments at once (forward- or backward-filling). As opposed to electronic entries, timely compliance of paper diaries cannot be verified. Analysis of the validity of the paper entries as reported in another
publication on the same data provided reassuring results, mitigating this concern (Van Zundert et al., resubmitted). Despite the foregoing, electronic diaries may be a more effective means to collect real-time information, and their use in EMA studies on adolescent smoking is highly recommended. Moreover, intensive self-monitoring is known to affect the experience or behavior that is being measured, which is known as ‘reactivity’ to assessment. Although reactivity is often noted as a concern in EMA studies, empirical evidence for its occurrence is limited (Shiffman, Stone & Hufford, 2008), and reactivity may not have been operational in our study by definition. However, the relapse rates in the present study were lower than those found in other studies (Mermelstein, 2003), which may signal a reactivity effect nonetheless. Future research is encouraged to test the effects of intensive self-monitoring on smoking relapse among quitting adolescents, as this strategy can be incorporated in adolescent behavior-change treatment should it be found to effectively reduce relapse rates.

In addition, the achievement of 24 hours of abstinence was not biochemically verified. However, it was emphasized with the participants that failure to achieve 24 hr abstinence on the target quit day (day 8) would not exclude them from the study, and would be regarded as ‘part of the natural process of quitting’ rather than as ‘failure’ by the research team. We believe that reports of abstinence were genuine, given that 27.5% of the participants did not show 24 hr abstinence on the target quit day. Prior studies have also indicated that self-reports indices of smoking are reliable and comparable to biochemical verification (Dolcini, Adler & Ginsberg, 1996; Patrick, Cheadle, Thompson, Diehr, Koepsell & Kinne, 1994). Furthermore, those who maintained abstinence throughout the entire study and those who would later (re)lapse may differ on unknown characteristics that would explain proneness to relapse (e.g., level of nicotine dependence). In addition, those who remained abstinent provided relatively more data points for the analyses of the abstinent interval than those who lapsed. The experiences of abstainers may therefore have relatively more weight in the abstinence analyses. The potential problem of including both groups in the analyses of the abstinent interval was in part obviated by including lapse status as an individual level moderator of the within-person associations. Although lapse status did not moderate these associations, several moderation effects might differ between abstainers and lapsers. For example, the moderating effect of ‘days since quitting’ on situational associations appeared to be different in subsamples of abstainers and lapsers, but we cannot verify that these differences are meaningful. To verify this, one needs to perform multigroup testing of the interaction between
situational variables. Similarly, for the cross-level interactions, we lacked power to examine whether the cross-level interactions might differ according to lapse status.

Lastly, the present study is restricted by the cross-sectional nature of our data where both self-efficacy and its correlates were assessed simultaneously. This precludes strong causal inferences about the temporal order of self-efficacy and the affect-motivational states and external contexts. Although we expect the latter to precede self-efficacy, drops in self-efficacy, for example, may reflect a decision or intention to smoke (Sayette, 2006) which in turn might induce craving at the thought of being able to smoke again. These potential limitations notwithstanding, the present study is one of the first (see also Gwaltney et al., 2008, for a pilot study) to monitor heavily smoking adolescents several times a day during their quit attempt, and to examine the intertwinement of adolescents’ self-efficacy with other internal and external contexts.

Conclusion

The present study shows that adolescents’ daily self-efficacy to maintain abstinence after smoking cessation is associated with various affect-motivational states and external contexts. Although some of these within-person associations seem to differ between boys and girls after the first lapse has occurred, individual differences in baseline self-efficacy and age do not seem to affect the association between situational contexts and adolescents’ self-efficacy. Different mechanisms seem to operate at different phases of adolescents’ quit attempts, which confirms that various milestones deserve separate study among adolescents as well. All in all, the present findings testify to the complex and dynamic nature of the interplay between internal and external conditions and self-efficacy, and advocate a dynamic approach of the adolescent relapse process and its determinants.
Footnotes
1. Some authors distinguish the concept of ‘craving’ from the concept of ‘urges to smoke’ (Kozlowski & Wilkinson, 1987), while others regard these terms to refer to the same concept (Shiffman et al., 1997; Sayette et al., 2000). Throughout this paper, we will use both terms interchangeably.
2. Because craving and negative affect have been shown to peak on the quit day (Van Zundert et al., in press), we also tested whether results would be identical when associations were tested excluding the quit day. Results (not reported) were identical.
3. Because those who will eventually lapse may follow a different abstinence trajectory than those who will remain abstinent, we examined whether the within-person associations varied as a function of the individual level factor ‘lapse status’. Lapse status discriminated those who remained abstinent throughout the entire study period from those who experienced at least one lapse. We did not find an interaction effect with lapse status for any of the affect-motivational or external contexts. Lapse status did significantly moderate the association between ‘days since quitting’ and self-efficacy (B = -.15, SE = .03, T-ratio = -4.99, p = .000). More specifically, this association proved to be non-significant in a subgroup of those who would remain abstinent throughout the diary period (B = .01, SE = .01, T-ratio = 1.32, p = .195), but was significant (and negative) in a subgroup including only those who would eventually lapse (B = -.16, SE = .03, T-ratio = -5.57, p = .000). Thus, levels of momentary self-efficacy decreased for those approaching their first lapse, but remained stable for those who would remain abstinent.
4. The baseline questionnaire scale for self-efficacy was chosen because this scale has been developed for adolescents specifically, and to be able to calculate internal consistency (which is not possible with one “core-item” question). However, to test whether the nonsignificance of the association between baseline self-efficacy and situational self-efficacy during the abstinent interval was due to the use of this specific scale, we ran this analysis with another item that was included in the baseline questionnaire of which the wording strongly resembled the situational self-efficacy question: “At this moment, how confident do you feel that you will be able to achieve prolonged cessation?” (Anchors ranged from 1 ‘not confident at all’ to 5 ‘very confident’). Abstinent interval: B = .18, SE = .09, T-ratio = 2.08, p = .040. Lapsed interval: B = .20, SE = .11, T-ratio = 1.85, p = .069. The associations seem to be reversed when the one “core”-item is used: baseline questionnaire self-efficacy was not associated with situational self-efficacy in the abstinent interval when using the 12-item scale, whereas it was when using the one-item instrument. Similarly, the 12-item scale predicted situational self-
efficacy after the first lapse, whereas the one-item instrument self-efficacy was not significantly associated with situational self-efficacy after lapsing.

5. The order of the second and third author was decided by means of a five-round arm-wrestling match.
### Table 1. Pearson and Spearman Correlations between Independent Variables.

<table>
<thead>
<tr>
<th>Measures</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Craving</td>
<td>-</td>
<td>.42***</td>
<td>.21***</td>
<td>.24***</td>
<td>.09***</td>
<td>.06***</td>
</tr>
<tr>
<td>Negative affect</td>
<td>.42***</td>
<td>-</td>
<td>.36***</td>
<td>.06***</td>
<td>-.02</td>
<td>.06***</td>
</tr>
<tr>
<td>Stressful event</td>
<td>.22***</td>
<td>.35***</td>
<td>-</td>
<td>.02</td>
<td>.00</td>
<td>.01</td>
</tr>
<tr>
<td>Others smoking</td>
<td>.21***</td>
<td>.03</td>
<td>.02</td>
<td>-</td>
<td>.14***</td>
<td>-.02</td>
</tr>
<tr>
<td>Alcohol consumption</td>
<td>.08***</td>
<td>.05**</td>
<td>.06**</td>
<td>.12***</td>
<td>-</td>
<td>-.08***</td>
</tr>
<tr>
<td>Coffee consumption</td>
<td>.05**</td>
<td>.07***</td>
<td>.00</td>
<td>-.04*</td>
<td>-.06**</td>
<td>-</td>
</tr>
</tbody>
</table>

*Note.* *p* < 0.05, **p* < 0.01, ***p* < 0.001. Spearman correlations were calculated for all correlations involving the external context variables. The correlations between craving and negative affect involved Pearson correlations. Correlations below the diagonal pertain to the abstinent interval, correlations above the diagonal pertain to the lapsed interval.
Table 2. *Univariate and Multivariate Associations between Affect-Motivational States, External Contexts, and Self-Efficacy in the Abstinent Interval, N = 134.*

<table>
<thead>
<tr>
<th></th>
<th>Univariate associations</th>
<th>Multivariate associations</th>
<th>Interactions with days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>with self-efficacy</td>
<td>with self-efficacy</td>
<td>since quitting</td>
</tr>
<tr>
<td></td>
<td>B  SE  T  p</td>
<td>B  SE  T  p</td>
<td>B  SE  T  p</td>
</tr>
<tr>
<td>Affect-motivational states</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Craving</td>
<td>-.25*** .03 -8.48 .000</td>
<td>-.21*** .03 -6.96 .000</td>
<td>-.25*** .05 -5.40 .000</td>
</tr>
<tr>
<td>Negative Affect</td>
<td>-.26*** .04 -5.79 .000</td>
<td>-.05 .04 -1.20 .232</td>
<td>-.12** .05 -2.65 .009</td>
</tr>
<tr>
<td>External contexts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others smoking</td>
<td>-.15** .04 -3.66 .001</td>
<td>-.04 .04 -0.90 .372</td>
<td>-.01* .01 -2.25 .026</td>
</tr>
<tr>
<td>Stress</td>
<td>-.48*** .09 -5.50 .000</td>
<td>-.23** .08 -2.95 .004</td>
<td>-.12*** .02 -5.15 .000</td>
</tr>
<tr>
<td>Alcohol</td>
<td>-.30* .13 -2.22 .028</td>
<td>-.16 .12 -1.38 .169</td>
<td>-.02 .02 -1.37 .174</td>
</tr>
<tr>
<td>Coffee</td>
<td>-.11 .07 -1.46 .148</td>
<td>.06 .08 0.72 .471</td>
<td>.03* .01 2.40 .018</td>
</tr>
<tr>
<td>Days since quitting</td>
<td>-.05** .02 -3.28 .002</td>
<td>- - - - - -</td>
<td>- - - - - -</td>
</tr>
</tbody>
</table>

*Note. * p < 0.05, ** p < 0.01, *** p < 0.001. B = Linear Coefficient, T = T-ratio.*
Table 3. *Cross-level Interactions with Individual Level Moderators Baseline Self-Efficacy, Sex, and Age in the Abstinent Interval, N = 134.*

<table>
<thead>
<tr>
<th>Association with SE</th>
<th>Baseline self-efficacy</th>
<th>Sex</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>T</td>
</tr>
<tr>
<td>Affect-motivational states</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Craving</td>
<td>.00</td>
<td>.06</td>
<td>-0.09</td>
</tr>
<tr>
<td>Negative Affect</td>
<td>.10</td>
<td>.09</td>
<td>1.18</td>
</tr>
<tr>
<td>External contexts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others smoking</td>
<td>-.05</td>
<td>.07</td>
<td>-0.73</td>
</tr>
<tr>
<td>Stress</td>
<td>.24</td>
<td>.14</td>
<td>1.67</td>
</tr>
<tr>
<td>Alcohol consumption</td>
<td>.18</td>
<td>.23</td>
<td>0.78</td>
</tr>
<tr>
<td>Coffee consumption</td>
<td>.18*</td>
<td>.09</td>
<td>2.11</td>
</tr>
</tbody>
</table>

*Note.* *p* < .05. B = Linear Coefficient, T = T-ratio.
Table 4. Univariate and Multivariate Associations between Affect-Motivational States, External Contexts and Self-Efficacy (SE), and Interactions with Days Since Quitting and Concomitant Smoking in the Lapsed Interval, N = 94.

<table>
<thead>
<tr>
<th></th>
<th>Univariate associations</th>
<th>Multivariate associations</th>
<th>Interactions with days since quitting</th>
<th>Interactions with concomitant smoking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>T</td>
<td>p</td>
</tr>
<tr>
<td>Affect-motivational states</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Craving</td>
<td>-.37***</td>
<td>.04</td>
<td>-9.71</td>
<td>.000</td>
</tr>
<tr>
<td>Negative Affect</td>
<td>-.34***</td>
<td>.06</td>
<td>-5.27</td>
<td>.000</td>
</tr>
<tr>
<td>External contexts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others smoking</td>
<td>-.39***</td>
<td>.06</td>
<td>-6.34</td>
<td>.000</td>
</tr>
<tr>
<td>Stress</td>
<td>-.50***</td>
<td>.11</td>
<td>-4.52</td>
<td>.000</td>
</tr>
<tr>
<td>Alcohol</td>
<td>-.52***</td>
<td>.13</td>
<td>-4.12</td>
<td>.000</td>
</tr>
<tr>
<td>Coffee</td>
<td>-.01</td>
<td>.10</td>
<td>-0.02</td>
<td>.985</td>
</tr>
<tr>
<td>Days since quitting</td>
<td>.02</td>
<td>.01</td>
<td>1.75</td>
<td>.082</td>
</tr>
<tr>
<td>Concomitant smoking</td>
<td>-.172</td>
<td>.14</td>
<td>-12.66</td>
<td>.000</td>
</tr>
</tbody>
</table>

Note. * p < 0.05, ** p < 0.01, *** p < 0.001. B = Linear Coefficient, T = T-ratio.
Figure 1. Interaction plots of the associations between self-efficacy and craving, negative affect, others smoking, coffee consumption, and stressful event, as moderated by ‘days since quitting’ (DSQ).

a) Craving (CR)

![Graph showing interaction between self-efficacy and craving, with lines indicating low and high DSQ categories.]

b) Negative Affect (NA)

![Graph showing interaction between self-efficacy and negative affect, with lines indicating low and high DSQ categories.]

c) Others smoking (OS)

![Graph showing the relationship between DSQ low and high with self-efficacy levels for OS no and OS yes.]

*d) Stressful event (STRESS)*

![Graph showing the relationship between DSQ low and high with self-efficacy levels for STRESS no and STRESS yes.]

e) Coffee consumption (COF)

Figure 2. Interaction between smoking in the past 30 minutes and days since abstinence in relation to self-efficacy.
References


Van Zundert, R. M. P., Kuntsche, E., & Engels, R. C. M. E. In the heat of the moment: Alcohol consumption during the process of smoking cessation is strongly related to the first lapse into smoking among adolescents. (Submitted).


Chapter 9

Nicotine withdrawal symptoms following a quit attempt: An ecological momentary assessment study among adolescents
Abstract

Objective. The present study describes growth curves of withdrawal symptoms among 138 daily smoking adolescents before, during, and after a quit attempt. Methods. Participants reported their levels of withdrawal symptoms (craving, negative affect, and hunger) three times a day over a period of 28 days: 1 week prior to and 3 weeks following a quit attempt. Results. Findings indicate that all withdrawal symptoms were quite stable at a relatively low level during the five days prior to the quit day. At day 8, withdrawal symptoms (especially craving) increased substantially. A significant decrease in symptoms was visible during the week following the quit day, and within 2 weeks post-quit, both abstinent and relapsed adolescents had reverted to levels comparable to those during the pre-quit period. The course over time for craving and hunger were best described by a quadratic term, and a linear model best suited negative affect. Individual intercepts and slopes of the growth curves were used to predict abstinence during the last week of the study and at the 2-month follow-up. Analyses revealed that higher levels of craving on both the beginning of the pre-quit week and on the target quit day (intercepts) decreased the odds of being abstinent during the last week of the study. In addition, the quadratic term for hunger predicted abstinence during the last week. Finally, among all three symptoms, none of the growth model characteristics predicted abstinence at follow-up. Conclusions. The findings generally suggest that smoking cessation among daily smoking adolescents does not largely depend on how their withdrawal symptoms evolve over time after achieving abstinence.
Introduction

Despite that prior research on smoking has mainly focused on initiation and escalation of use, more recent research has been devoted to the area of adolescent smoking cessation. It has become evident that teenagers experience great difficulties when attempting to refrain from smoking, and approximately 90%-95% of adolescents who make an unaided attempt to quit smoking will relapse (Mermelstein, 2003; Sussman, 2002). Participating in adolescent cessation programs does not seem to guarantee more success either (Garrison, Christakis, Ebel, Wiehe, & Rivara, 2003; Leatherdale, 2006), and more insight into the natural history of adolescent quit attempts is crucial to tailor psychosocial or pharmacological treatments to this particular group (Mermelstein, 2003).

Studies among adults have demonstrated that withdrawal symptoms can predict failure to quit smoking (McCarthy et al., 2006; Piasecki, Fiore, & Baker, 1998). Withdrawal symptoms refer to a set of physical and mental discomforts that emerge when individuals abstain from smoking, such as cigarette craving, irritability, restlessness, insomnia, anxiety, depression, increased appetite and poor concentration (see Hughes, 2007 for a review). Withdrawal symptoms typically increase strongly during the first week of deprivation after which they gradually revert to an equal or even lower level than apparent at baseline (Hughes, 1992; Jorenby et al., 1996; Piasecki et al., 1998; for an exception see Shiffman et al., 1997), and individual characteristics of withdrawal symptoms’ course over time can predict cessation outcomes in adults (McCarthy et al., 2006). Although we know that adolescents experience withdrawal symptoms during smoking deprivation as well and that they report similar symptoms (Prokhorov, Hudmon, Cinciripini, & Marani, 2005; Smith, Cavallo, McFetridge, Liss, & Krishnan-Sarin, 2008), few studies have modeled the natural history of withdrawal in adolescents following a quit attempt and related the course of withdrawal over time to relapse outcomes.

There are, however, several reasons why we cannot assume that the course of withdrawal symptoms over time nor its association with cessation outcomes as observed among adults are by definition identical for adolescents. Firstly, adolescence is a developmental phase in which impulsivity, novelty seeking, and suboptimal decision making are considered to be normative traits (Chambers, Taylor & Potenza, 2003), and in which individuals are still in the process of maturing and developing self-reflective and introspective skills (Beyth-Marom, Fischhoff, Jacobs-Quadrel, & Furby, 1991; Steinberg & Cauffman, 1996). In addition, both hormonal processes and social, cognitive and environmental influences that are uniquely associated with adolescence contribute to adolescents’ moods.
being different from those of young children and adults (Buchanan, Eccles & Becker, 1992). Adolescents may therefore experience more variable and more intense moods, more variable energy levels, more restlessness, and more anxiety than individuals at other stages of development.

Given the abovementioned characteristics, it has been postulated that the fact that adolescents display similar withdrawal symptoms as adults might be attributed to the phase of adolescence itself rather than to cessation (Prokhorov et al., 2005). Though the study by Prokhorov and colleagues (2005) suggests that this is true to some extent (since individual withdrawal symptoms did not effectively differentiate between never-smokers and former light smokers), symptoms for former smokers were reported retrospectively and duration of time since cessation was not taken into account. However, the psychophysiological characteristics and states that typify adolescence might affect withdrawal in yet other ways. Negative affect among adults, for example, seems to diminish over time to levels lower than reported prior to quitting among successful quitters, and to persist at equal or even higher levels among those who fail. Moreover, there is a fairly robust within-subject association between negative affect and smoking lapses after a period of abstinence among adults (Kassel, Stroud, & Paronis, 2003). Since adolescence is characterized by increased and more variable levels of negative affect, it is possible that cessation does not instigate substantial increases in negative affect, or that if it does, it might not necessarily provoke relapse among adolescents as they may be more used (and thus more tolerant) to mood changes. This hypothesis is partly supported by preliminary findings from Smith and colleagues (2008), who assessed withdrawal symptoms weekly for four weeks among adolescent smokers participating in a pilot cessation intervention. They did not find symptoms of depressed mood, irritability, difficulty concentrating, appetite, sleep problems, and anxiety on the quit day to significantly differ from the baseline assessments. Craving and restlessness, however, significantly increased after cessation. In addition, none of the symptoms predicted the likelihood of lapse during the treatment, although this finding may have been the result of small sample size. Nonetheless, it seems that there are clear indications why the course of tobacco withdrawal symptoms over time and its association with cessation outcomes might differ between adolescents and adults.

In the present study, data were collected using Ecological Momentary Assessment (EMA), which uses intensive repeated sampling to gather data on momentary states of individuals in real-time and real-world contexts (Shiffman, Stone, & Hufford, 2008). Participants reported on their withdrawal symptoms and smoking behavior three times a day.
during four weeks: One week prior to the quit attempt, and three weeks after the quit attempt. Using daily measures of withdrawal has two major advantages over retrospective ratings (especially those with large time intervals between the targeted experience and time of reporting), namely in that it reduces the susceptibility of reports to recall bias and that sufficient data are provided to be able to assess within-person developmental processes (Shiffman et al., 2008).

This study’s primary aim was to describe the elevation and shape of the withdrawal symptoms craving, negative affect and hunger during the periods preceding and following a target quit date in a large sample of 138 adolescent daily smokers. We also tested whether individual growth curve estimates differed as a function of post-quit smoking and sex, and whether individual estimates predicted abstinence during the last week of the monitoring period and at the 2-month follow-up. Age, sex and baseline nicotine dependence were entered into the equations as covariates.

Method

Participants

A number of 272 Dutch daily smoking adolescents contacted the research team in response to the advertisements and articles about our study that were published and displayed in newspapers, on websites, and in community centers. Upon contacting the researchers, interested candidates were sent a detailed description of the study. After reading the detailed information, 189 of the 272 candidates still wanted to participate, and were assessed for eligibility through a telephone screening. To qualify, candidates had to be between 15 and 19 years of age, smoke at least one cigarette per day, be highly motivated to quit, and, not be currently enrolled in a cessation program. Participants aged 15 had to have been smoking daily for at least one year to be eligible (this criterion did not apply for those between 16 and 19). Four candidates were not accepted because they had already quit smoking, and nine candidates withdrew before entering the study, leaving a number of 176 adolescents who were officially enrolled. Of those 176 persons, 19 stopped completing assessments before or right after the quit day, and 16 dropped out during the first post-quit week. For these patterns of missing data we concluded that they were not at random and therefore should be excluded from our analyses. Three additional subjects were excluded because they achieved 24 hr abstinence for the first time a week after the target quit day, which is problematic for the present analyses since actual quit day was set to the target quit day. The final sample thus consisted of 138 subjects. In the logistic regression analysis, 12 subjects could not be included because they had failed to successfully return the baseline questionnaire and for 4 subjects
smoking during the last week could not be verified. Half of the 38 subjects who were excluded from the original sample of 176 individuals did not return their baseline questionnaire and thus are not included in the following attrition analysis. \( T \)-tests indicated that those excluded were marginally more nicotine dependent (\( t (136) = 2.04, p = .053 \)), and reported a higher average of number of cigarettes smoked per day at baseline (\( t (136) = 2.04, p = .015 \)) compared to those who were retained in the analyses. Excluded subjects did not seem to differ according to age, sex, and whether they quit in the past 12 months (yes or no) from those included.

The final sample (\( n = 138 \)) consisted of 49 male (35.5%) and 89 female (64.5%) adolescents, who were receiving or had recently received regular education; 5.7% received lower vocational education, 39.7% received intermediate vocational education, 13.5% received high school education, 12.8% received pre-university education and 16.3% was in college (12.1% unknown due to missing baseline questionnaire). Ages were distributed as follows: 15 (2.2%), 16 (32.4%), 17 (30.1%), 18 (15.4%), 19 (18.4%), and two persons had just turned 20 (1.5%) (\( M = 17.2, SD = 1.2 \)). The average age of onset of daily smoking was 14.3 years (\( SD = 1.5 \)), and the average length of time during which adolescents smoked daily was 2.9 years (\( SD = 1.6 \)). Regarding prior quit attempts in the past 12 months, 14.5% had not tried to quit or cut down their smoking; 31.9% had tried to quit smoking, but not to cut down; 15.9% had tried to cut down their smoking, but not to quit; and 29.0% had made attempts to cut down and quit smoking (8.7% unknown). Among those who reported to have made a quit attempt, the average number of prior quit attempts in the past 12 months was 1.9 (\( SD = 1.2 \)).

Most participants smoked between 11 and 20 cigarettes per day.

**Procedure and Design**

All 176 participants from the original sample were sent a baseline questionnaire, which was generally completed 1 week prior to the onset of the monitoring period. If needed, participants also received a letter for their schools which requested the school board's cooperation. For each individual, the period of monitoring always started on the first Monday following the telephone screening. Participants were monitored for four weeks: One week prior to the target quit day during which they were instructed to smoke ad-lib, and three weeks after the target quit day. For all participants, the assigned target quit day was the eighth day of the study. During their monitoring period, participants were asked to fill out an internet-based survey (on any desktop or laptop computer available) three times per day during the following intervals: In the morning (to be completed between 10am and noon), the afternoon (3pm – 5pm), and evening (8pm – 10pm). Participants were not required to specify
their location when they completed the assessments. The survey always contained the same questions and took about three minutes to complete. Printed paper diaries with identical questions were provided in case participants were unable to access the internet, and were to be submitted online as soon as participants had access to internet again. Participants who failed to complete a questionnaire within the designated sampling window were sent a text message to remind them. Participants were not required to initiate reports of smoking or experience withdrawal symptoms outside the fixed intervals (event-contingent recording). Participants received the first instructions on the study during the telephone screening interview and instructions on the use of the internet-based survey through email. Participants were phoned by the research team twice during the course of the study to check how they were doing and to maintain compliance. Two months after the end of the monitoring period participants completed an online follow-up survey. Participants received a remuneration of 40 Euros for completion of the baseline questionnaire and the four weeks of monitoring, and an additional 10 Euros upon completion of the follow-up.

Measures

**Withdrawal symptoms.** Ten items of the Wisconsin Smoking Withdrawal Scale (WSWS) were used to determine adolescents’ daily levels of the withdrawal symptoms craving, negative affect, and hunger (Welsch, et al., 1999). The subscales ‘negative affect’ and ‘hunger’ of the Wisconsin Smoking Withdrawal Scale (Welsch et al., 1999) include items that cover all symptoms of the smoking withdrawal syndrome as listed in the DSM-IV, except for insomnia. Although ‘craving’ is not part of the DSM-IV criteria, it is considered to be an essential component of the abstinence withdrawal syndrome (e.g., Hughes, Higgins et al., 1994), and was therefore included in the daily assessments as well. The WSWS has been found to show good construct validity with high reliabilities for the three symptoms (West, Ussher, Evans, & Rashid, 2006), and the shortened version of ten items has been successfully applied in prior EMA research on smoking relapse (McCarthy et al., 2006). Two WSWS-items were used to measure craving, six items to measure negative affect, and two items to measure hunger at each daily assessment. The ten items could be answered on a Likert-scale ranging from 1 ‘strongly disagree’ to 5 ‘strongly agree.’ A high score on the items thus represented high levels of withdrawal symptoms.

Prior to performing the analyses, we examined the factorial validity and internal validity of the three subscales of the WSWS. For each assessment (28 days x 3 times a day = 84) we conducted a confirmatory factor analysis. The results indicate that the WSWS had a firm factorial validity with high principal loadings (the mean values varied between .74 and
To determine the internal consistency of the withdrawal scales across all assessments, we computed alphas for each assessment and averaged these. This resulted in an average alpha of .88 (SD = .04) for craving, .75 (SD = .04) for negative affect, and .66 (SD = .09) for hunger. All three factors were intercorrelated: craving and negative affect: $r = .54$; craving and hunger: $r = .42$, and negative affect and hunger: $r = .31$.

**Nicotine dependence.** Nicotine dependence at baseline was assessed using a multidimensional measure of nicotine dependence for adolescents, which has good psychometric properties (Kleinjan, Van Den Eijnden, Van Leeuwe, Otten, Brug, & Engels, 2007). This composition was derived from the modified Fagerström Tolerance Questionnaire (mFTQ) (Fagerström, & Schneider, 1989), and Hooked on Nicotine Checklist (HONC) (DiFranza, Rigotti, McNeill, Ockene, Savageau, St Cyr, & Coleman, 2000). The total 11 items of the three subscales include aspects of emotional and physical symptoms of dependence (irritation, anger, restlessness, etc., when abstaining or smoking less), and behavioural symptoms of nicotine dependence (e.g., intensity of smoking). The scale was composed with the standardized values (range: 1-4), since answering categories were not all the same for each item. Cronbach’s alpha was .79. The average level of baseline nicotine dependence was 2.6 (SD = .48).

**Outcome variables**

For the present analyses, we examined abstinence during the last week of the study, and at the 2-month follow-up. A dummy coded variable was constructed with ‘0’ indicating that smoking occurred during the last seven days of the monitoring period (even if only one cigarette), and ‘1’ represented abstinence. Similarly, at follow-up, participants were asked whether they were currently abstinent or not, with response choices being: 1 ‘I have reverted to smoking as much as when I started the study’, 2 ‘I have cut back on smoking (compared to when I started the study), and 3 ‘I have quit smoking entirely’. Response choices 1 and 2 were grouped and given the score ‘0’ which indicated that they had reverted to smoking, and 3 was recoded to ‘1’, representing abstinence.

**Strategy of analysis**

We used piecewise Linear Growth Curve Modeling (LGCM) in MPLUS (Muthén & Muthén, 1998-2006) to specify growth models of craving, negative affect and hunger, containing an intercept as well as linear and/or quadratic terms during both pre-quit (day 3 until day 7. The first two days of the week prior to the quit attempt (day 1 and 2) were omitted
from the growth curves as the withdrawal scores on those two days were much higher relative to the other pre-cessation days. This is a common issue in EMA studies since participants need to complete the questions a number of times before their responses are valid.) and post-quit (day 8 until day 21) periods. Since the last week (days 22 until 28) was used to determine one of the study outcomes (smoking during last week), the growth curves did not include this particular week. For those who did not achieve 24 hr abstinence on the target quit day, the actual quit day was set to day 8. The three daily assessments were aggregated into daily averages. Because the distributions of the symptoms were somewhat skewed and leptokurtic and assuming random missing values, we used the robust Full Information Maximum Likelihood estimator. In addition, a large proportion of the sample reported smoking after achieving abstinence (68.8% in the first week after the target quit day, and 40.6% in the second week after the target quit day), which is likely to affect the growth curves. If we would compose different groups on the basis of their smoking after achieving 24 hr abstinence, the groups would be too small to perform LGCM, and statistical power would be jeopardized. To obtain some indication of how growth curves might differ as a function of post-abstinence smoking, we performed t-tests to compare the growth parameters of the post-quit growth curve between the following 2 groups: 1) those who did not smoke on any day during the second study week (which was the first week after cessation), and 2) those who smoked on at least one day during that week. We performed similar t-tests for groups that were distinguished on the basis of their smoking in the third week of the study. Differences between boys and girls in pre-quit and post-quit estimated means were tested as well. Next, logistic regression analyses were conducted to test whether individual estimates of symptom trajectories (pre-quit and post-quit intercepts, slopes, and quadratic terms) predicted abstinence during the last week of the monitoring period and abstinence at follow-up. Since slopes and quadratic terms automatically have very low standard deviations, odd’s ratios obtained in the logistic regression analyses are likely to be excessively large. We avoided this problem by using standardized values of the growth curve estimates in the logistic regression analyses. Lastly, age, sex, and nicotine dependence were included as covariates for both outcomes.

Results

Although participants were instructed to smoke ad-lib during the first week of monitoring, eight participants (5.8%) quit smoking before the target quit day. The majority of the participants reached 24 hr abstinence on the target quit day (73.2%), and 14.5% on the
next day. The remaining participants (4.3%) reached 24 hr abstinence between days 10 and 12.

Latent Growth Curve Analysis

We first examined whether a linear or quadratic trend best fitted the data. All pre-quit intercepts significantly deviated from zero (Table 1), but the pre-quit slopes were not significant as can also be seen in Figure 1 which depicts the best fitting growth curves.

For post-quit craving and hunger, a quadratic model described the data best, with intercepts that significantly deviated from zero, and with significant negative slopes and positive quadratic terms. For the course of post-quit negative affect a linear function was most suitable, with a significant intercept and significantly declining slope. The model fit indices evidenced of good to excellent fit of the models (Table 1).

Translated to more descriptive terms, we can say that pre-quit withdrawal levels were highly stable and that on day 8, withdrawal symptoms (especially craving) increased substantially. A strong decrease in symptoms was visible during the week following the quit day. During the two weeks after the target quit day, negative affect and hunger decreased monotonically to a level comparable to the beginning of day 8, and craving showed a steeper decrease. As can be seen from Figure 1, the three symptoms followed the same overall pattern, although craving was most salient in its elevation on the quit day and its curvature.

We also tested whether the growth curve parameters differed as a function of post-abstinence smoking and sex (only the significant results are reported). Pre-quit intercepts of craving were significantly higher among those who had smoked during the third study week compared to those who were abstinent that entire week ($t (120) = -2.23, p = .027$). In addition, those who had smoked during the third study week displayed marginally stronger negative slopes for hunger ($t (120) = 1.91, p = .058$), and stronger quadratic estimates for hunger ($t (120) = -1.98, p = .050$). As for differences between sexes, girls had on average a marginally higher post-quit intercept of negative affect ($t (120) = -1.86, p = .066$).

Predicting Abstinence

Abstinence during the last study week as verified for the subsample of 122 subjects was observed for 51.6%. At follow-up, 32.5% reported to be currently abstinent. Age, sex and nicotine dependence were not significantly related to abstinence during the last week nor with abstinence at follow-up (Table 2).

Of all individual growth curve parameters, only the pre-quit and post-quit intercepts of craving, and the post-quit slope and quadratic term of hunger predicted abstinence during the last study week. Higher intercepts of pre-quit craving – or put differently considering that the
pre-quit slope of craving was not significant – a higher general craving level across all pre-quit days decreased the odds for abstinence during the last week. For hunger, a lower slope and higher quadratic term predicted failure of abstinence during the last week. This means that those who reverted to their pre-quit levels of hunger fastest were less likely to be abstinent later on. We found no effects of growth curves estimates on abstinence at the 2-month follow-up.

**Discussion**

The main objective of this study was to describe within-person variability in withdrawal symptoms and its association with smoking cessation in a sample of daily smoking adolescents who embarked on a serious quit attempt. The key findings indicate that all withdrawal symptoms (craving, negative affect, and hunger) increased on the designated quit day. The course over time for craving and hunger were best described by a quadratic term, and a linear model best suited negative affect. Within 2 weeks post-quit, both abstinent and relapsed adolescents had reverted to levels comparable to those during the pre-quit period. Higher levels of craving during the pre-quit week and on the target quit day (intercepts) decreased the odds of being abstinent during the last week of the study. The pre-quit and post-quit slopes of craving did not predict abstinence during the last week. Growth parameters of negative affect were not associated with chances of being abstinent either. For hunger it appeared that those who reverted to their pre-quit levels of hunger fastest were less likely to be abstinent during the last study week. Finally, among all three symptoms, none of the growth model characteristics predicted abstinence at the 2-month follow-up.

The elevation of all three withdrawal symptoms on the designated quit day is in line with prior findings among adults (Hughes, 1992; Jorenby et al., 1996; McCarthy et al., 2006; Piasecki et al., 1998; for an exception see Shiffman et al., 1997), and preliminary results among adolescents (Smith et al., 2008). Craving appeared to be the most salient symptom in its elevation and curvature, which is in accordance with the study on adolescents by Smith and colleagues (2008). It is also in line with craving being consistently reported by adolescents as the most salient and severe symptom in general (Colby, Tiffany, Shiffman, & Niaura, 2000).

Comparing the current growth curve of craving with the one among adults as reported by McCarthy and colleagues (2006) (who used an identical craving scale) shows that both adult and adolescent craving levels remained quite stable during the pre-quit period, but that adolescents seemed to revert to their baseline craving levels more quickly. It seems plausible that those who reverted to smoking after achieving abstinence experienced relief of craving,
which may account for the relatively quick overall decline. However, given that the post-quit slopes did not differ between those who reported post-quit smoking and those who did, it seems that adolescents who successfully quit were not bothered by elevated craving for long either. This may explain why the rate of decline did not predict abstinence.

It is interesting that both pre-quit and post-quit intercepts of craving had a significant effect on abstinence during the last study week whereas the shape of the course over time did not. Thus, for the withdrawal symptom craving, this seems to suggest that how adolescents enter the quitting process is more important than the process itself. This explanation is somewhat contradicted by our findings that baseline nicotine dependence did not predict abstinence. It is possible that an elevation in symptoms had already taken place in the one week between the time of completing the baseline questionnaire and the start of the monitoring period. Since the pre-quit period was very short (7 days, of which only 5 were included in the growth curves), the present effects of craving intercepts might reflect anticipatory mechanisms (cf. McCarthy et al., 2008). Taking this one step further, this may indicate that it may be less crucial to target craving once 24 hr abstinence is achieved, but that it is rather essential to decrease craving levels before the attempt is started. Although nicotine replacement therapy (NRT) has been found to reduce levels of craving among adults (Hughes, Shiffman, Callas & Zhang, 2003), prior studies have found little support for the efficacy of NRT among adolescents (Hanson, Allen, Jensen, & Hatsukami, 2003; Killen et al., 2004; Moolchan et al., 2005). More research is needed to examine how NRT could be improved and to explore alternative treatments to decrease pre-quit craving among adolescents.

The peak in negative affect on the target quit day was less pronounced than that of craving, and the pre-quit and post-quit intercepts and slopes of negative affect did not predict treatment outcomes. The observation that levels of both pre-quit and post-quit negative affect were relatively low and showed only a modest elevation is conform prior findings among adolescents (Smith et al., 2008). However, the post-quit part of the growth curve for negative affect did show discrepancies with that among adults (McCarthy et al., 2006). Whereas adults’ levels of negative affect remained stable across the three weeks after cessation (the slope coefficient was positive but not significant), the post-quit slope among adolescents was significant and negative. Thus, as with craving, adolescents seem to revert to their baseline levels of negative affect more quickly than adults. Apparently, trying to quit does not instigate intense negative affect among adolescents, and the elevation and pace of the subsequent decrease in symptoms do not seem to provoke relapse either. This may be the result of adolescents in general being subject to more variable and intense moods and more anxiety.
than young children and adults (Buchanan et al., 1992). Alternatively, despite that moods may be more variable and intense during adolescence, those predisposed to depressive feelings may be more sensitive to mood changes and it is conceivable that changes in negative affect are more closely linked to abstinence among adolescents vulnerable to depressive mood.

Regarding hunger, we found that pre-quit levels of hunger were low and stable, and resembled pre-quit levels of hunger among adults (McCarthy et al., 2006). Despite that adults and adolescents seem to experience a similar modest increase in hunger during the quit day, the post-quit course over time appears to be different. Whereas the post-quit slope among adults showed a marginally significant linear increase over time, the trend among adolescents was significantly declining and quadratic. However, this difference in results might be explained by post-quit smoking, since those who had been smoking during the third study week displayed stronger quadratic terms for hunger. In other words, those who had reverted to smoking experienced faster declines in feelings of hunger. The latter also provides an explanation for why the quadratic term of hunger predicted abstinence during the last week, since those who smoked during the third week were more likely to be smoking during the fourth week as well.

Despite that previous findings by Smith and colleagues (2008) indicated that the course of withdrawal over time among adolescents who achieved abstinence differed for boys and girls, we found little evidence for this. One exception was that girls had marginally higher post-quit intercepts of negative affect than boys, which is plausible considering that the literature provides consistent indications that females are more vulnerable to depressive symptoms (Piccinelli & Wilkinson, 2000), and this also applies to Dutch adolescents (Engels, Finkenauer, Meeus, & Dekovic, 2001). Nonetheless, girls did not seem to be at additional risk since the intercepts of negative effect were not associated with cessation outcomes, and sex as independent covariate did not predict abstinence either.

In sum, the findings generally suggest that the answer to how adolescents manage to successfully quit smoking does not largely depend on how their withdrawal symptoms evolve over time after achieving abstinence. We should be cautious, however, in declaring withdrawal symptoms as less important to the adolescent cessation process, since, firstly, the present findings do not elucidate whether day-to-day variations in withdrawal might predict lapse or relapse the next day (as has been demonstrated for at least craving among adults; Shiffman, Paty, Gwaltney, & Dang, 2004). Up to now, almost no research has been devoted to examining the dynamic effects of withdrawal symptoms among smoking adolescents who are in the midst of a quit attempt (except for an exploratory study among 13 adolescents by
Secondly, in interpreting the present results, we must recognize several limitations of the study. For instance, there is a chance that participants who were categorized as ‘abstinent’ during the last week of the monitoring period had smoked on assessments that were not recorded. The likelihood that this occurred is restricted since compliance was high and only 7.1% of post-quit assessments (not days) were not completed, but it remains a possibility.

Furthermore, not all participants managed to achieve 24 hr abstinence on the designated quit day. Despite that each person’s actual quit day was set to day 8 and that the post-quit growth models thus started with the actual quit day for each person, it is possible that those who did not manage to quit until after the target quit day differed in initial levels of withdrawal from the ones who succeeded. This may be the case as those who quit later had more days between the target quit day and their actual quit day during which smoking continued, which is likely to influence the course of withdrawal.

We must also take into account a possible reactivity effect associated with the intensive self-monitoring that is a core component of EMA research designs. Intensive self-monitoring has been argued to reduce the problem behavior that is being targeted to be changed (Shiffman et al., 2008). This may particularly be the case when people want to change their behavior and are able to exert control over it, which is the case for smoking cessation. Although the concern that EMA produces significant reactivity can be abated by studies that have found little support for this (Shiffman et al., 2008), it remains possible that the intensive self-monitoring has influenced the way adolescents dealt with withdrawal symptoms, and that it has contributed to the rates of abstinence success as found in the present study. We must especially keep this in mind since abstinence rates were remarkably high (51.6% during the last study week, and 32.5% at the 2-month follow-up) compared to other studies among adolescents (O’Connell et al., 2004; Sussman, 2002). Alternatively, high abstinence rates as found in the present study may also have been caused by the effect of attrition. Those who dropped out and/or were excluded from the present analyses had significantly higher levels of baseline daily smoking and were more dependent on nicotine. Although higher levels of nicotine dependence did not affect cessation outcomes, it is often assumed that those who drop out of studies in which smoking abstinence needs to be achieved can be considered unsuccessful quitters (e.g., Smith et al., 2008). The present results may therefore be somewhat restricted in generalizability to all daily smoking adolescents. These limitations notwithstanding, the present study has revealed new insights into the natural
history of the course of withdrawal symptoms over time and its association with cessation outcomes with adolescents.
Tables and figures

Table 1. *Intercepts, slopes and model fit indices of craving, negative affect, and hunger*  
(*N=138*)

<table>
<thead>
<tr>
<th></th>
<th>b</th>
<th>SE</th>
<th>z</th>
<th>p</th>
<th>$\chi^2$(295)</th>
<th>CFI</th>
<th>RMSEA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Craving – Pre-quit</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>2.319</td>
<td>.083</td>
<td>27.95</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slope</td>
<td>.011</td>
<td>.023</td>
<td>0.46</td>
<td>.649</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Craving – Post-quit</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>3.053</td>
<td>.098</td>
<td>31.13</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slope</td>
<td>-.140</td>
<td>.021</td>
<td>-6.57</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quadratic term</td>
<td>.007</td>
<td>.002</td>
<td>4.58</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Negative affect – Pre-quit</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>1.412</td>
<td>.044</td>
<td>31.92</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slope</td>
<td>.018</td>
<td>.014</td>
<td>1.34</td>
<td>.179</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Negative affect – Post-quit</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>1.662</td>
<td>.055</td>
<td>30.17</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slope</td>
<td>-.014</td>
<td>.004</td>
<td>-3.80</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hunger – Pre-quit</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>1.737</td>
<td>.060</td>
<td>29.17</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slope</td>
<td>.017</td>
<td>.016</td>
<td>1.04</td>
<td>.297</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hunger – Post-quit</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>2.179</td>
<td>.086</td>
<td>25.32</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slope</td>
<td>-.057</td>
<td>.017</td>
<td>-3.32</td>
<td>.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quadratic term</td>
<td>.003</td>
<td>.001</td>
<td>2.32</td>
<td>.020</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2. Cessation outcomes as predicted by individual characteristics and individual estimates of the growth curve analyses (N=122).

<table>
<thead>
<tr>
<th></th>
<th>Smoking during last week</th>
<th>Smoking status at follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=122</td>
<td>N=126</td>
</tr>
<tr>
<td></td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
</tr>
<tr>
<td>Age</td>
<td>1.34 .97 – 1.85</td>
<td>.86 .61 – 1.21</td>
</tr>
<tr>
<td>Sex</td>
<td>1.35 .63 – 2.91</td>
<td>1.61 .69 – 3.78</td>
</tr>
<tr>
<td>Nicotine dependence</td>
<td>.72 .33 – 1.59</td>
<td>1.04 .45 – 2.43</td>
</tr>
<tr>
<td>Craving – Pre-quit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>.63* .42 – .94</td>
<td>.91 .59 – 1.40</td>
</tr>
<tr>
<td>Slope</td>
<td>.90 .60 – 1.33</td>
<td>1.11 .74 – 1.67</td>
</tr>
<tr>
<td>Craving – Post-quit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>.59* .38 – .91</td>
<td>.69 .42 – 1.12</td>
</tr>
<tr>
<td>Slope</td>
<td>.90 .60 – 1.35</td>
<td>.66 .42 – 1.05</td>
</tr>
<tr>
<td>Quadratic term</td>
<td>.98 .67 – 1.44</td>
<td>1.27 .83 – 1.94</td>
</tr>
<tr>
<td>Negative affect – Pre-quit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>.93 .62 – 1.40</td>
<td>.85 .54 – 1.35</td>
</tr>
<tr>
<td>Slope</td>
<td>.76 .50 – 1.14</td>
<td>1.22 .81 – 1.84</td>
</tr>
<tr>
<td>Negative affect – Post-quit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>.76 .45 – 1.25</td>
<td>.64 .34 – 1.18</td>
</tr>
<tr>
<td>Slope</td>
<td>.90 .57 – 1.41</td>
<td>.60 .34 – 1.08</td>
</tr>
<tr>
<td>Hunger – Pre-quit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>.82 .57 – 1.20</td>
<td>1.19 .80 – 1.76</td>
</tr>
<tr>
<td>Slope</td>
<td>.99 .68 – 1.45</td>
<td>1.43 .93 – 2.21</td>
</tr>
<tr>
<td>Hunger – Post-quit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>1.07 .69 – 1.66</td>
<td>1.13 .72 – 1.79</td>
</tr>
<tr>
<td>Slope</td>
<td>1.68* 1.03 – 2.72</td>
<td>1.12 .73 – 1.73</td>
</tr>
<tr>
<td>Quadratic term</td>
<td>.63* .41 – .97</td>
<td>.90 .60 – 1.36</td>
</tr>
</tbody>
</table>

Note. * p < .05, ** p < .01. The estimates for the effects of intercepts, slopes and quadratic terms are from the multivariate analyses in which age, sex and nicotine dependence were included as covariates. Pre-quit and post-quit predictors were not included in the analyses simultaneously.
Figure 1. *Estimated growth curves of craving, hunger and negative affect.*
References


Chapter 10

Dynamic effects of withdrawal symptoms on adolescent smoking cessation
Abstract

The present study examined dynamic effects of daily variations in craving and negative affect on the first lapse and relapse the next day, among 149 adolescent daily smokers who achieved at least 24 hr abstinence. Participants completed real-time assessments of their smoking, craving, and negative affect three times per day during the three weeks following their quit attempt. The main findings show that daily variations in craving predict the first lapse as well as relapse into smoking the next day, above and beyond baseline levels of craving and nicotine dependence, and concurrent smoking after quitting. Day-to-day variations in negative affect did neither predict time to the first lapse nor to relapse. Individual differences in baseline craving, nicotine dependence, and depressive symptoms did not predict the first lapse or relapse either, although using a more stringent definition of relapse revealed that higher levels of baseline craving and nicotine dependence did predict ‘heavy’ relapse. The findings challenge the significance of adolescents’ negative affect during cessation, and emphasize the need to assess dynamic effects of craving in addition to baseline ratings of craving and nicotine dependence as they may not be sufficient in explaining adolescent smoking cessation outcomes.
Introduction

Recent publications have called for a stronger focus on the cessation process of adolescent smokers since smoking rates remain high (Mermelstein, 2003), and figures show that cessation is achieved by no more than 12% of regularly smoking adolescents (Sargent, Mott & Stevens, 1998). Although many adolescents seem to undertake quit attempts, their trials prove to be unsuccessful most of the time (for an overview see Mermelstein, 2003). Individual variation in nicotine dependence is known as an important barrier for successful smoking cessation among adults (Abrams, Herzog, Emmons, & Linnan, 2000; West, McEwen, Bolling, & Owen, 2001), and in adolescents (Bagot, Heishman, & Moolchan, 2007; Colby, Tiffany, Shiffman & Niaura, 2000; Kleinjan et al., 2009). Former assumptions that adolescents would have too short histories of smoking to develop nicotine dependence have been countered by recent studies (for an overview see Colby et al., 2000). DiFranza, Savageau, Rigotti and colleagues (2002), for example, have shown that symptoms of tobacco dependence develop rapidly after the onset of intermittent smoking, and there does not seem to be a minimum nicotine dose or duration of use that needs to be reached for symptoms to arise. In fact, quite a large proportion of adolescent smokers is dependent on nicotine, in particular those who smoke daily (Colby et al., 2000).

Anecdotal reports from (ex-)smokers as well as empirical studies point out that being deprived of tobacco incites aversive states known as ‘withdrawal symptoms’ or ‘abstinence symptoms’ in both adults (Hughes, 1992), and adolescents (Hurt, Croghan et al., 2000; Killen, Ammerman et al., 2001; Riedel et al., 2003). These symptoms include among others cigarette craving, irritability, restlessness, insomnia, anxiety, depression, increased appetite and poor concentration (see Hughes, 2007 for a review). Although the terms ‘abstinence effects’ and ‘withdrawal effects’ are often used interchangeably, Hughes (2007) suggests that withdrawal effects are to be distinguished from abstinence effects in that withdrawal effects typically follow a time-limited pattern. When averaged across individuals, withdrawal symptoms typically show a strong increase during the first week of deprivation after which they gradually revert to an equal or even lower level than that at baseline (Hughes, 1992; Jorenby, Hatsukami et al., 1996; Piasecki et al., 1998; for an exception see Shiffman, Engberg et al., 1997). It is known that both the characteristics of the course of withdrawal symptoms over time and daily variations in withdrawal symptoms determine successful smoking cessation and lapse and relapse among adults (Ferguson, Shiffman, & Gwaltney, 2006; McCarthy et al., 2006). This notion, however, has inspired only a few studies on the impact of abstinence and withdrawal symptoms on smoking cessation and relapse among adolescents. Moreover, the
few studies available mainly relied on cross-sectional and retrospective reports of withdrawal experiences (Colby et al., 2000).

As previously noted, more research has been dedicated to the withdrawal-relapse relation among adult smokers, but those efforts have revealed inconsistent findings. Some studies have shown that withdrawal symptoms are potent predictors of lapse and relapse among adults (Ferguson, Shiffman, & Gwaltney, 2006; McCarthy et al., 2006; Swan, Ward & Jack, 1996). Yet a large number of other studies have failed to establish a prospective association between withdrawal and relapse (for an overview, see Patten & Martin, 1996). More recently, authors have proposed that this lack of evidence can among others be attributed to the fact that the variability of smoking withdrawal symptoms has often been neglected (Piasecki et al., 2003a; Shiffman, 2005). Not only do withdrawal symptoms show variability in severity over time and across individuals, they are also quite volatile since they fluctuate in response to episodic events (such as stressful events or seeing someone smoke), sometimes also referred to as ‘momentary states’ (McCarthy et al., 2006; Shiffman, 2005). Research acknowledging the dynamics of both withdrawal and relapse processes is emerging increasingly, as we will outline below. Inspired by the study by McCarthy and colleagues (2006), the present study focuses on the withdrawal symptoms craving and negative affect. These two symptoms have been shown to display quite different trajectories, and seem to interact differently with episodic events (McCarthy et al., 2006; Piasecki et al., 1998). We will therefore give an overview of the available literature for symptoms separately.

To start with, craving, or urge to smoke (footnote 1), refers to an intense desire to smoke, which varies in intensity over time both between and within individuals. This variability is presumed to be caused by intra-individual physiological processes, such as deprivation of nicotine, and by external influences, such as exposure to smoking cues (Killen & Fortmann, 1997; Niura et al., 1988). The activation of craving by environmental cues can occur long after deprivation, and craving may thus be experienced even after physical withdrawal symptoms have subsided (Killen & Fortmann, 1997). Craving has consistently been reported to be the most salient and severe ‘withdrawal’ symptom among adolescents (Colby et al., 2000), and similar to adults, adolescents’ levels of craving increase as a function of smoking deprivation (Kleinian, Van Den Eijnden, Brug, & Engels, submitted; Smith, Cavallo, McFetridge, Liss, & Krishnan-Sarin, 2008; Van Zundert, Boogerd, Vermulst, & Engels, 2009). Previous studies among adults have not only shown that if people experience craving, they are more likely to lapse or relapse (Killen, Fortman, Kramer, Varady & Newman, 1992; Killen, Fortman, Newman, & Varady, 1992; Shiffman, Paty et al., 1996), but
also *when* they experience intense urges to smoke. It appears that strong daily urges to smoke predict lapses into smoking the next day, even when baseline urge to smoke is controlled for (Ferguson et al., 2006; Shiffman, Engberg, Paty et al., 1997). A recent study that modeled the natural history of smoking withdrawal among adolescents revealed that higher pre-quit and quit-day intercepts of craving decreased the odds of abstinence whereas the pace with which symptoms declined (slope) did not predict abstinence (Van Zundert et al., 2009). Although this is important information, it does not reveal whether changes in craving from day to day can predict lapse and relapse the next day. To our knowledge, there is no study to date that has examined the effects of day-to-day variations in craving on relapse among adolescents who have quit smoking.

Another well-known effect of smoking deprivation is an increase in negative affect, which generally refers to a variety of aversive mood states such as among others nervousness, anger, frustration, irritability, and feeling depressed (Kassel, Stroud, & Paronis, 2003). This increase in negative affect after quitting appears to occur in both adults and adolescents, although the increase among adolescents seems to be less salient (Hughes, 1992; Van Zundert et al., 2009). Numerous retrospective self-report studies demonstrate that between 35%-100% of adult smokers report that they lapsed while experiencing some form of stress or negative affect (Kassel et al., 2003). More specifically, daily real-time reports of quit attempts revealed that negative affect is higher during temptation episodes (described as episodes of strong urge to smoke without lapsing) than during random assessments (Shiffman, Gnys, Richards et al., 1996). When enduring a temptation to smoke, strong negative affect makes adult smokers more likely to lapse than to resist the temptation (Shiffman, Paty, Gnys, et al, 1996).

Preliminary findings from a pilot study among 12 adolescents who quit smoking suggest that first lapses were associated with increased negative affect, but the small sample size did not allow for significance testing (Gwaltney, Bartolomei, Colby, & Kahler, 2008). Thus, as with craving, there is a relative absence of research on the dynamic effects of negative affect on relapse in adolescent smokers who try to quit. Given that adolescents are known to experience more variable and more intense moods due to hormonal, social, and cognitive processes unique to adolescence (Buchanan, Eccles, & Becker, 1992), it is possible that increases in daily negative affect have a differential impact on adolescent smoking cessation compared to adults.

In summary, the studies outlined above emphasize that dynamics of withdrawal are critical to our understanding of the relapse process. Traditional approaches have mainly drawn on single-occasion measures, which do not allow for temporal variations to be captured. This
is especially the case for studies on adolescent smoking cessation. Ecological Momentary Assessment (EMA; Shiffman, Stone, & Hufford, 2008) comprises methods that focus on collecting real-time data on momentary states in real-world environments. The particular advantages of using EMA in studying smoking relapse are, firstly, that relapse is in part affected by real-life situations (e.g., experiencing a stressful situation) and as such requires people to be studied in their natural environment. Secondly, EMA designs typically use intensive repeated sampling with at least one measurement per day which enables investigation of the temporal dynamics that characterize both withdrawal and relapse (Shiffman, 2005). Third, as lapses are often succeeded by more lapses and are very likely to eventually result in relapse, it is very difficult to discern the first lapse from the other lapses and from full relapse if people are not frequently and closely monitored. Such a confounding of single lapses and relapse is undesirable as they are each important milestones that are distinctly different from one another (Shiffman, Scharf et al., 2006). Finally, and more generally, an important contribution of real-time data collection methods is that they minimize recall, recency, and availability biases (Hammersly, 1994; Stone & Shiffman, 1994).

The present study used EMA methods to gather data from 149 daily smokers in the ages of 15 to 19, who were monitored three times a day for one week prior to, and three weeks after embarking on a serious quit attempt. We used Cox proportional-hazard survival analyses (Cox, 1972) to examine whether day-to-day variations in craving and negative affect influenced subsequent lapse and relapse risk, while controlling for between-person differences in baseline nicotine dependence, craving, and depressive symptoms. This was done because baseline nicotine dependence and craving are supposed to be related to situational craving after quitting. Depressive symptoms were chosen to be controlled for when assessing the dynamic effects of negative affect, because participants with higher levels of baseline depressive symptoms may report more daily negative affect by implication. Smoking after having achieved abstinence for some time is a notoriously strong predictor of relapse into smoking (Kenford et al., 1994). Thus, to isolate the day-to-day variations in withdrawal from the possible effects of concomitant smoking, we also adjusted for daily smoking in the survival analyses.

Method

Sample characteristics

Participants (n = 176) were Dutch adolescent daily smokers recruited for the study by means of community advertisements and newspaper articles. To qualify, candidates had to: be between 15 and 19 years of age; smoke at least one cigarette per day; and, not be currently
enrolled in a cessation program. Of the 176 participants who were eventually enrolled, a sample of 149 participants provided sufficient data for the present analyses (for more details on inclusion criteria, compliance, and attrition, please consult other publications on these data; Van Zundert et al., 2009a; Van Zundert et al., 2009b; Van Zundert, Ferguson, Shiffman, & Engels, resubmitted). The majority of the sample was female (63.7%), and the mean age was 17.2 (SD = 1.2). All participants received regular education, and all levels of educational attainment were represented: Lower vocational training (53.9%), higher vocational training (14.6%), pre-university education (13.8%), and college (17.7%). The average number of years that participants had been smoking daily was 2.9 (SD = 1.6). At the time of enrolment in the study, smoking rate was distributed as follows: 1-5 cigarettes per day (11.9%), 6-10 cigarettes per day (34.3%), 11-20 cigarettes per day (47.0%), 21-30 cigarettes per day (3.7%), and 31 or more cigarettes per day (3.0%). Participants nor their parents were required to provide active consent. This study was approved with the Dutch Medical-Ethical Committee on Research Involving Human Subjects.

Procedure

Participants were asked to complete a baseline questionnaire after which they were monitored for a total of four weeks. The first day of monitoring was always a Monday. Participants started the monitoring period with seven days of baseline monitoring, during which they were instructed to smoke ad lib. The eighth day was the assigned quit day for each participant. Following the quit day, subjects were monitored for an additional three weeks. On each day of monitoring, participants were asked to complete three internet-based questionnaires – in the morning (to be completed between 10 a.m. and noon), the afternoon (3 p.m. – 5 p.m.), and evening (8 p.m. – 10 p.m.). Each questionnaire was identical and asked participants questions about smoking, motivation, self-efficacy, withdrawal symptoms, and situational stimuli (e.g., alcohol/coffee consumption, seeing others smoke), and took approximately three minutes to complete. Questionnaires were automatically time-stamped with the time that they were completed on-line. Participants who failed to complete a questionnaire within the designated sampling window were sent a text message to remind them. If a participant did not have access to the internet during the sampling window, they were asked to complete a paper version of the questionnaire – which included a question on the date and time at the time of completion – and to transcribe the paper version online as soon as they had access to internet again. Prior analyses on the timeliness of paper diary entries in this EMA study indicated that the majority of the paper diaries were entered online on the same day, and that they were not bunched together at the end of the day. Analyses
excluding paper entries also revealed similar results as those obtained using both paper and real-time assessments (Van Zundert, Ferguson, Shiffman, & Engels, resubmitted). Participants completed an average of 25 ($SD = 4.5$) days of monitoring, during which they completed a total of 10501 assessments. All data were collected between October 2006 and March 2007.

**Measures**

*Daily withdrawal symptoms.* Eight items of the Wisconsin Smoking Withdrawal Scale (WSWS) were used to determine adolescents’ daily levels of craving and negative affect (Welsch et al., 1999). The WSWS has been found to show good construct validity with high reliabilities for the three symptoms (West, Ussher, Evans, & Rashid, 2006). In addition, the shortened version of ten items has been successfully applied in prior EMA research on smoking relapse among adults (McCarthy et al., 2006), and showed firm factorial validity with high principal loadings in an adolescent sample (Van Zundert et al., 2009). At each assessment, participants were asked to report on these symptoms as experienced during the past 30 minutes. Two WSWS-items were used to measure craving (“I have been bothered by the desire to smoke”, and “I had trouble getting cigarettes off my mind”). Six items tapped negative affect (e.g., I have been bothered by negative moods such as anger, frustration, and irritability”, and “I felt sad or depressed”). The eight items could be answered on a Likert-scale ranging from 1 ‘strongly disagree’ to 5 ‘strongly agree.’ A high score on the items thus represented high levels of withdrawal symptoms. In a prior study on the same data, the internal consistencies of the craving and negative affect scales were found to be .88 ($SD = .04$) and .75 ($SD = .04$), respectively (as computed by calculating Cronbach’s alpha per assessment and then taking the average alpha across all assessments).

*Nicotine dependence.* Nicotine dependence at baseline was assessed using a multidimensional measure of nicotine dependence for adolescents, which has good psychometric properties (Kleinjan, Van Den Eijnden, Van Leeuwe, Otten, Brug, & Engels, 2007). This composition was derived from the modified Fagerström Tolerance Questionnaire (mFTQ) (Fagerström, & Schneider, 1989), and Hooked on Nicotine Checklist (HONC) (DiFranza, Rigotti, McNeill, Ockene, Savageau, St Cyr, & Coleman, 2000). The total 11 items of the three subscales include aspects of emotional and physical symptoms of dependence (irritation, anger, restlessness, etc. during smoking deprivation), and behavioral symptoms of nicotine dependence (e.g., intensity of smoking). The scale was composed with the standardized values (range: 1-4), since answering categories were not all the same for each
item. Cronbach’s alpha was .80. The average level of baseline nicotine dependence was 2.63 (SD = .49).

**Craving.** Baseline levels of craving for tobacco were assessed through five items on a 5-point scale that asked about the frequency of missing, desiring, thinking of, or longing for a cigarette; for example, “I desire smoking a cigarette” and “I miss a cigarette.” Items could be scored from 1 ‘never’, 2 ‘sometimes’, 3 ‘regularly’, 4 ‘often’, to 5 ‘very often’ (Dijkstra & Borland, 2003). Cronbach’s alpha was .85.

**Depressive symptoms.** To assess depressive feelings, we used the Depressive Mood List as developed by Kandell and Davies (1982). Six items assessed how often participants felt unhappy, sad, depressed, nervous, tense, or too tired to do things, and how often they worried about current issues and the future. This scale has been frequently used and several studies have shown sufficient psychometric properties in terms of internal consistency, reliability and stability over time (Kandell & Davies, 1986). Item anchors ranged from 1 ‘never’ to 5 ‘always’. Cronbach’s alpha was .77.

Please note that the ‘baseline’ characteristics craving, nicotine dependence, and depressive symptoms refer to these concepts as assessed through the baseline questionnaire, and not during the first week of monitoring (which is sometimes also referred to as ‘baseline’ period).

**Outcomes: First lapse and relapse.**

Two outcomes of interest were specified for the present analyses: The first lapse and relapse (e.g., Gwaltney et al., 2005; Shiffman et al., 2000; Shiffman et al., 2006). A participant’s first lapse day was defined by any report of smoking (even if only a puff), after having accomplished 24 hours of abstinence. The literature on adolescent smoking does not provide standard definitions of relapse that are suitable for adolescents specifically. Common definitions of relapse as applied to adult smokers may be too stringent in adolescent samples (e.g., smoking at least five cigarettes for three consecutive days; Shiffman et al., 1996) given that adolescents have shorter histories of smoking and may not smoke five cigarettes daily even before quitting. For the purposes of these analyses, we defined relapse as smoking at least one cigarette per day for three consecutive days. The first day of the relapse episode was counted as the relapse day.

**Analytic Plan**

To assess the associations between baseline questionnaire craving, nicotine dependence, and depressive symptoms, and progression to lapse and relapse, we used Cox proportional hazards survival analysis (Cox, 1972). Such analyses evaluate the risk of a target
event (lapses or relapse) occurring per unit of time, while taking into account that some observations are censored because participants’ status after the study ended is unknown or because participants may drop out before the end of the monitoring period. Subsequently, we tested the dynamic effects of craving and negative affect on the risk of lapse and relapse, by means of proportional hazards regression survival analyses. These analyses used days as the primary unit of analysis – a study day was defined as the period between two consecutive morning reports. We computed daily averages from the three daily assessments for craving and negative affect and used these values as time-varying covariates in the Cox regression to test whether daily variations in craving and negative affect predicted the following day’s risk of lapsing or relapsing. Daily craving and negative affect were each first tested univariately in association with lapse and relapse. In a second step, baseline levels of craving and nicotine dependence were entered into the equation for the analysis of daily craving, and baseline levels of depressive symptoms were included in the regression with daily negative affect. We then included both daily craving and daily negative affect in a multivariate analysis, after which we introduced all three baseline measures in a next step. For the relapse analyses, concurrent smoking was included as a time-varying covariate.

Of the included 149 participants, 14 participants failed to complete and/or to successfully return the baseline questionnaire. These 14 participants are excluded from the analyses in which we examine the effects of baseline craving, nicotine dependence, and depressive symptoms on lapse and relapse risk. Attrition analyses between those 14 subjects and those who were included in the analyses showed no differences in smoking rates during the first week of ad lib smoking, nor in relapse rates. All analyses were conducted using SAS Version 9.1.3.

Results

Descriptives

The majority of the participants reached 24 hr abstinence on the target quit day (72.5%, n = 108 of 149). The majority of the participants (71.8%, n = 107 of 149) experienced at least one lapse during monitoring, typically, soon after achieving initial abstinence (M = 4.0 days; SD = 3.37; Range = 0-20 days), and 83.2% of these (n = 89 of 107) reported a second lapse. The average number of days between the first and second lapse was 2.2 (SD = 3.11; Range = 0 - 15); however roughly a third of the second lapses (31.5%; n = 28 of 89) occurred on the same day as the first lapse. Relapse occurred for 52 participants (34.9%, n = 52 of 149). For more than half of the subjects who lapsed (59.6%), the first lapse marked the
beginning of a relapse. For the remaining 40.4%, the average number of days between the initial lapse day and relapse was 4.7 (SD = 3.32; Range = 1-12 days).

All three baseline individual characteristics were significantly correlated. Baseline levels of craving and nicotine dependence were positively correlated ($r = .67$, $p < .001$), and both variables were positively associated with depressive symptoms ($r = .34$, $p < .001$, and $r = .31$, $p < .001$, respectively). Thus, those with high levels of nicotine dependence and craving were more likely to report depressive symptoms.

**Progression to a first lapse**

*Individual differences in baseline characteristics as static predictors of lapse risk.* We first tested whether the baseline questionnaire measures of nicotine dependence, craving, and depressive symptoms predicted the risk of a first lapse. Compared to those who did not lapse, participants who reported a first lapse reported equal levels of baseline craving (2.82 [SD = .74] vs 2.91 [SD = .86]), nicotine dependence (2.61 [SD = .49] vs 2.64 [SD = .49]), and depressive symptoms (2.65 [SD = .59] vs 2.66 [SD = .69]). In a survival analysis, none of the individual characteristics predicted time to first lapse (Nicotine dependence: HR = 1.07, CI = .71 – 1.62, $p = .748$; Craving: HR = 1.04, CI = .81 – 1.34, $p = .766$; Depressive symptoms: HR = .95, CI = .70 – 1.30, $p = .763$).

**Daily craving and negative affect as predictors of lapse risk.** To test whether daily measures of craving and negative affect predicted the risk of a first lapse the following day, we entered daily measures of craving and negative affect as time-varying covariates. Increments in daily craving significantly predicted a first lapse on the subsequent day – for each 1-point increase in craving, the risk of lapsing the following day increased by 24% (HR = 1.24, CI = 1.06 - 1.46, $p = .007$). Controlling for baseline levels of nicotine dependence and craving showed that individual differences did not account for the effect of daily craving on the first lapse (adjusted HR = 1.22, CI = 1.03 – 1.45, $p = .025$). Although daily variations in negative affect showed a trend effect on the first lapse, the effect was not statistically significant (univariately: HR = 1.26, CI = .98 - 1.62, $p = .076$; Controlling for baseline depressive symptoms: Adjusted HR = 1.24, CI = .91 - 1.68, $p = .170$).

When daily craving and daily negative affect were included in a multivariate analysis, craving still predicted the first lapse (craving: Adjusted HR = 1.22, CI = 1.02 - 1.45, $p = .029$; negative affect: Adjusted HR = 1.10, CI = .83 - 1.45, $p = .526$). Finally, entering baseline characteristics into the multivariate analysis of daily craving and negative affect reduced the effect of craving to a trend effect (Adjusted HR = 1.20, CI = 1.00 - 1.45, $p = .053$).
association between negative affect and the first lapse remained unchanged (Adjusted HR = 1.08, CI = .76 - 1.52, p = .673).

**Progression from first lapse to relapse**

*Baseline characteristics as static predictors of relapse risk.* Again, baseline nicotine dependence and depressive symptom scores among those who relapsed did not significantly differ from those who did not (‘no relapse’ vs ‘relapse’; Craving: 2.83 [SD = .80] vs 2.96 [SD = .87]); Nicotine dependence (2.61 [SD = .49] vs 2.67 [SD = .49]); Depressive symptoms (2.67 [SD = .65] vs 2.64 [SD = .69]). As with the first lapse, none of the baseline questionnaire measures predicted relapse risk (nicotine dependence: HR = 1.25, CI = .69 – 2.26, p = .456; Craving: HR = 1.19, CI = .84 – 1.69, p = .327; Depressive symptoms: HR = .95, CI = .61 – 1.47, p = .813) (Footnote 2).

*Daily craving and negative affect as dynamic predictors of relapse.* Daily variations in craving significantly predicted relapse (HR = 1.57, CI = 1.23 – 2.01, p < .001) – for each 1-point decrease in daily craving, the risk of relapsing the following day increased by 57%. Controlling for baseline craving and nicotine dependence, and concomitant smoking (as time-varying covariate), did not reduce this effect (Adjusted HR = 1.53, CI = 1.16 – 2.01, p = .003). Daily variations in negative affect did not predict progression to relapse (univariately: HR = 1.28, CI = .94 - 1.72, p = .114; Controlling for baseline depressive symptoms and concomitant smoking: Adjusted HR = 1.25, CI = .87 - 1.81, p = .226).

When daily craving and daily negative affect were included in a multivariate analysis, craving still predicted relapse (craving: Adjusted HR = 1.63, CI = 1.22 - 2.18, p < .001; negative affect: Adjusted HR = .92, CI = .64 - 1.31, p = .636). Finally, when baseline characteristics and concomitant smoking were entered into the multivariate analysis of daily craving and negative affect, the effect of craving still held (adjusted HR = 1.56, CI = 1.16 – 2.10, p = .004), and the association between negative affect and the first lapse remained largely unchanged (adjusted HR = .92, CI = .59 - 1.44, p = .714).

**Discussion**

The present study examined dynamic effects of daily variations in craving and negative affect on the first lapse and relapse the next day, among adolescent daily smokers who achieved 24 hr abstinence. The main findings show that daily variations in craving predict the first lapse as well as relapse into smoking, above and beyond baseline levels of craving and nicotine dependence, and concurrent smoking after quitting. Day-to-day variations in negative affect did not predict time to the first lapse nor to relapse. Individual differences in baseline craving, nicotine dependence and depressive symptoms did not predict
the first lapse or relapse either, although using a more stringent definition of relapse revealed that higher levels of baseline craving and nicotine dependence did predict ‘heavy’ relapse. *Baseline craving and nicotine dependence.*

Individual differences in craving and nicotine dependence did not discriminate lapsers and relapers from abstainers, which is somewhat surprising given that recent research shows that adolescents’ nicotine dependence poses a substantial barrier to successful cessation (Colby et al., 2000; Horn, Fernandes, Dino, Massey & Kalsekar, 2003; Kleinjan et al., 2009). These discrepancies with previous studies may be explained by the fact that the aforementioned studies used a wider range of adolescent smokers including both monthly, weekly, and daily smokers. The sample of participants in the EMA study was rather homogeneous as it comprised only daily smokers, and it is possible that we found limited support for the effect of nicotine dependence on relapse outcomes because of a restricted range of variation. However, when we tested a more stringent definition of relapse (‘heavy relapse’), we did find individual differences in baseline questionnaire craving and nicotine dependence to predict relapse.

When testing the three subscales of the presently used nicotine dependence scale (Kleinjan et al., 2007), we found that it was actually the behavioral component (which represents the frequency and intensity of one’s smoking) that predicted time to heavy relapse. Although we did not include the follow-up measurement in the present study, a previous study on the same data revealed that baseline smoking status (which is the core indicator of the behavioral subscale as it measures the average number of cigarettes smoked per day, cf. Horn et al., 2003) did not discriminate between those who were still abstinent and those who had reverted to smoking at the follow-up, which was administered 2 months after the end of the monitoring period (Van Zundert, Nijhof, & Engels, 2009). The findings that nicotine dependence, or important indicators thereof do not predict the first lapse, mild relapse, nor smoking cessation three months after quitting are important, considering that the lack of understanding how nicotine dependence affects adolescent smoking cessation still constitutes a critical gap in the adolescent smoking literature. From a positive view, the present findings show that even the teenagers that smoke heaviest and who feel most dependent are not necessarily doomed to lapse or experience a mild relapse. This is something encouraging that might be conveyed to highly dependent adolescent smokers who aspire to quit smoking. It also shows that using static measures of individual differences in nicotine dependence (and craving) is not sufficient in gaining insight into the adolescent relapse process, considering that day-to-day variations in craving predicted lapse and relapse the next day.
This finding on daily changes in craving mirrors previous findings among adults in which increases in craving on a given day significantly predicted lapsing the next day (Ferguson, Shiffman, & Gwaltney, 2006; Shiffman et al., 1997). It is also in line with the consistent finding that craving is the most commonly cited withdrawal symptom among adolescents who refrain from smoking for some period of time (Colby et al., 2000). Although this is important information, it has been shown that urge experiences after quitting are rather episodic, and not constantly present or elevated (Shiffman et al., 1997). In addition, various aspects of urge episodes, such as intensity, frequency, and duration are known to have differential effects on relapse (West, Hajek, & Belcher, 1989, Shiffman et al., 1997). As we used three fixed assessment windows per day that only assessed the intensity of craving at the present moment, and not duration and frequency of other urge peaks (if any) throughout the day, we cannot verify whether acute urges provoked relapse, and whether the frequency and duration of cravings were important determinants of the lapse and relapse that followed. Ideally, future EMA studies on adolescent smoking relapse should employ designs that include random prompts several times a day and that require participants to initiate a report when they are at the end of a so called ‘temptation episode’ (i.e., when they experience acute increases in urge to smoke or when they feel they have come to the brink of smoking regardless of subjective urges; cf. Gwaltney et al., 2008; Shiffman, Paty, Gnys et al., 1996). Next to gaining insight into all characteristics of craving episodes and their associations with relapse, this will help to determine which factors discriminate temptation situations from lapse and relapse situations.

Contrary to craving, daily variations in negative affect did not predict lapse or relapse, not even when tested univariately in relation to these milestones. This is in contrast with most studies among adults (Kassel et al., 2003), but is in line with one other study that did not find negative affect to predict lapse risk the next day either (Shiffman & Waters, 2004). However, few studies have included negative affect as time-varying predictor of lapse risk based on real-time assessments. A study that did use real-time measures showed that negative affect predicted lapse the next day in a univariate analysis, but this effect diminished when daily craving was controlled for (Ferguson et al., 2006). Although our results do not suggest the presence of such a mediational effect, they show that craving is a more significant risk factor than negative affect among adolescents as well. Several explanations as to why we did not find effects for negative affect may apply here. First, the age range of the participants included (15 to 19 years) may play a role. One of our reasons to replicate findings of negative affect on adults’ relapse among adolescents was that teenagers are known to display a
worsening trend in mood during adolescence (Buchanan et al., 1992). However, most studies that demonstrate such affective declines have described this process to occur in early adolescence (Garber, Keiley, & Martin, 2002; Ge, Lorenz, Conger, Elder, & Simons, 1994), and to stabilize by mid-high school (Larson et al., 2002; Moneta, Schneider, & Csikszentmihalyi, 2001). If developmental changes indeed account for differences in responsiveness to negative affect, then including older teenagers might obscure the association between daily negative affect and relapse. Regarding the notion that negative affect may play a different role across subgroups, it is also possible that increments in negative affect pose more lapse risk among those who are depressed. Although we measured depressive feelings, we did not assess clinical depression.

Second, several studies on adolescents’ motives to initiate smoking report that the most commonly cited motive is that smoking is calming, relaxing, and reduces stress (Kassel et al., 2003). However, it is not yet known whether smoking actually relieves negative affect among adolescents, and to examine this would require controlled laboratory studies. Nonetheless, one can question whether if smoking indeed helps to calm down, relax, and alleviate stress, will it veritably decrease negative affect? Could it be that although adolescents find smoking relaxing, that it does not necessarily uplift their spirits, and that low mood is not compensated by smoking? Instead, could it be that the arousal that experiencing stress induces – and its possible impact on relapse – might be countered by smoking? In an earlier study on the situational correlates of adolescents’ momentary self-efficacy to maintain abstinence after quitting, we found that although both the experience of a stressful event and negative affect were significantly associated with lower self-efficacy in a univariate analysis, only stress remained significantly associated with self-efficacy in a multivariate analysis. This was observed when participants were still abstinent and after they had lapsed. Thus, it is possible that different mood states have different effects on adolescent relapse as a function of the potentially differential effects of smoking on various mood states.

This would also advocate examining the association between positive affect and adolescent smoking relapse. It is known that positive and negative affect do not represent the outer ends along one affect continuum, but are distinct constructs of their own (e.g., Watson & Tellegen, 1985). Ferguson and colleagues (2006) examined positive affect as well, and found that daily decreases in positive affect increased lapse risk the next day independently from craving and negative affect. Moreover, studies on longitudinal patterns of daily affect in adolescents suggest that normative mood declines in adolescence may be driven by deteriorations in positive affect, rather than increases in negative affect (Weinstein,
Mermelstein, Hankin, Hedeker, & Flay, 2007). Lastly, we note that the effects of smoking on adolescents’ negative and positive affect may differ across contexts. It is, for example, possible that in the context of being with friends or at a party smoking has a cumulative effect on positive affect, rather than decreasing negative affect. Summarizing, these findings show that negative affect and craving play differential roles in the day-to-day processes involved in adolescents smoking relapse.

Limitations

Several limitations of the present study should be acknowledged. The restrictions that pertain to the design of the study are the use of paper diaries as alternative when internet was not available, the possibility of reactivity effects due to the intensive self-monitoring, and the fact that abstinence and relapse were not biochemically verified. These issues have been discussed in detail in several prior publications on these data (Van Zundert et al., 2009a, 2009b, Van Zundert et al., resubmitted). Briefly, the use of paper-and-pencil-diaries constitutes a limitation in the sense that timely reporting cannot be verified, and reports may have been completed in bunches after the assessment window, or even in advance (Shiffman, Stone & Hufford, 2008). Additionally, as intensive self-monitoring appears thus helpful in changing behavior that it is included in behavior-change treatments (Shiffman et al., 2008), this may have affected the relapse rates which are higher than usually found in non-aided adolescents who quit smoking (Mermelstein, 2003). Biochemical validation, finally, would verify more objectively whether reports of abstinence and smoking were accurate. Although prior analysis of the validity of the paper entries provided reassuring results (Van Zundert et al., resubmitted), and the scientific literature shows little evidence of reactivity effects in smoking cessation EMA studies (Rowan et al., 2007; Shiffman et al., 2008) these issues should be borne in mind when interpreting the present results.

A limitation more specific to the present study include the over-representation of the Caucasian ethnicity (95% of the sample). Prior studies have found significant ethnic differences in retrospectively reported withdrawal symptoms during a quit attempt (Breslau, Kilbey & Andreski, 1992; Riedel, Robinson, Klesges & McLain-Allen, 2003), with African-Americans reporting significantly fewer withdrawal effects than Caucasians, even after controlling for smoking frequency. The results may thus not be generalizable to non-white adolescents.

Recommendations

As noted above, standard definitions of relapse as applied to adult smokers may be too stringent in adolescent samples (e.g., smoking at least five cigarettes for three consecutive
days; Shiffman et al., 1996), given that adolescents have shorter histories of smoking and may not smoke five cigarettes daily even before quitting. In the present sample, 11.9% reported to smoke 1 to 5 cigarettes per day before quitting, and it is possible that a part of this group could therefore not meet the definition of ‘heavy relapse’ even if they relapsed. Nonetheless, the additional findings point out that results may be contingent of the definition used, which can produce misleading interpretations (e.g., concluding that adolescents’ individual differences in nicotine dependence do not discriminate abstainers from those who relapse). Considering that the literature on adolescent smoking relapse is still relatively underdeveloped, it is important to acknowledge that percentages of relapse rates as well as effects of possible predictors differ as a function of definition.

Based on the present finding that daily increases in craving robustly predicted lapse and relapse, it seems tempting to recommend that adolescents should be offered pharmacotherapy. Indeed, prior research has demonstrated that withdrawal symptoms can be successfully alleviated by using nicotine patches in adolescents (Smith et al., 1996). However, the efficacy and possible side effects of nicotine replacement therapy (NRT) and bupropion have not been straightforwardly demonstrated in teenagers. Although some studies show promise of NRT in this age group, studies are limited in number and provide inconclusive results (for an overview, see Grimshaw & Stanton, 2006). In addition, although it is often assumed that NRT exercises its efficacy in preventing (re)lapse by alleviating withdrawal symptoms that normally jeopardize abstinence (Hughes, 1993), this mediation hypothesis has recently been shown to be insufficient (Ferguson et al., 2006). Using dynamic measures of craving and withdrawal symptoms in a randomized clinical trial, Ferguson and colleagues found that the preponderance of the effect of NRT was not accounted for by symptom relief. The few studies on the effectiveness of NRT among adolescents have not examined the mechanisms behind NRT’s effectiveness (if it were present). Researchers are thus encouraged to conduct more randomized controlled trials to test the efficacy of several NRT or bupropion applications (nicotine patch, nicotine gum), differential effects of various doses, and the mechanisms behind the potential effectiveness.
Footnotes

1. Some authors distinguish the concept of ‘craving’ from the concept of ‘urges to smoke’ (Kozlowski & Wilkinson, 1987), while others regard these terms to refer to the same concept (Shiffman et al., 1987; Shiffman et al., 1997; West et al., 1989). Adding discussion on this is beyond the scope of the present study, but based on previous studies that show that craving and urge to smoke are one and the same phenomenon (Shiffman et al., 1997), we will use both terms interchangeably.

2. We also tested a more stringent definition of relapse (‘heavy relapse’) that is more commonly used in studies on relapse among adults (smoking at least 5 cigarettes for 3 consecutive days; Shiffman et al., 1996). Baseline questionnaire craving and nicotine dependence did predict time to heavy relapse (nicotine dependence: HR = 2.57, CI = 1.17 – 5.66, \( p = .019 \); Craving: HR = 1.79, CI = 1.16 – 2.75, \( p = .009 \)). In addition, we used a multidimensional scale for the measurement of baseline nicotine dependence, based on the modified Fagerström Tolerance Questionnaire (mFTQ) and the Hooked on Nicotine Checklist (HONC) (Kleinjan et al., 2007). This scale comprises three distinct dimensions: behavioral aspects of nicotine dependence (when, where, and how much one smokes), craving (frequency of urges to smoke), and nervousness during abstinence (negative affective symptoms, such as trouble concentrating and restlessness). There were no differences in subscales regarding their association with the first lapse and ‘mild’ relapse. However, only the behavioral subscale predicted time to heavy relapse, whereas the other two subscales did not, which indicates that behavioral aspects of nicotine dependence account for the effect on heavy relapse. Depressive symptoms did not predict time to heavy relapse (HR = 1.13, CI = .64 – 1.98, \( p = .673 \)).
References


Chapter 11

Alcohol consumption and smoking relapse among adolescents
Abstract

**Aims.** The present study tested the co-occurrence of alcohol use and the first lapse and relapse into smoking among daily smoking adolescents who quit smoking. **Design.** Participants completed web-based questionnaires on a daily basis during 1 week prior to and 3 weeks after a quit attempt. **Setting.** Participants completed the study in their own natural environments. **Participants.** Participants were 134 daily smoking adolescents in the ages of 15 to 19. **Measurements.** Participants were asked whether they had consumed any beverage in the past 30 minutes at each assessment. The three daily measures were aggregated into one daily measure of alcohol consumption. Lapse was defined as the first incidence of smoking after achieving 24 hr abstinence, relapse was defined as smoking at least one cigarette on three consecutive days. **Findings.** The first lapse was strongly associated with alcohol use on the same day. Individual characteristics did not predict the first lapse, but the effect of alcohol consumption on the first lapse appeared to be stronger for younger participants. Progression from lapse to relapse did not seem to be associated with alcohol use, but did seem to occur faster among boys. **Conclusions.** Adolescent drinking during smoking cessation poses a strong risk factor for the first lapse into smoking and should be targeted in smoking cessation interventions for adolescents.
Introduction

Alcohol consumption and tobacco use are known to be strongly associated in both clinical and non-clinical samples. Studies on clinical samples of adult alcoholics have revealed that 80-95% are smokers [1-4], and conversely, smokers are at higher risk to develop alcohol use disorders than non-smokers [1, 5, 6]. Individuals from non-clinical samples who both drink and smoke tend to drink to a greater extent than non-smoking drinkers [7-9]. In addition, drinkers smoke more than non-drinkers, and the amount of cigarettes smoked increases with increments in alcohol consumption [7, 10-12]. Smokers also report a stronger desire to smoke and more enjoyment of their cigarette while drinking than while not drinking [13,14]. Among adolescents, alcohol consumption and tobacco use seem to be reciprocally associated as well [15-19]. For example, adolescents who drink more heavily display the most persistent smoking patterns [20], and adolescents who are more persistent smokers have significantly greater odds of alcohol relapse after substance abuse treatment [21].

The combined use of alcohol and tobacco not only poses additive health risks [22, 23], but constitutes a significant impairment for successful smoking cessation as well. Studies among adults have demonstrated this in several ways. Smoking relapse seems to occur more often on heavy drinking days compared to moderate or non-drinking days [24]. Another study among heavy social drinkers showed that after consuming an alcohol beverage, participants were less capable of resisting the first cigarette after 3 hours of smoking deprivation and resumed smoking sooner than those who received a placebo beverage [25]. Furthermore, after achieving at least 24 hr abstinence, adult smokers’ real-time reports indicate that situations in which they feel tempted to smoke as well as lapse situations are among others marked by alcohol consumption [26-28]. Currently, it is unknown how alcohol consumption relates to smoking lapse and relapse among adolescents who have quit smoking.

Several theories offer explanations as to why alcohol consumption is associated with tobacco use and with failure to quit the latter. Firstly, the theory of cross-substance cue reactivity [29] and the cognitive processing model of craving [30] share common ground in positing that over a history of smoking, alcohol consumption may be frequently paired with smoking and as a result may become a conditioned stimulus provoking conditioned craving for tobacco and automatized smoking behavior. Craving for tobacco, or urge to smoke, in turn is a notorious predictor of smoking lapse and relapse in adults (for a review, see [31]), and to some extent in adolescents [32]. Secondly, neurophysiological responses to alcohol intoxication may be an obstacle to cessation and maintenance of abstinence. It is known that addictive substances negatively affect response inhibition by increasing the salience of
substance-related cues and by decreasing one’s ability to inhibit impulses such as refraining from smoking [33-35].

Summarizing, alcohol use evidently poses a significant threat to successful smoking cessation and maintained abstinence among adults. However, despite that very few adolescents manage to achieve long-term smoking abstinence [36], and despite that the majority of adolescents in most Western societies drink regularly [37, 38], no study to date has examined the immediate association between alcohol consumption and relapse among adolescents who attempt to quit smoking. Although it is possible that juvenile alcohol consumption affects cessation outcomes in a similar vein as in adults, we cannot be certain that results can be replicated for this age group per se. It is not known, for example, whether and how adolescents in cessation respond to any smoking cue, much less how they respond to alcohol use. Preliminary findings from pilot data among adolescents who attempted to quit smoking suggest that lapses are associated with being around others who smoke and having cigarettes available [39], but alcohol consumption was not included. Furthermore, the parts of the brain that serve cognitive, emotional and behavioral regulation (e.g., impulse control) undergo active development during adolescence [33, 40, 41], and impulse control levels relatively lower than those of adults might make adolescents particularly vulnerable to smoking relapse.

The present study aimed to test the effect of alcohol consumption on a given day on the first lapse and progression to relapse in a sample of 92 adolescents who achieved at least 24 hr abstinence, and who reported at least one lapse during a four-week period of ecological momentary assessment (EMA). EMA refers to methods that obtain real-time reports across a variety of real-life situations [42]. We hypothesized that drinking on a given day would be related to a first lapse and/or relapse into smoking on that same day. Further, we tested whether this association varied as a function of age, sex, and baseline smoking. Finally, because those who drink more frequently might be more tolerant against the disinhibitory effects of alcohol intoxication, we explored whether the expected association between drinking and (re)lapse would be stronger among those who drank less frequently throughout the study.

Method

Sample characteristics

The present data pertain to an ecological momentary assessment study that was carried out between October 2006 and March 2007. The study was approved of by the medical ethical committee (CMO Arnhem-Nijmegen). Participants were 149 Dutch adolescent daily smokers.
who were between 15 and 19 years of age, who smoked at least one cigarette per day, and who were not enrolled in a cessation program. The average participant was female (63.8%), Caucasian (96.3%), 17.2 years old ($SD = 1.2$), smoked 11 to 20 cigarettes per day before quitting, and had been smoking daily for 2.9 years ($SD = 1.6$). Fifteen out of the 149 participants (10.1%) did not successfully return their baseline questionnaire, and were excluded from the present analyses. To test whether lapse and relapse are associated with alcohol use, the present analyses include only those among the 134 participants who experienced the relevant milestone (first lapse: $n = 92$; mild relapse: $n = 46$).

**Procedure**

Participants were asked to complete a baseline questionnaire on average a week before they started the EMA study period in which they were monitored for a total of four weeks. The first day of monitoring was always a Monday, so that any temporal influence (e.g., weekends versus weekdays) would be equal across participants. Participants started the EMA period with seven days of baseline monitoring, during which they were instructed to smoke ad lib. Internet-based questionnaires with identical questions were administered three times daily: in the morning (10 a.m. – noon), afternoon (3 p.m. – 5 p.m.), and evening (8 p.m. – 10 p.m.). The eighth day was the assigned quit day for each participant, after which participants were monitored for three ensuing weeks. More details on participants and procedure are provided elsewhere [32, 43, 44].

**Measures**

**Independent variable (situational level).** To measure whether participants had consumed alcohol, participants were asked whether they had consumed any beverage in the past 30 minutes at each assessment. One of the response choices included ‘an alcohol beverage’. We aggregated the three daily measures into one daily measure of alcohol consumption, with value 0 indicating no alcohol consumption on that particular day, and value 1 representing use of alcohol that day. Please note that for the present analyses, a daily measure of alcohol was used. In hierarchical linear modeling, the effect of alcohol use on a given day is modeled on the first level, which is referred to as the ‘situational level’. Thus, when we speak of ‘situational effect of alcohol use’ and ‘situational alcohol use’, we do not refer to the effect of alcohol use in a given situation, but on a given day.

**Independent variables (individual level).** Baseline smoking status was assessed through the baseline questionnaire using one item of the mFTQ [45]: “How many cigarettes do you smoke per day?” Response anchors were ‘1’ (1-5 cigarettes per day), ’2’ (6-10), ‘2’ (11-20), ‘4’ (21-30), and ‘5’ (31 or more). To assess sex effects, boys were assigned a value
of 1 and girls a value of 2. “General drinking level” was calculated by counting the frequency of alcohol consumption during the study across all assessments per person divided by the number of assessments completed, and thus represents the percentage of assessments at which alcohol use was reported. A median split (median: .04; range: .00 - .25) was used to distinguish between ‘abstainers and infrequent drinkers’ (value 0) from ‘frequent drinkers’ (value 1).

**Outcomes.** Two outcomes were specified: Time to first lapse, and progression from lapse to relapse. The first lapse was defined as the first report of smoking (even if only a puff) after achieving 24 hr abstinence. Relapse was defined as smoking at least 1 cigarette per day for 3 consecutive days after achieving 24 hr abstinence. For the analyses, we used different time intervals according to the outcome of interest: First lapse analyses included the time between achieving 24 hr abstinence and the first lapse. Progression to relapse included the time between the first lapse and the first day of the relapse [cf. 44]. The outcome variables were coded to have a value of 1 when the event was reported that day, with a reference category value of 0 indicating that the event did not occur that day.

**Analytic strategy**

Due to the nested data structure (days within individuals), we applied hierarchical linear modeling (HLM) using the statistical program HLM 6.02 [46]. In a first model, we tested the main effect of alcohol consumption on the situational level. This was done for lapse and relapse separately. Logistic regression functions were applied since both alcohol consumption and outcome variables (lapse and relapse) were dichotomous. In this way, the odds ratio obtained in the situational analysis indicates the proportion of how often alcohol use and (re)lapse co-occurred, relative to days on which participants consumed alcohol but did not (re)lapse or (re)lapsed but did not consume alcohol. In the second model, we tested the direct effects of the individual level factors age, sex, general drinking level, and baseline smoking status on outcomes. This equation pertains to the second level main effect that describes the individual differences in effects between persons. To test whether the individual factors moderated the possible situational effect of alcohol consumption on the first lapse and relapse, we performed cross-level interactions in a third model. This means that individual characteristics were taken into account to explain variations in the association between situational alcohol use and (re)lapse. All three models were estimated simultaneously using restricted maximum likelihood estimation [47]. Lastly, it should be noted that in multilevel modeling, the number of assessments (and not the number of participants) constitute the sample size. The 92 persons who experienced a first lapse completed 459 days of assessment.
between their quit day and the first lapse altogether. Thus, the “sample size” for the quit-to-lapse interval was n = 459. In a similar vein, the sample size for relapse was n = 117.

**Results**

**Descriptive results**

On the target quit day, 24 hr abstinence was achieved by 72.8% of the participants (n = 67 of 92). Three persons (3.3%) quit smoking before the target quit day (TQD), 16.3% the day after the TQD, and the remaining 7.7% achieved 24 hr abstinence between days 10 and 12. The first lapse occurred on average 4 days after achieving 24 hr abstinence ($M = 4.04$, $SD = 3.5$). More specifically, 80 participants (87.0% of 92) experienced the first lapse within a week after quitting, among which were 49 persons (53.3% of 92) who lapsed within 3 days. The first lapse coincided with the beginning of relapse in 58.7% of the cases. The remaining 41.3% relapsed on average within 3.9 days ($SD = 3.08$) after the first lapse. Alcohol use was reported on 10.0% of the quit-to-lapse days, and on 16.5% of the lapse-to-relapse days. Figure 1 shows that the frequency of alcohol use peaked during the weekend days.

**Situational level main effect of alcohol consumption on outcomes.** Participants were over five times more likely to have their first lapse on days they consumed alcohol than on days of non-drinking (Table 1, Footnote 1). Progression to relapse was not associated with alcohol consumption.

**Individual level main effects on outcomes.** Contrary to the strong situational effect of alcohol consumption, none of the individual characteristics were associated with the first lapse. Progression to relapse was neither associated with age, general drinking level, nor with baseline smoking status, but girls who lapsed seemed to progress to mild relapse less quickly than boys (Table 2).

**Cross-level interactions.** The significant situational level main effect of alcohol consumption on the first lapse was moderated by age (Table 3). The association between alcohol use and first lapse was significantly stronger among younger participants as compared to the older ones. Sex, general drinking level, and baseline smoking status did not moderate the effect of alcohol on first lapse. No significant cross-level interactions were detected for relapse.

**Discussion**

The present study tested the association between situational alcohol use and the first lapse and relapse among daily smoking adolescents who quit smoking. The main findings show that the first lapse was strongly associated with alcohol use on the same day. Individual characteristics did not predict the first lapse, but the effect of alcohol consumption on the first
lapse appeared to be stronger for younger participants. Progression from lapse to relapse did not seem to be associated with situational alcohol use, but did seem to occur faster among boys.

The strong association between situational alcohol use and the first lapse is in line with the literature on adults [26-28], and highlights the substantial risk of adolescent drinking during the process of smoking cessation. In line with the theory of cross-substance cue reactivity [29], adolescents’ desire to smoke might have been triggered by the habitual aspect of combining alcohol consumption with smoking. Moreover, any intent to abstain from smoking may have been overruled by the disinhibitory properties of alcohol [33-35, 48, 49]. Although we do not have information on participants’ whereabouts during alcohol consumption, it is likely that alcohol consumption took place in social settings as in the Netherlands, 80% of juvenile alcohol consumption is concentrated in public drinking places and parties [50]. In these settings, smokers are most likely around (Footnote 2). It has been suggested that seeing others smoke is associated with lapsing among adolescents [39]. Thus, to determine whether the effect of alcohol use on the first lapse can either be attributed to the physiological (intoxicating) effects of alcohol (prior refs) and its consequent impact on self-control processes, or to the smoking cues that were present in the drinking setting (e.g., seeings other smoke) requires a design in which alcohol consumption is extricated from the setting in which it commonly occurs [cf. 25]. Nonetheless, the present results strongly suggest that adolescents in cessation should be informed that drinking poses a strong risk for smoking relapse. It might be fruitful to advise teenagers, especially younger teenagers, to avoid any drinking setting and to abstain from alcohol while trying to quit smoking.

Situational alcohol use was not associated with progression from lapse to relapse. However, given that the first lapse marked the beginning of a relapse in 58.7% of the cases, it is possible that alcohol consumption does trigger relapse in some people by instigating the first lapse. But this does not seem to apply to participants for whom the beginning of their relapse episode did not coincide with their lapse day. For this group of people, but also more generally, it is possible that after the first lapse, the event of lapsing itself – rather than drinking – is mainly responsible for progression to relapse. It is known that the act of lapsing can instigate a series of negative cognitive and affective reactions, such as decreased self-efficacy and increased negative affect, that in turn can result in excessive use of the substance and thus in relapse (the abstinence violation effect, [51]). Indeed, lower levels of self-efficacy to maintain abstinence on the lapse day have been found to predict progression to relapse among adolescents [44].
Age accounted for variation in the effect of drinking on the first lapse; the effect of alcohol consumption on the first lapse was stronger for younger adolescents. It is possible that the effect of alcohol intoxication on the parts of the brain involved in response inhibition [33-35] is stronger among younger teenagers as they have shorter histories of drinking than their older counterparts, and since these brain regions may be less matured in younger adolescents [33, 40-41]. It is also possible that younger adolescents (with a shorter smoking history) are less serious about quitting smoking and may have weaker intentions to remain abstinent. For this reason, disinhibition due to alcohol consumption might make them even more prone to lapse. Alternatively, the moderating effect of age may reflect a tendency toward deviant behavior of which both early use of alcohol and quick resumption of smoking might be indicators [52].

Further, we hypothesized that the association between alcohol consumption and the first lapse could be weaker for those who generally drink more frequently, as they may have developed more tolerance against the disinhibiting effects of alcohol. However, this assumption was not directly supported by our findings. We found that the association between drinking and the first lapse did not differ according to general drinking level. It is of course possible that those who drink more frequently also drink more per occasion, which would offset any possible buffering effect of prior drinking experience and its attendant tolerance. In addition, for those who drink more frequently, the conditioned association of alcohol with tobacco use may be stronger, which could increase the risk of smoking (re)lapse [29, 30]. More generally, the degree of smoking reinforcement afforded by the exposure to alcohol might also depend on the amount of alcohol consumed. Future studies are encouraged to include information on quantity of drinking to determine whether there is a dose-response relation between the amount of glasses consumed and the risk of (re)lapse.

In interpreting the above results, we acknowledge the following limitations. Firstly, participants were asked to report on their alcohol use during the past 30 minutes. If drinking occurred an hour before completing the assessment, alcohol use was not reported (provided that participants adhered to the instructions of reporting on the past 30 minutes, which is something we cannot verify). Given that the evening assessment interval ended at 10 p.m., and given that adolescents go out late at night during the weekends, it is also conceivable that drinking occurred after completion of the last assessment, and thus was not reported to have occurred that day. As a consequence, it is possible that the prevalence of drinking in the present study as well as the situational effect of alcohol use on lapse are somewhat underestimated. Further, the results pertaining to the cross-level interactions for relapse need
to be interpreted with caution, as the analysis may have been underpowered to detect significant interactions in a relatively small sample. For all other analyses, however, statistical power was not a problem as was evidenced by the small confidence intervals. A more general limitation is that we do not know by which mechanisms the presently demonstrated effect of alcohol use on the first lapse operates in adolescents, and future research on the association between adolescent drinking and smoking relapse is needed to further elucidate the processes behind. These limitations notwithstanding, the present study suggests that adolescent drinking during smoking cessation poses a strong risk factor for the first lapse into smoking and should be targeted in smoking cessation interventions for adolescents.
Footnotes

1. We also performed the situational level analyses including the participants who had not completed the baseline questionnaire, and results for all three outcomes were identical to the results without those participants.

2. At the time of data collection, the current smoking ban in bars and restaurants was not yet operational in the Netherlands.
Alcohol Consumption & Smoking Relapse

Tables and figures

Table 1. *Full models for lapse and relapse.*

<table>
<thead>
<tr>
<th></th>
<th>Progression from Quit to Lapse (N = 459)</th>
<th>Progression from Lapse to Relapse (N = 117)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>95% CI</td>
</tr>
<tr>
<td>Situational level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol consumption</td>
<td>5.45***</td>
<td>2.55 – 11.66</td>
</tr>
<tr>
<td>Individual level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>.96</td>
<td>.82 – 1.12</td>
</tr>
<tr>
<td>Sex</td>
<td>.84</td>
<td>.56 – 1.26</td>
</tr>
<tr>
<td>Alcohol use during study (AUS)</td>
<td>.94</td>
<td>.62 – 1.42</td>
</tr>
<tr>
<td>Smoking status</td>
<td>1.14</td>
<td>.91 – 1.44</td>
</tr>
<tr>
<td>Cross-level interactions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol consumption * Age</td>
<td>.54*</td>
<td>.29 – .98</td>
</tr>
<tr>
<td>Alcohol consumption * Sex</td>
<td>.75</td>
<td>.19 – 2.93</td>
</tr>
<tr>
<td>Alcohol consumption * AUS</td>
<td>.66</td>
<td>.16 – 2.77</td>
</tr>
<tr>
<td>Alcohol consumption * Smoking status</td>
<td>1.41</td>
<td>.65 – 3.08</td>
</tr>
</tbody>
</table>

*Note.* *p* < 0.05, **p* < 0.01, ***p* < .001. AUS: Alcohol use throughout the study (median split).
Figure 1. Distribution of alcohol consumption across study days.

![Histogram showing distribution of alcohol consumption across study days.](Image)
References


44. Van Zundert R. M. P., Ferguson S. G., Shiffman S., Engels R. C. M. E. Dynamic Effects of Self-Efficacy on Smoking Lapse and Relapse among Adolescents. (Resubmitted to *Health Psychol*).


Chapter 12

Asthma and the development of nicotine dependence among adolescents: A longitudinal study

(short report)
Abstract

Objective. To test differences in the development of nicotine dependence and smoking cessation attempts between adolescents with and without asthma. Methods. Longitudinal study among 286 adolescents who were never smokers at baseline and current smokers 22 months later. Regression analyses were applied to test the effects of four asthma indicators on nicotine dependence and quit attempts. Results. Adolescents with high symptom severity and indication of asthma developed higher levels of dependence over time than those with fewer or no symptoms or without asthma. More severe symptoms and indication of asthma increased the odds of having made an unsuccessful quit attempt in the past 12 months. These effects were partly mediated by nicotine dependence. Conclusions. Nicotine dependence develops more quickly in youth with asthma and explains unsuccessful cessation attempts. Prevention programs are encouraged to provide additional support for youth with asthma focusing on both the physiological and psychological aspects of dependence.
Asthma & Nicotine Dependence

Introduction

Worldwide, smoking poses major health risks and has become the leading preventable cause of death (WHO, 2003). Smoking is even more harmful for individuals with chronic diseases such as asthma, yet a growing body of research demonstrates that smoking prevalence rates are highly similar between people with and without asthma (Forero, Bauman, Young, Booth, & Nutbeam, 1996; Van de Ven, Engels, Kerstjens, & Van den Eijnden, 2007). Regarding smoking onset, recent research revealed that adolescents with current diagnosed asthma are less likely to start experimenting with smoking (Van de Ven et al., 2007). Once started, the likelihood that adolescents will progress in their smoking rate seems similar for those with and without asthma (Tercyak, 2006), but the pace at which adolescents progress appears to be higher among youth with asthma. Van de Ven and colleagues (2007) demonstrated that if adolescents with asthma started smoking, they had more often progressed to regular smoking than to experimental smoking 22 months later compared to healthy peers. This suggests that the transition from non-smoking to regular smoking is accelerated among youth with asthma. In addition, Van de Ven and colleagues (2007) found that those with more severe symptoms of asthma had an increased risk to become regular smokers compared to those with no or less severe symptoms.

Despite that adolescents with asthma seem to be ahead of their peers in the earlier stages of smoking, one might expect that the additional health risks stimulate them to give up their habit. Indeed, Van Zundert, Engels, Kleinjan and Van den Eijnden (2008) found that daily smoking adolescents with asthma were relatively more motivated to quit than their non-asthmatic peers. This is in line with cross-sectional research from U.S. samples showing that adolescents with asthma were more likely to have made a recent quit attempt (Tercyak, 2003). However, this was tested among current smokers, indicating that these quit attempts had been unsuccessful. Nicotine dependence has been shown to be a strong precursor of both current smoking and unsuccessful smoking cessation among adolescents (Kleinjan, Engels, Van Leeuwe, Brug, Van Zundert & Van Den Eijnden, 2009). It is possible that differences in the development of nicotine dependence between those with and without asthma can account for the accelerated
transition from non-smoking to regular smoking among adolescents with asthma as well as for the effect of asthma on unsuccessful quit attempts.

There are, however, very few studies that have examined nicotine dependence among youth with asthma in comparison with non-asthmatic peers and none were longitudinal. One cross-sectional study among daily smoking adolescents with and without asthma showed that there were no differences between groups in absolute levels of nicotine dependence and craving (i.e., strong urge to smoke) (Van Zundert et al., 2007). But due to its cross-sectional design, this study left unclear whether adolescents with and without asthma had developed nicotine dependence at the same pace or not. At present, no longitudinal data on the development of nicotine dependence among adolescents with asthma has been presented. In addition, the effect of asthma status on quit attempts (Tercyak, 2003) has not been replicated, nor tested longitudinally. The present study aims to test differences in the development of nicotine dependence and quit attempts between adolescents with and without asthma in a longitudinal study among 286 adolescents who were never smokers at baseline and smokers at follow-up.

Method

The data of the present study pertain to the first (T1) and third wave (referred to as “T2” in the present study) of a larger nationwide study among 7,426 Dutch adolescents. More detailed information about the data collection and informed consent can be found in other publications on these data (Kleinjan, Van den Eijnden, van Leeuwe, Brug, Otten & Engels, 2007; Van de Ven et al., 2007; Van Zundert et al., 2007). The study was approved by the medical ethics committee (CMO Arnhem-Nijmegen). Ages ranged between 12 and 15 years ($M = 12.9$, $SD = .76$) at T1, and between 14 and 17 ($M = 14.8$, $SD = .75$) at T2.

Four indicators of asthma were used that originate from the ISAAC self-report questionnaire (Asher et al., 1995) and the student questionnaire of the American College of Allergy, Asthma and Immunology (ACAAI) (Redline et al., 2004). These indicators of asthma have been successfully applied in a prior publication on asthma and smoking (Van de Ven et al., 2007; See this publication for more information about how these indicators were defined). The indicators were 1) current wheeze, 2) indication of asthma (IoA), 3) symptom severity, and 4) current diagnosed asthma.
To examine the development of nicotine dependence after smoking initiation, we selected the respondents who reported to never have smoked at T1, and who reported to have smoked in the past month at T2 (n = 286). At T2, nicotine dependence was measured using a scale with 11 items that has been designed for adolescents specifically (Kleinjan et al., 2007), including items on ‘behavioral aspects’ (‘How many cigarettes do you smoke per day?’), ‘physiological aspects’ (Do you ever have strong cravings to smoke?’) and ‘nervousness’ (‘In times that you tried to stop or weren’t able to smoke, how often were you troubled by feeling nervous, restless or anxious?’). Cronbach’s alpha was .89. Reports of unsuccessful attempts to quit smoking in the past 12 months (no/yes) were also administered at T2. Age, sex, education, ethnicity, maternal and paternal smoking (yes/no) were tested in association with the dependent variables and included in the multivariate analyses as control variables if significantly related. We used t-tests, and linear and logistic regression analyses to test the associations between the four asthma indicators at T1 and nicotine dependence and having made a quit attempt at T2.

Results

Nicotine dependence

Bivariate analyses. Symptom severity at T1 was significantly positively correlated with nicotine dependence at T2 (r (272) = .16, p = .008), indicating that the more severe asthma symptoms were at baseline, the higher the level of nicotine dependence was 22 months later. Respondents with IoA scored higher on nicotine dependence as well (t (260) = -2.13, p = .035). Respondents with current diagnosed asthma and current wheezing also appeared to have higher levels of nicotine dependence at T2 compared to adolescents without respiratory problems, but these differences were not statistically significant (t (266) = -0.44, p = .669; t (272) = -0.55, p = .587 respectively).

Multivariate analyses. Of all control variables, only maternal smoking at T1 predicted the level of nicotine dependence at T2: Smoking by mothers was associated with stronger dependence (β = .15, p = .031). IoA, current diagnosed asthma, and current wheezing at T1 did not predict nicotine dependence (β = .10, p = .115; β = .05, p = .421; β = .04, p = .515, respectively). Symptom severity, however, significantly predicted
nicotine dependence at T2 after controlling for maternal smoking (adjusted $\beta = .14, p = .017$); more severe symptoms were associated with higher levels of dependence. 

Unsuccessful quit attempts.

Bivariate analyses. Nicotine dependence was strongly related to having made an unsuccessful quit attempt: Individuals with high levels of dependence were over 2.5 times more likely to have made a quit attempt in the past 12 months (OR = 2.52, CI = 1.64 – 3.87, $p < .001$). Symptom severity and IoA were also significantly related to an attempt to quit (OR = 3.01, CI = 1.20 – 7.60, $p = .019$; OR = 1.77, CI = 1.01 – 3.09, $p = .045$ respectively); there was a threefold increase of the odds of having made an attempt to quit for those with higher symptom severity. Those with IoA had higher odds of reporting an unsuccessful quit attempt compared to those without IoA. Current wheezing and current diagnosed asthma were not related to attempts to quit (OR = 1.05, CI = .49 – 2.26, $p = .908$; OR = 1.01, CI = .37 – 2.77, $p = .988$ respectively).

Multivariate analyses. Of the control variables, only educational level predicted whether someone had made a quit attempt, with those receiving higher education being less likely to report an unsuccessful attempt (OR = .60, CI = .45 – .78, $p < .001$).

The effect of symptom severity on unsuccessful quit attempts remained significant when controlling for nicotine dependence (adjusted OR = 2.77, CI = 1.04 – 7.36, $p = .042$). Moreover, the Sobel statistic demonstrated that nicotine dependence significantly mediated the effect of symptom severity on unsuccessful quit attempts ($z = 2.24, p = .025$). The effect of symptom severity diminished to significance on a trend level when nicotine dependence and educational level were controlled for simultaneously (adjusted OR = 2.57, CI = .94 – 7.00, $p = .066$). The effect of IoA diminished when controlling for nicotine dependence alone (adjusted OR = 1.75, CI = .95 – 3.21, $p = .071$), and when controlling for nicotine dependence and educational level simultaneously (adjusted OR = 1.75, CI = .95 – 3.21, $p < .071$). The Sobel statistic demonstrated that nicotine dependence mediated the effect of IoA on unsuccessful quit attempts on a trend level ($z = 1.89, p = .058$).

Discussion

The main findings show that those who scored higher on symptom severity and who were indicated to have asthma developed higher levels of nicotine dependence over
time than those with fewer or no symptoms or who did not have an indication of asthma. Having more severe symptoms and indication of asthma increased the odds of having made an unsuccessful attempt to quit in the past 12 months. High levels of nicotine dependence were strongly related to having made an unsuccessful quit attempt, and partly mediated the effects of symptom severity and indication of asthma on quit attempts.

The finding that symptom severity and IoA predicted nicotine dependence 22 months later in a sample of baseline never smokers seems to support the assumption that adolescents with respiratory difficulties develop nicotine dependence more quickly than those with fewer or no symptoms. The accelerated progression in nicotine dependence might be explained by the short-term beneficial health effects that certain components of cigarette smoke seem to have on respiratory problems through suppressing symptoms (Melgert et al., 2004). This may cause individuals with asthmatic symptoms to feel a stronger need or higher necessity to smoke, thereby possibly intensifying the psychophysiological aspects of nicotine dependence such as craving. Other aspects of nicotine dependence are feelings of restlessness, nervousness and anxiety that individuals experience when being deprived of smoking. Considering that the prevalence of panic disorders, affective disorders and anxiety appear to be higher in samples with asthma than in normative samples (Goodwin, Fergusson, & Horwood, 2004), and that smoking is often used to reduce stress symptoms and negative affect (Balfour, & Ridley, 2000), it seems plausible to assume that adolescents with asthma are more easily hooked on nicotine. Especially since studies have also suggested that negative mood states adversely affect pulmonary function in asthmatics (Zaubler & Katon, 1996), it is possible that smoking seems even more appealing to youth with asthma, which might explain their faster transition to higher levels of nicotine dependence as well.

Our findings also suggest that those with indication of asthma, and especially those with more severe symptoms are more likely to be unsuccessful in quitting. The finding that adolescents with respiratory problems developed higher levels of nicotine dependence may account for the increased likelihood of cessation failure. Indeed, we found that the effects of symptom severity and indication of asthma on unsuccessful quit attempts were in part mediated by nicotine dependence. However, the observation that symptom severity predicted quit attempts above and beyond nicotine dependence
suggests a unique contribution of asthma status on cessation efforts. Anecdotal reports of people with respiratory problems often indicate that they experience more coughing and production of sputum when attempting to quit, which may hinder prolonged abstinence.

Combining the present results with the existing literature, the following picture seems to emerge: Compared to non-asthmatic peers, adolescents with asthma are less inclined to try smoking (Van de Ven et al., 2007). Yet if they start smoking, they progress to regular smoking more quickly (Van de Ven et al., 2007), and according to the present results they develop symptoms of dependence more quickly as well. Nonetheless, adolescents with asthma seem more motivated to quit (Van Zundert et al., 2007). However, the present results show that those smokers with indication of asthma and with more severe symptoms are more likely to experience failure of a quit attempt (cf. Tercyak, 2003).

Limitations of the present study are, firstly, that smoking was assessed using self-reports, yet confidentiality was ensured and self-reports have been demonstrated to be valid and reliable when anonymity is guaranteed (Dolcini, Adler, Lee & Bauman, 2003). Symptoms of asthma were also assessed through self-reports, but the instruments used have been validated to adequately detect atopic diseases (Asher et al., 1995). Moreover, a considerable number of participants were lost to follow-up, but previous attrition analyses on the same data suggested that potential selective attrition was very limited (Van de Ven et al., 2007). These limitations notwithstanding, the present longitudinal study provides new insight into the role of asthma status in the development of nicotine dependence and quit attempts among adolescents.

Considering that adolescents with asthma seem more motivated to quit but appear less successful in achieving cessation, intervention programs might need to provide additional support to adolescents with asthma compared to what would be required for non-asthmatic peers. Since adolescents with asthma seem to develop dependence more quickly, and since cessation failure is in part explained by nicotine dependence, nicotine replacement therapy could be considered to be provided to counter the physiological effects of cessation. The psychological aspects of dependence need consideration as well, and may be particularly important to adolescents with asthma since previous findings
suggest that youth with asthma attach more value to the positive aspects of smoking (Van De Ven, Engels, Otten & Van Den Eijnden, 2007; Van Zundert et al., 2008).
References


Chapter 13

Parents’ and best friends’ smoking, smoking-specific cognitions, and nicotine dependence in relation to readiness to quit smoking: A comparison between adolescents with and without asthma
Abstract

Objective. To study the impact of parents’ and best friends’ smoking, nicotine dependence, and craving on smoking-specific cognitions, and readiness to quit in adolescents with and without asthma. Methods. Structural equation analyses were applied to 1120 daily smoking adolescents, 83 of whom had asthma. Results. Adolescents with asthma felt more ready to quit, and cognitions were more strongly related to readiness to quit among adolescents with asthma than among adolescents without asthma. Moreover, best friends’ smoking seemed more relevant to the cognitions of adolescents with asthma. Nicotine dependence and craving were strongly related to cognitions, and to readiness to quit in both groups. The relation between craving and readiness to quit, however, was stronger among participants with asthma. Conclusions. Reduction of nicotine dependence and craving is essential for both groups. Youth with asthma may benefit even more from cognitive-based cessation services than healthy youth. The finding that adolescents with asthma are relatively more ready to quit, and that their cognitions are more easily affected can be turned into advantages in asthma-specific cessation services.
Asthma & Readiness to Quit

Introduction

Smokers with asthma have been abundantly shown to suffer exacerbation of asthma symptoms and to have a higher risk for developing chronic obstructive pulmonary disease (COPD) compared to people with asthma who do not smoke (Althuis, Sexton, & Prybylski, 1999; Floreani, & Rennard, 1999). Despite these significant and enhanced health risks of smoking for people with asthma, some studies have shown that adolescents and young adults with asthma are more likely to smoke (Tercyak, 2003; Zbikowski, Klesges, Robinson, & Alfano, 2002), and to have equivalent or even higher smoking rates than individuals without asthma (Backer, Nepper-Christensen, Ulrik, von Linstow & Porsbjerg, 2002; Forero, Bauman, Young, Booth, & Nutbeam, 1996; Kaplan, & Mascie-Taylor, 1997; Precht, Keiding, & Madsen, 2003; Sherman, Tosteson, Tager, Speizer, & Weiss, 1990; Van de Ven, Van den Eijnden, & Engels, 2006). Moreover, adolescents with and without asthma are equally likely to progress to more heavy levels of smoking (Tercyak, 2006). Successful smoking cessation is highly beneficial to people with asthma, as smoking cessation seems to cause improvements in asthma-specific quality of life scores, reductions in intake of rescue beta2-agonists and inhaled corticosteroids, reduction in asthma symptoms, and reduction in bronchial hyperreactivity (Tønnesen, Pisinger, Hvidberg, Wennike, Bremann, Westin, Thomsen, & Nilsson, 2005). As a result, tobacco use is highly contraindicated among adolescents with asthma (NAEPP, 1997), and virtually every study on asthma and the health risks of smoking conclude that it is crucial to dedicate greater efforts to promoting smoking cessation, or readiness to quit smoking which has been found to be a precursor of smoking cessation among adolescents without asthma (Engels, Knibbe, De Vries & Drop, 1998; Lichtenstein, Lando, & Notwehr, 1994; Osler & Prescott, 1998).

Tyc and Throckmorton-Belzer (2006) also note that there is an urgent need for more studies on predictors of smoking and smoking cessation in chronically ill children and adolescents. To our knowledge, there has been only one study to date which has explored aspects of smoking cessation among adolescents with asthma. Tercyak (2003) found that adolescents with asthma more often had attempted to quit smoking than peers without asthma, although their attempts seemed equally unsuccessful. Readiness to quit refers to on what term smokers are planning to quit smoking, for example, nowhere in the future, or within one month. Since readiness to quit may be a necessity to attempt to quit smoking in the first place (Engels et al., 1998; Lichtenstein et al., 1994; Osler & Prescott, 1998), it is important to establish factors that play a role in readiness to quit among adolescents, particularly among
those with asthma. The present study is the first to focus on readiness to quit smoking among daily smoking adolescents with and without asthma.

Research among healthy adolescents and adults has revealed a number of important determinants of readiness to quit, which include factors related to the social environment, individuals’ own smoking-related cognitions, and psychophysiological factors, such as nicotine dependence and craving. In the present study, we aimed to integrate all three concepts in relation to adolescent readiness to quit. Regarding environmental smoking exposure, it appears that if persons in the immediate social environment smoke, such as friends and parents, adolescents seem less motivated to quit smoking or to undertake fewer quit attempts (Burt & Peterson, 1998; Farkas, Distefan, Choi, Gilpin & Pierce, 1999; Kleinjan, Engels, Van Leeuwe, Brug, Van Zundert, & Van Den Eijnden, submitted; Van Zundert, Van de Ven, Engels, Otten, & Van den Eijnden, 2007). Parental smoking, for example, is related to a lower self-efficacy to resist smoking, and as such may discourage adolescents from wanting to quit in the first place (Van Zundert et al., 2007). This may also apply to friends’ smoking.

Smoking-specific cognitions, such as the pros of smoking and quitting, and self-efficacy to resist smoking have consistently been found to be related to readiness to quit among both adults and adolescents (Dijkstra, Bakker, & De Vries, 1997; Engels et al., 1998; Hansen, Collins, Anderson Johnson, & Graham, 1985; Prochaska, & DiClemente, 1984; Prochaska, Velicer, Guadagnoli, & Rossi, 1991; Van Zundert et al., 2007). Apparently, if smokers perceive relatively many pros of quitting, relatively few pros of smoking, and have a high self-efficacy to resist smoking, they are more ready and motivated to quit smoking. Furthermore, although studies on this subject are scarce, a few have consistently shown a very strong negative association between nicotine dependence and craving on the one hand, and readiness to quit smoking on the other, in samples of both adolescents and adults (Breslau & Peterson, 1996; Horn, Fernandes, Dino, Massey & Kalsekar, 2003; Kleinjan, Van Den Eijnden, Van Leeuwe, Brug, Otten & Engels, 2007; Prokhorov, Suchanek Hudmon, De Moor, Kelder, Conroy, & Ordway, 2001).

Beside the fact that nicotine dependence and craving as well as smoking by significant others are directly related to readiness to quit, they are likely to have an indirect impact through smoking-specific cognitions as well. Most studies focus on the direct relation between nicotine dependence and readiness to quit without examining possible mediators. In relation to smoking-specific cognitions, for example, research on nicotine dependence and craving among both adults and adolescents is scarce. One exception would be accounted for
by Kleinjan, Van Den Eijnden, Van Leeuwe, Brug, Van De Ven, & Engels (resubmitted), who showed that among adolescents, higher levels of nicotine dependence were indirectly negatively related to readiness to quit through cognitive/affective strategies that are applied to achieve changes in smoking behavior (processes of change). Moreover, it is conceivable that a strong dependence on nicotine and strong feelings of craving stimulate a more positive perception of smoking and may discourage smokers to feel efficacious to resist smoking. Fagan, Eisenberg, Frazier, Stoddard, Avrunin, and Sorensen (2003), for example, found that high scores on nicotine dependence were related to a decreased score on self-efficacy to avoid smoking. In turn, readiness to quit may be lowered by an elevated positive perception of the pros of smoking and a low sense of self-efficacy. Previous findings also suggest that parental and friends’ smoking have a negative impact on smoking-specific cognitions in the sense that smoking by these significant others is related to a perception of relatively many pros of smoking, few pros of quitting, and a low self-efficacy (Chen, Stanton, Fang, Li, Lin, Zhang, Liu, & Yang, 2006; Harakeh, Scholte, Vermulst, De Vries, & Engels, 2004; Van Zundert et al., 2007). Similarly, smoking by significant others in the social environment may have an indirect impact on adolescent’s readiness to quit through smoking-specific cognitions.

Consequently, we tested a series of structural models in which the smoking status of parents and participants’ best friends, as well as nicotine dependence and craving, were expected to be directly related to readiness to quit, as well as indirectly through the smoking-specific cognitions (see Figure 1). This model was tested for smokers with asthma and without asthma separately to establish which factors are specifically important for adolescents with asthma.

Method

Participants

The present study was part of a broader representative nationwide study on psychological processes in relation to tobacco use among 10,265 Dutch adolescents with and without asthma. Other publications on these data involve those of Kleinjan and colleagues (2007; in resubmission; in submission), Van De Ven and colleagues (2006; 2007), and Van Zundert and colleagues (2007). The data were collected during November 2004. Fifty-five schools had been approached to participate, of which 33 schools agreed to cooperate. The questionnaires were administered during school hours, in the presence of an instructed teacher. To assure confidentiality and anonymity, each student received an unmarked envelope in which they had to enclose the completed questionnaires. All procedures had been approved by the Committee on Research Involving Human Subjects. Of the 12,532 eligible
students, 10,265 students (81.9%) completed the questionnaire. Sickness, truancy, leaving school, and repeating class were noted by teachers as the primary causes for non-response.

Asthma status was assigned to those respondents who reported to have had asthma in the past 12 months, as acknowledged by their physician, or to have taken asthma medication in the past 12 months. Respondents who did not report current asthma, but who had had asthma in the past were excluded from both the groups with and without asthma. As readiness to quit may be an entirely different construct for regularly smoking adolescents compared to less frequently smoking adolescents, particularly as pertains to craving and dependence, only those respondents who reported to smoke daily were selected. This resulted in a final sample of 1,120 daily smokers, with 83 smokers with asthma and 1,037 smokers without asthma. Regarding the prevalence of daily smoking in the entire original sample (including those who have been excluded from the present analyses), we found that 8.0% of the adolescents aged 14 reported to smoke daily. Percentages of daily smoking were 12.6% among 15-year-olds, 18.0% among 16-year-olds, and 24.8% among 17-year-olds.

The entire sample of 1,055 respondents consisted of 554 boys (49.5%) and 563 girls (and 3 adolescents (0.3%) without reports on sexes), with ages distributed as follows: 14 (18.0%), 15 (40.3%), 16 (30.4%), 17 (9.8%), 18 years (0.3%), and 1.4% unknown (M = 15.30, SD = 1.07). All students received regular education; 55.3% received lower vocational training, 22.3% received intermediate vocational training, 16.1% received high school education, 3.9% received pre-university education, and the remaining 2.4% had not specified their educational attainment. Amount of cigarettes smoked per day for adolescents with and without asthma respectively: 1-5 cigarettes (27.7% [adolescents with asthma]; 24.2% [adolescents without asthma]), 6-10 cigarettes (27.7%; 36.5%), 11-20 cigarettes (31.3%; 32.9%), 21-30 cigarettes (7.2%; 5.2%), 31 cigarettes or more (4.8%; 1.2%), and unknown (1.2%; 0.0%).

Measures

Parents’ and best friends’ smoking. Standard items were used to ask participants whether their fathers, mothers, and best friends were smokers or non-smokers. These items are identical to those used in other studies (Harakeh et al., 2004; Kleinjan et al., 2007; Van De Ven et al., 2006)

Nicotine dependence and craving. Nicotine dependence was measured with a measure of nicotine dependence attuned to adolescents specifically, which has good psychometric properties (Kleinjan et al., 2007). This composition was derived from the modified Fagerström Tolerance Questionnaire (mFTQ) (Fagerström, & Schneider, 1989), and Hooked
on Nicotine Checklist (HONC) (DiFranza, Rigotti, McNeill, Ockene, Savageau, St Cyr, & Coleman, 2000). The total 11 items of the three subscales include aspects of emotional and physical symptoms of dependence (irritation, anger, restlessness, etc., when abstaining or smoking less), and behavioral symptoms of nicotine dependence (e.g., intensity of smoking). The scale was composed with the standardized values, since answering categories were not all the same for each item. Alpha was .80. Craving was assessed with six items which tapped how often one craved or looked forward to smoke a cigarette or to inhale smoke, on a 5-point Likert scale, with anchors ranging from 1 (never) to 5 (very often) (Dijkstra & Borland, 2003). Alpha was .91.

**Smoking-specific cognitions.** The smoking-specific cognitions included the pros of smoking, pros of quitting (De Vries, & Backbier, 1994; Dijkstra et al., 1997; Van Zundert et al., 2007) and self-efficacy to resist smoking (Velicer, DiClemente, Rossi, & Prochaska, 1990; Van Zundert et al., 2007). Pros of smoking involved 10 items measuring the perceived positive aspects of smoking, such as “Smoking helps to relax”, and “Smoking helps to concentrate”. Cronbach’s alpha was .83. Pros of quitting were measured through 14 items about the perceived advantages of smoking cessation, such as “To quit smoking decreases the risk for lung cancer”, and “To quit smoking will get me in better shape”. Cronbach’s alpha was .90. Both scales had response choices ranging from 1 (totally disagree) to 4 (totally agree), and were constructed by De Vries and Backbier (1994), and validated in other studies (cf. Dijkstra et al., 1997). Self-efficacy represented the perceived difficulty to resist smoking in tempting situations on a scale from 1 (very easy) to 5 (very difficult). Exemplary situations of the 8 situations given are: “When things are not going your way and when you are frustrated”, and “When your friends offer you a cigarette”. Alpha was .86.

**Readiness to quit.** This measure had been derived from the original stages of change measure by Prochaska, Velicer, Guadagnoli, and Rossi (1991), and was similar to stages of change derived scales as used in other studies (Dijkstra et al., 1997; Kleinjan et al., 2007; Van Zundert et al., 2007). On a scale from 1 to 9, respondents could rate their readiness to quit: 1 (within 10 days), 2 (within 1 month), 3 (within 6 months), 4 (within 1 year), 5 (within 5 years), 6 (within 10 years), 7 (in the future, but not within 10 years), 8 (I intend to keep smoking, but to cut down), 9 (I intend to keep smoking and not to cut down). The items had been recoded so that a high score on this scale represented a high readiness to quit. To restrict the skewness of the distribution, the answering possibilities were recategorized as follows: ‘1’ (anchors 8 and 9), ‘2’ (anchors 5 through 7), ‘3’ (anchors 3 and 4), and ‘4’ (anchors 1 and 2). We found this distribution the most suitable one with regard to both content and normality.
Responses to this reduced scale by adolescents with asthma, respectively, without asthma, were as follows: 1 ‘intend to keep smoking and not to quit in the future’ (34.6% (adolescents with asthma); 50.2% (adolescents without asthma)), 2 ‘intend to quit somewhere in the future’ (23.1%; 20.4%), 3 ‘intend to quit within 6 months to 1 year’ (21.8%; 17.2%), and 4 ‘intend to quit within 10 days to 1 month (20.5%; 12.2%).

Strategy for analyses

To test if there were differences between adolescents with and without asthma in mean scores on all model variables, t-tests and chi-square tests were conducted. Subsequently, structural equation modelling using AMOS 5.0 (Arbuckle, 2003) was applied to test the structural models for both the groups with and without asthma separately (see Figure 1). Incidental missings were handled by using the maximum likelihood estimator in AMOS. The Comparative Fit Index (CFI) and the Root Mean Square Error Of Approximation (RMSEA) indices were used to determine the fit of the structural models, as recommended by Kline (1988). First, a basic model was tested with only smoking-specific cognitions and readiness to quit included. Next, to examine the interplay between the social environmental and psychophysiological factors on the one hand, and the cognitions and readiness to quit on the other, the basic model was extended. The sample size of the group with asthma (n = 83) did not allow to test structural equation models with many variables. Therefore, in following the guidelines by Stevens (1996), who recommends to have at least 15 cases per measured variable or indicator, and Bentler and Chou (1987) who recommend at least 5 cases per parameter estimate, we decided to test five different models with five observed variables. In each model, one independent (exogenous) variable, as depicted in Figure 1, was tested in relation to the pros of smoking and quitting, self-efficacy, and readiness to quit.

Results

Descriptive analyses: t-tests and chi-squares for independent samples

Chi-square tests revealed no differences between adolescents with and without asthma in terms of smoking of father, mother, and best friend (Table 1). Further, t-tests were performed for the pros of quitting, pros of smoking, self-efficacy, nicotine dependence, and craving. Both groups did not differ significantly on either one of these variables. However, adolescents with asthma did differ from their peers without asthma in scores on readiness to quit, with those without asthma being less ready to quit smoking. Of the participants with asthma, 34.6% fell in category ‘1’ of the reduced readiness scale (“I intend to keep smoking and not to quit in the future”), compared to 50.2% of the group without asthma ($\chi^2 [3, 1115] = 8.64, p = .034$).
Structural Equation Modelling

All model fits ranged from excellent to acceptable (see Table 2). The results of all 5 models will be described for adolescents with and without asthma separately (see Table 3), after which patterns of similarities and differences between groups will be described.

Adolescents with asthma. Basic model. The basic model showed that perceiving relatively many pros of quitting, and fewer pros of smoking, was significantly related to a higher readiness to quit. The regression weight of the relation between self-efficacy and readiness to quit seemed moderate, but did not reach significance. Extended models. Further, smoking by fathers was associated with a lower readiness to quit, and a trend was found for paternal smoking being related to lower scores on the pros of quitting. Paternal smoking was not associated with the pros of smoking nor with self-efficacy. Maternal smoking was not significantly associated with readiness to quit, nor with the pros of smoking and self-efficacy. However, if mothers were smokers, adolescents seemed to perceive less pros of quitting. Furthermore, best friends’ smoking was not directly related to readiness to quit among adolescents with asthma. However, if their best friend smoked, adolescents with asthma were more likely to perceive both more pros of smoking and more pros of quitting. Given that the pros of smoking and quitting were significantly related to readiness to quit, this suggests an indirect relation between best friends’ smoking and readiness to quit among adolescents with asthma, through both the types of pros. Best friends’ smoking was not related to self-efficacy.

Nicotine dependence was moderately related to readiness to quit directly, and was strongly related to perceiving more pros of smoking. Thus, the relation between nicotine dependence and readiness to quit may be indirect, partly through the pros of smoking. Nicotine dependence was also related to a lower self-efficacy to resist smoking. There was no relation between nicotine dependence and the pros of quitting. Furthermore, stronger feelings of craving appeared to be directly related to a lower readiness to quit. Higher levels of craving were also strongly positively related to the pros of smoking, and negatively related to self-efficacy. There was no relation between craving and the pros of quitting.

Adolescents without asthma. Basic model. Among adolescents without asthma, the basic model indicated that perceiving relatively many pros of quitting, and fewer pros of smoking, was significantly related to a higher readiness to quit. Self-efficacy appeared to be unassociated with readiness to quit. Extended models. Smoking by fathers was directly, but modestly, associated with a lower readiness to quit, and a lower perception of the pros of quitting. Paternal smoking was not associated with the pros of smoking nor with self-efficacy. Mothers’ smoking was modestly negatively related to both readiness to quit, the pros of
quitting, and to self-efficacy. Maternal smoking was not associated with the pros of smoking. Considering that in the two models of fathers’ and mothers’ smoking, the pros of quitting were significantly related to readiness to quit, and that fathers’ and mothers’ smoking were related to the pros of quitting, there may be a modest indirect relation between parental smoking and readiness to quit among adolescents without asthma. Best friends’ smoking was neither related to readiness to quit, nor to either one of the smoking-specific cognitions.

Furthermore, nicotine dependence was directly associated with a lower readiness to quit, and was also strongly related to perceiving more pros of smoking and having less self-efficacy. Given that the pros of smoking were significantly related to readiness to quit, there may be a modest indirect relation between nicotine dependence and readiness to quit through the pros of smoking. Nicotine dependence was not related to the pros of quitting. Craving was also directly related to a lower readiness to quit, perceiving less pros of quitting, more pros of smoking, and reporting a lower level of self-efficacy. In the craving model, only the pros of quitting were related to readiness to quit, which makes it possible that craving is also indirectly related to readiness to quit, through the pros of quitting.

Comparison of samples. Firstly, the explained variance of all models was consistently higher in the sample of adolescents with asthma. Secondly, judging from the basic model, the regression weights of the relations between pros of smoking and self-efficacy, and readiness to quit were higher in the sample with asthma (6% more explained variance). In general, the roles of parents’ and best friends’ smoking, as well as the role of nicotine dependence and craving in the smoking-specific cognitions and readiness to quit, was quite similar for adolescents with and without asthma. Best friends’ smoking, however, seemed unassociated with both the pros of smoking and quitting among adolescents without asthma. Yet if the best friends of adolescents with asthma smoked, adolescents were more likely to perceive both more pros of quitting and more pros of smoking. Lastly, craving was more strongly related to a low readiness to quit among adolescents with asthma (10% more explained variance).

Discussion

The present study investigated determinants of readiness to quit in a representative sample of daily smoking adolescents with asthma versus adolescents without asthma. The percentages of daily smoking adolescents in the entire original sample (n = 10,265) were somewhat lower compared to figures from a Dutch national survey in 2005 which show that percentages of daily smoking were 12% at the age of 14 (8.0% in our sample), 15% at the age of 15 (12.6 % in our sample), 28% of the 16-year-olds (18.0% in our sample), and 30% of those aged 17 smoked daily (24.8% in our sample) (Dutch Foundation for National Health
and Smoking [STIVORO], 2005). Adolescents with and without asthma did not differ in mean scores on the social environmental variables, nor on psychophysiological measures. Adolescents with asthma, however, were more ready to quit than their peers who do not have asthma.

**Smoking-specific cognitions and readiness to quit**

Perceiving relatively many pros of smoking and few pros of quitting was associated with a lower readiness to quit, which is in line with previous studies (Dijkstra et al., 1997; Hansen et al., 1985; Prochaska, & DiClemente, 1984; Van Zundert et al., 2007). Self-efficacy, however, appeared to be predominantly unrelated to readiness to quit, which contradicts our expectations as well as findings from a previous study among adolescents (Engels et al., 1998). Self-efficacy seems to differ across the various stages of motivation to quit, being most salient among smokers who are highly motivated to quit (Engels et al., 1998). It is thus possible that self-efficacy to resist smoking is relevant only in an advanced state of motivation to quit, and in the actual cessation and relapse process, rather than that it determines the motivation or readiness to quit smoking in the first place. The literature shows that the effect of self-efficacy seems to be dependent on both the time of reporting and the specific outcome variable. For example, self-efficacy as measured before the quit attempt seems to be a weak predictor of successful smoking cessation, whereas self-efficacy as reported during the actual cessation period appears to be a more significant predictor (Garcia, Schmitz & Doerfler, 1990).

When comparing the two samples on the relations between the smoking-specific cognitions on the one hand, and readiness to quit on the other, it appeared that pros of smoking and self-efficacy were more strongly related to readiness to quit among adolescents with asthma. The explained variance in the sample with asthma was 6% higher, which suggests that these differences in regression weights are meaningful. The finding that the pros of smoking seem to be more strongly associated with readiness to quit among adolescents with asthma than among those without asthma resembles previous findings showing positive attitudes towards smoking to be more strongly related to smoking onset among adolescents with asthma compared to healthy peers (Van De Ven et al., 2006; Van De Ven et al., 2007). This seems to imply that adolescents with asthma may view smoking as advantageous as their peers without asthma, but they may attach more value to these advantages. A possible explanation for this could be that adolescents with asthma are well aware that smoking is additionally unhealthy for them, and that they need to attach more value to the pros of smoking in order to justify their behaviour. This would imply processes of cognitive
dissonance reduction, which means that if people experience an inconsistency between their cognitions and their actual behaviour, they tend to adjust their cognitions to the behaviour in order to reduce or eliminate the dissonance (Festinger, 1957). The idea that cognitive dissonance reduction regarding smoking onset, and possibly also the cessation process, may be more intensively applied by adolescents with asthma has been previously suggested (Van de Ven et al., 2006), but has not yet been tested and requires longitudinal research.

Social environmental and psychophysiological factors

Although the path coefficient for maternal smoking in relation to readiness to quit failed to reach significance in the sample with asthma (due to sample size), smoking by parents generally seemed related to perceiving fewer pros of quitting, and to lower levels of readiness to quit among adolescents both with and without asthma, which is in accordance with the literature (Burt & Peterson, 1998; Farkas et al., 1999; Kleinjan et al., submitted; Van Zundert et al., 2007). Best friends’ smoking, however, seemed to play a more prominent role among adolescents with asthma, as the relations between best friends’ smoking and the pros of smoking and quitting were only existent among participants with asthma. Tercyak (2006) also found that exposure to friends who smoked was a consistent and strong social risk for smoking progression in adolescents with asthma as compared to adolescents without asthma. Strangely enough, in the present study, smoking by the best friends of adolescents with asthma was related to perceiving both more pros of quitting and more pros of smoking, which seems contradictory. Thus, if best friends of adolescents with asthma are smokers, this has both positive and negative sides. This may involve a selection effect in that adolescents with asthma who view smoking as advantageous may sooner look for friends who endorse their smoking than healthy peers would do. Again, adolescents with asthma may also be aware that smoking is harmful to their condition, but to mitigate that awareness, they may need more confirmation that smoking is acceptable. They may find this confirmation in selecting smoking best friends. Simultaneously, however, smoking cessation will be more of an issue for smoking best friends than for non-smoking best friends. It is possible that positive aspects of quitting are discussed among friends. Reasoning from the assumption that adolescents with asthma may be aware that smoking is extra harmful for their health, they may be more sensitive to arguments why smoking cessation would be favourable.

Regarding the psychophysiological factors, we found that nicotine dependence and craving were strongly positively related to the pros of smoking, and negatively related to self-efficacy and readiness to quit. These are important findings considering that nicotine dependence and craving have hardly been studied in relation to smoking-specific cognitions
or in relation to adolescent readiness to quit. The consistent finding that attitudes towards smoking are relevant to adolescents’ readiness to quit (Dijkstra et al., 1997; Prochaska & DiClemente, 1984; Prochaska et al., 1991; Van Zundert et al., 2007), and that self-efficacy is associated with actual smoking cessation and maintenance (Engels et al., 1998) emphasizes the importance of nicotine dependence and craving all the more.

In comparing the two samples on the psychophysiological factors, we found that results were quite similar, except for the relation between craving and readiness to quit, which was more than twice as strong among participants with asthma. As craving was operationalized as craving or looking forward to smoke, craving represents positive aspects of smoking. Adolescents with asthma may overrate the importance of craving in a similar vein as we have proposed that their perception of the pros of smoking is more important to their readiness to quit than is the case for healthy peers. There may also be a physiological aspect about smoking that discourages individuals with asthma from feeling prepared to quit. Researchers using animal models, for example, have found that short-term smoking decreases airway inflammation (Melgert, Postma, Geerlings, Luinge, Klok, Van Der Strate, Kerstjens, Timens & Hylkema, 2004). If such an effect of relief is indeed experienced by smokers with asthma (and craving may be felt as a craving for that relief), they may fear that asthmatic symptoms will increase after cessation, and consequently feel even less ready to quit than healthy adolescents who do not necessarily experience this advantage. Even though these ‘beneficial’ aspects of smoking are short-term (Melgert et al., 2004), they may construct the belief that smoking gives relief of asthmatic symptoms; a belief that may persist and discourage readiness to quit among adolescents with asthma.

Strengths and limitations

The present study is limited in that it has a cross-sectional study design, which does not allow us to determine the causality of relations. In addition, self-reports and reports by proxy were used to assess adolescents’ smoking status, and parents’ and best friends’ smoking status respectively. Despite that biological screening and multiple informants would be useful to corroborate these reports, previous studies have shown that self-reports on smoking status are reliable and comparable to biochemical verification (Dolcini, Adler & Ginsberg, 1996; Patrick, Cheadle, Thompson, Diehr, Koepsell & Kinne, 1994), and that children can adequately estimate parental smoking behavior (Vink, Willemsen & Boomsma, 2003). Moreover, the percentages of daily smoking in our sample were somewhat lower compared to figures from another Dutch national survey in 2005 (Dutch Foundation for National Health and Smoking [STIVORO], 2005), which may limit generalizability. Lastly, the large
difference in sample sizes between the group with asthma and the group without asthma prohibits multi-group testing. This is not an uncommon statistical problem in studying complex models on smoking behavior among adolescents with asthma (Van De Ven et al., 2007). However, the present samples were drawn from a large representative sample, which make the present data valuable and enables this study to be the first on readiness to quit smoking among regularly smoking adolescents with asthma.

Practical implications

According to the present results, there is a risk that adolescents with asthma overrate the benefits of smoking, and a particular health-specific advantage could be a short-term relief of asthmatic symptoms. Available adolescent smoking cessation programs that are based on cognitive theories, such as the Social Cognitive Theory (Horn, Dino, Kalsekar & Mody, 2005), and the Theory of Planned Behavior (Cuijpers, Jonkers, De Weerdt, & De Jong, 2002) may be even more successful among adolescents with asthma. It may be fruitful to incorporate these programs in clinic-based prevention approaches as well. Furthermore, the present results also indicate that the smoking-specific cognitions of youth with asthma are more easily influenced by other people than the cognitions of healthy peers. Moreover, despite their similar or even higher smoking rates, once started, the intention to quit smoking again is higher among adolescents with asthma as compared to peers without asthma. Both aspects can be turned into advantages in asthma-specific cessation services. Health care providers are encouraged to address and challenge the perceived pros of smoking, including possibly false beliefs about health-specific benefits of smoking, and to enhance the perception of the pros of quitting among youth with asthma. However, cognitive counseling should be accompanied by efforts to lower the level of nicotine dependence, both in adolescents with and without asthma. Nicotine dependence appears to be negatively related to readiness to quit directly and indirectly through the cognitions. However, since the relation of the pros of smoking with readiness to quit appears to be stronger for adolescents with asthma, dependence on nicotine may be additionally detrimental for this group. This would advocate an approach in which the use of asthma medication is accompanied by nicotine replacement therapy.
Table 1. *Descriptive Analyses of the Model Variables.*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Asthma Mean and SD (M ± SD)</th>
<th>No asthma Mean and SD (M ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Father is a current smoker</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>45.5%</td>
<td>48.2%</td>
</tr>
<tr>
<td>Yes</td>
<td>54.5%</td>
<td>51.8%</td>
</tr>
<tr>
<td>Mother is a current smoker</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>45.1%</td>
<td>50.7%</td>
</tr>
<tr>
<td>Yes</td>
<td>54.9%</td>
<td>49.3%</td>
</tr>
<tr>
<td>Best friend is a current smoker</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>12.5%</td>
<td>15.2%</td>
</tr>
<tr>
<td>Yes</td>
<td>87.5%</td>
<td>84.8%</td>
</tr>
<tr>
<td>Nicotine dependence</td>
<td>.32 ± .58</td>
<td>.26 ± .55</td>
</tr>
<tr>
<td>Craving</td>
<td>2.96 ± 1.04</td>
<td>2.92 ± .98</td>
</tr>
<tr>
<td>Pros of quitting</td>
<td>2.86 ± .74</td>
<td>2.84 ± .65</td>
</tr>
<tr>
<td>Pros of smoking</td>
<td>2.58 ± .63</td>
<td>2.65 ± .63</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>2.80 ± .87</td>
<td>2.84 ± .90</td>
</tr>
</tbody>
</table>

*Note.* Mean scores on ‘nicotine dependence’ are based on standardized values.
Table 2. *Model Fit Indices for All Five Models.*

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>N</th>
<th>Chi-square</th>
<th>df</th>
<th>p</th>
<th>CFI</th>
<th>RMSEA</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Basic Model</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitions - readiness</td>
<td>83/1037</td>
<td>1.20/0.94</td>
<td>1/1</td>
<td>.273/.333</td>
<td>.986/1.00</td>
<td>.049/.000</td>
</tr>
<tr>
<td><em>Model 1</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking Father</td>
<td>83/1037</td>
<td>1.77/0.91</td>
<td>1/1</td>
<td>.183/.340</td>
<td>.958/1.00</td>
<td>.097/.000</td>
</tr>
<tr>
<td><em>Model 2</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking Mother</td>
<td>83/1037</td>
<td>1.93/0.98</td>
<td>1/1</td>
<td>.165/.321</td>
<td>.944/1.00</td>
<td>.011/.000</td>
</tr>
<tr>
<td><em>Model 3</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking Best Friend</td>
<td>83/1037</td>
<td>0.14/0.98</td>
<td>1/1</td>
<td>.704/.323</td>
<td>1.00/1.00</td>
<td>.000/.000</td>
</tr>
<tr>
<td><em>Model 4</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nicotine dependence</td>
<td>83/1037</td>
<td>1.13/2.48</td>
<td>1/1</td>
<td>.289/.115</td>
<td>.997/998</td>
<td>.039/.038</td>
</tr>
<tr>
<td><em>Model 5</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Craving</td>
<td>83/1037</td>
<td>1.67/6.76</td>
<td>1/1</td>
<td>.197/.009</td>
<td>.983/992</td>
<td>.090/.075</td>
</tr>
</tbody>
</table>

*Note.* Fit indices for the smokers with asthma are depicted before the slash; fit indices for the smokers without asthma are depicted after the slash.
Table 3. Standardized Estimates of the Structural Equation Models.

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Basic Model</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cognitions— readiness</td>
<td>Fathers’ smoking</td>
<td>Mothers’ smoking</td>
<td>Best friends’ smoking</td>
<td>Nicotine dependence</td>
<td>Craving</td>
</tr>
<tr>
<td>Pros of Quitting</td>
<td>Asthma: -.18† No asthma: -.06†</td>
<td>Asthma: -.21* No asthma: -.09**</td>
<td>Asthma: .28* No asthma: -.02</td>
<td>Asthma: .03 No asthma: -.04</td>
<td>Asthma: -.03 No asthma: -.09**</td>
<td></td>
</tr>
<tr>
<td>Pros of Smoking</td>
<td>.11</td>
<td>.01</td>
<td>.10</td>
<td>.01</td>
<td>.30**</td>
<td>.03</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>-.12</td>
<td>-.03</td>
<td>-.11</td>
<td>-.10**</td>
<td>.01</td>
<td>.02</td>
</tr>
<tr>
<td>Pros of Quitting</td>
<td>Readiness to Quit: .25* No asthma: .30**</td>
<td>Readiness to Quit: .21* No asthma: .30***</td>
<td>Readiness to Quit: .21* No asthma: .29***</td>
<td>Readiness to Quit: .27* No asthma: -.30***</td>
<td>Readiness to Quit: .25* No asthma: .30***</td>
<td>Readiness to Quit: .23* No asthma: .29***</td>
</tr>
<tr>
<td>Pros of Smoking</td>
<td>Readiness to Quit: -.21* No asthma: -.11**</td>
<td>Readiness to Quit: -.18† No asthma: -.11**</td>
<td>Readiness to Quit: .21* No asthma: -.11**</td>
<td>Readiness to Quit: -.19† No asthma: -.10**</td>
<td>Readiness to Quit: -.21* No asthma: -.07*</td>
<td>Readiness to Quit: -.17 No asthma: -.06†</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>Readiness to Quit: .16 No asthma: .06</td>
<td>Readiness to Quit: .15 No asthma: .05</td>
<td>Readiness to Quit: .14 No asthma: .05</td>
<td>Readiness to Quit: .16 No asthma: .06†</td>
<td>Readiness to Quit: .01 No asthma: .00</td>
<td>Readiness to Quit: -.02 No asthma: .02</td>
</tr>
<tr>
<td>Independent variable</td>
<td>Readiness to Quit: -.23* No asthma: -.09**</td>
<td>Readiness to Quit: -.15 No asthma: -.09**</td>
<td>Readiness to Quit: -.09 No asthma: -.03</td>
<td>Readiness to Quit: -.20† No asthma: -.16***</td>
<td>Readiness to Quit: -.34** No asthma: -.14***</td>
<td></td>
</tr>
<tr>
<td>R²</td>
<td>.17</td>
<td>.11</td>
<td>.22</td>
<td>.12</td>
<td>.18</td>
<td>.16</td>
</tr>
</tbody>
</table>

Note. a) Coefficients for the smokers with asthma are depicted before the slash; the coefficients for the smokers without asthma are depicted after the slash. The ‘Independent Variables’ in the left columns are the ones denoted in the upper right columns. † p<.10, * p<.05, ** p<.01, *** p<.001.

b) Some paths were not significant among adolescents with asthma whereas they were significant among adolescents without asthma, and vice versa. Although this may seem as a difference, please note that significance of estimates is dependent on sample size.
Figure 1. Theoretical Model of Parental and Friends' Smoking, Nicotine Dependence and Craving as Independent Variables, in Relation to the Pros of Quitting and Smoking, Self-efficacy, and Readiness to Quit.

Note. The model depicted above represents the structural model of 5 separately tested models. Each separate model was tested with one independent variable.
### Pearson and Spearman Correlations between Model Variables.

<table>
<thead>
<tr>
<th>Measures</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 Smoking Father</strong></td>
<td>-</td>
<td>.30**</td>
<td>.02</td>
<td>-.02</td>
<td>-.06</td>
<td>-.03</td>
<td>.08**</td>
<td>.06</td>
<td>-.12**</td>
</tr>
<tr>
<td><strong>2 Smoking Mother</strong></td>
<td>.45**</td>
<td>-</td>
<td>-.04</td>
<td>.00</td>
<td>-.10**</td>
<td>-.10**</td>
<td>.15**</td>
<td>.03</td>
<td>-.14**</td>
</tr>
<tr>
<td><strong>3 Smoking Best Friend</strong></td>
<td>-.14</td>
<td>-.04</td>
<td>-</td>
<td>.03</td>
<td>-.02</td>
<td>-.00</td>
<td>.04</td>
<td>.04</td>
<td>.03</td>
</tr>
<tr>
<td><strong>4 Pros of Smoking</strong></td>
<td>.14</td>
<td>.08</td>
<td>.29*</td>
<td>-</td>
<td>.03</td>
<td>-.49**</td>
<td>.40**</td>
<td>.44**</td>
<td>-.12**</td>
</tr>
<tr>
<td><strong>5 Pros of Quitting</strong></td>
<td>-.18</td>
<td>-.22*</td>
<td>.23*</td>
<td>.09</td>
<td>-</td>
<td>.101</td>
<td>-.04</td>
<td>-.09**</td>
<td>.30**</td>
</tr>
<tr>
<td><strong>6 Self-efficacy</strong></td>
<td>-.11</td>
<td>-.10</td>
<td>-.01</td>
<td>-.32**</td>
<td>.09</td>
<td>-</td>
<td>-.47**</td>
<td>-.44**</td>
<td>.12**</td>
</tr>
<tr>
<td><strong>7 Nicotine Dependence</strong></td>
<td>.17</td>
<td>.23</td>
<td>.21</td>
<td>.37**</td>
<td>.03</td>
<td>-.49**</td>
<td>-</td>
<td>.66**</td>
<td>-.20**</td>
</tr>
<tr>
<td><strong>8 Craving</strong></td>
<td>.03</td>
<td>.29**</td>
<td>.15</td>
<td>.37**</td>
<td>-.04</td>
<td>-.46**</td>
<td>.64**</td>
<td>-</td>
<td>-.20**</td>
</tr>
<tr>
<td><strong>9 Readiness to Quit</strong></td>
<td>-.33**</td>
<td>-.26*</td>
<td>.07</td>
<td>-.27*</td>
<td>.25*</td>
<td>.26*</td>
<td>-.29*</td>
<td>-.40**</td>
<td>-</td>
</tr>
</tbody>
</table>

*Note. Data for the adolescents with asthma are below the diagonal; data for the adolescents without asthma are above the diagonal.

* p < .05; ** p < .01.
References


Kleinjan, M., Van Den Eijnden, R. J. J. M., Van Leeuwe, J., Brug, J., Van de Ven, M. O. M., Engels, R. C. M. E. Adolescents’ movement towards cessation of smoking: Role and relative value of the processes of change and nicotine dependence. (In resubmission to *Addiction*).


Chapter 14

General Discussion
This thesis examined which internal and external factors contribute to smoking cessation outcomes among adolescents with and without asthma. In this final chapter, findings will be summarized and reflected on in the light of existing theories and findings from prior empirical research. We will then go on by describing the limitations of this thesis, after which we will close with offering suggestions and recommendations for future research and prevention and intervention programs.

Summary of main findings

- Cognitions play relatively small roles in adolescent smoking reduction, but do seem to be relevant in progression in smoking after experimentation or recent onset.  
- Interactions between cognitions are important to both reduction and progression in smoking and place adolescents at cumulative risk.  
- Parental smoking has a negative impact on adolescents’ readiness to quit and actual smoking cessation, but does not seem to be a threat to adolescents’ relapse after quitting.  
- Smoking cessation-specific parenting is positively associated with adolescents’ readiness to quit, but does not predict actual cessation or relapse.  
- Parents who smoke themselves might still be effective in aiding their child’s smoking cessation process.  
- Static measures of cognitions do neither predict smoking cessation over time nor outcomes of adolescents’ quit attempts (i.e., relapse).  
- Day-to-day variations in self-efficacy (situational self-efficacy) predict the first and second lapses, and mild relapse, whereas baseline measures of self-efficacy do not. However, individual differences in self-efficacy may account for variability in heavy relapse.  
- Situational self-efficacy itself is associated with affect-motivational states (craving and negative affect) as well as with external contexts (seeing others smoke, stress, and alcohol consumption) when participants are still abstinent, but also after they have lapsed.
• The natural history of adolescents’ withdrawal symptoms after quitting shows that all symptoms were quite stable at a relatively low level during the five days prior to the quit day. On the quit day, withdrawal symptoms (especially craving) increased substantially, and significantly decreased again during the week following the quit day. Within 2 weeks after cessation, both abstinent and relapsed adolescents had reverted to levels comparable to those during the pre-quit period.

• Prolonged abstinence after smoking cessation among adolescents does not largely depend on how their withdrawal symptoms evolve over time after achieving abstinence.

• Individual differences in baseline nicotine dependence and craving do not predict the first lapse and relapse into smoking after quitting.

• Daily variations in craving do predict the first lapse and relapse into smoking. Changes in situational negative affect do not trigger lapses and relapse.

• Craving and negative affect seem to be responsive to external situational factors, such as seeing others smoke, drinking coffee and alcohol, and experiencing a stressful event.

• Adolescents’ alcohol use was strongly associated with the first lapse on the same day. This effect appeared to be stronger for younger participants.

• Adolescents with high symptom severity and indication of asthma developed higher levels of nicotine dependence over time than those with fewer or no symptoms or those who did not have asthma.

• Adolescents with asthma were more ready to quit and were more likely to have made an unsuccessful quit attempt compared to non-asthmatic peers.

• Reduction of nicotine dependence and craving is essential for adolescents with and without asthma, and craving is even more strongly related to readiness to quit among those with asthma. Smoking-specific cognitions of youth with asthma are also more strongly related to peer behavior than cognitions of youth without asthma.
**Reflection on the main findings**

**Prevalence figures**

The distribution of the stages of changes construct was highly similar to those reported by Kleinjan and colleagues (2008a, 2008b) who analyzed the same dataset (chapter 3), and who already noted that readiness to quit among adolescents seems notably lower than adults’ readiness to quit. The distribution of the stages of change also resembled those among adolescents in the United States (Pallonen, 1998), with the vast majority being in the precontemplation phase, a smaller number contemplating quitting somewhere in the future, and the minority thinking about quitting within the next month or next six months. Of the daily smokers included in the longitudinal study on the national dataset (chapter 4), 11.1% reported to have quit smoking one year later. This figure compares with studies from other countries, in which between 5.3% and 12.3% of daily smoking adolescents reported successful unaided smoking cessation (Sargent, Mott, & Stevens, 1998; Stanton, McClelland, Elwood, Ferry, & Silva, 1996; Sussman, 2002).

The occurrence of a first lapse among the adolescents who participated in our ecological momentary assessment (EMA) study (70.4%) was comparable to that among adults without nicotine patch treatment (65.6%; Ferguson et al., 2006). However, the success (non-relapse) rate at the follow-up (29.6%) was considerably higher than those reported in other studies of both self-initiated and aided cessation among adolescents (Mermelstein, 2003; Sussman, 2002). This may be due to the relatively short term interval of follow-up, which comprised only two months, while only about 3–5% of self-quitters will attain prolonged abstinence at 6–12 months post-quit (Hughes, Keeley, & Naud, 2004). Differences in duration of follow-up intervals do hinder solid comparison across studies (Mermelstein, 2003). In addition, those who dropped out of the study prematurely may have done so because of failure to achieve or to maintain abstinence. Indeed, many studies regard drop-outs as relapsers (Grimshaw & Stanton, 2009). Despite that relapse rates could have increased if we had included longer term follow-ups or considered drop-outs as relapsers, several characteristics of our EMA study may have stimulated successful prolonged abstinence. By reporting on their feelings and behavior three times a day, participants were forced to reflect on themselves, which may have created a learning effect, which is also commonly known as the ‘reactivity effect’ in EMA research (Shiffman, Stone & Hufford, 2008). Reactivity is defined as the potential for behavior or experience to be affected by the act of assessing it. This can occur to such an extent that problem behaviors have been found to be reduced by the act of
self-monitoring alone. For this reason, repeated self-monitoring is sometimes incorporated in behavior-change treatments (Shiffman et al., 2008). Anecdotal accounts of participants in our study confirm this. Some participants indicated that they were more consciously involved in their quitting process and became more aware of their behavior patterns, and that this helped them in maintaining abstinence. In this way, the EMA study in the present thesis might be considered to be a minimal intervention that may have facilitated lower relapse rates than usually found.

Social environment: parents and friends

As described in the introduction of this thesis, the main tenet of Social Learning Theory is that individuals acquire certain behavior patterns by observing behavior, attitudes and responses of others. One of the primary social agents in this regard are parents, and regarding smoking, parents’ behavior has been shown to be related to adolescent smoking initiation and continuation, both through parents’ smoking and parenting practices (see Darling & Cumsille, 2003, for an overview). In the case of smoking cessation, the present thesis supports the premise of Social Learning Theory as relates to parental modeling in several ways, but parents’ roles do seem to differ depending on which stage of the smoking cessation continuum adolescents find themselves in.

Starting with parental smoking, the present thesis shows that if parents smoke, adolescents report feeling less ready to quit smoking (chapter 3). This is in line with research on parental smoking in association with earlier phases of smoking, such as initiation (Darling & Cumsille, 2003) and may be explained by mechanisms of modelling and genetic predisposition to smoke. Parental smoking has also been shown to be positively related to nicotine dependence among adolescents (Kleinjan, Engels, Van Leeuwe, et al., 2009). Given that nicotine dependence, in turn, predicts the number of quit attempts adolescents undertake (Kleinjan et al., 2009), and actual cessation over time (Kleinjan et al., 2009, and chapter 4 of the present thesis), smoking by parents appears to have an (indirect) effect on adolescent actual cessation as well. However, whether parents smoked or not did not seem to be relevant to the outcome of adolescents’ quit attempts as it did not differentiate adolescents who relapsed from those who remained abstinent after quitting (chapter 5). This finding was remarkable since the influence of parental smoking has been demonstrated so abundantly in earlier phases of the smoking career.

Several explanations might apply here. Firstly, smoking initiation seems to largely depend on environmental factors, whereas genetic factors more strongly determine the
intensity of smoking and nicotine dependence (Heath, Madden, Slutske, & Martin, 1995; Vink, Willemsen, & Boomsma, 2004). Although individual differences in nicotine dependence did not predict lapse or relapse, those higher on nicotine dependence at baseline were more likely to report higher craving to smoke after quitting, and craving was found to predict lapse and relapse into smoking. It is also possible that, at some point, the influence of parents is overruled by individual and situational factors that are relevant to smoking relapse. The importance of situational craving and low situational self-efficacy as demonstrated by this thesis (chapters 7 and 10) might provoke relapse regardless of parents’ behavior. Alternatively, parental smoking may instigate increments in craving and decreases in self-efficacy. Darling and Cumsille (2003), for instance, suggested that when focusing on proximal processes that operate at transitional points (undertaking a quit attempt), stable characteristics (such as parental smoking) can predict change only in the presence of a triggering event (such as the offer of a cigarette by a peer). If adolescents are constantly exposed to smoking at home while they attempt to quit, they are likely to be challenged more severely to maintain their abstinence. Indeed, seeing others smoke was related to lower self-efficacy, and parents could have been the individuals who were seen smoking. Therefore, we caution against dismissing entirely the impact of parental smoking on adolescent smoking relapse.

Most importantly, unfortunately, we did not gather daily data on parental smoking and other parental smoking-related behaviors in the EMA study. Therefore, we cannot determine whether parents who were smokers also smoked in the company of their children who attempted to quit smoking or not, and how often participants were around their smoking parents. We also do not know whether parents adjusted their smoking behavior during their child’s quit attempt or not, for example, by smoking outside the house instead of inside, or perhaps even by quitting smoking themselves. In one of the check up telephone conversations, one participant told us that he and his mother had quit simultaneously and that they found great support in each other. Though this concerns just one anecdotal report, it shows that the active feat of parents quitting may motivate their offspring in their attempt to quit, maybe even more so if both the parent and the adolescent quit smoking simultaneously. To date, there is neither empirical literature on the effect of parental smoking cessation on adolescent relapse after quitting, nor on the effect of “co-quitting”, and we encourage researchers to test this in the future.

As Social Cognitive Theory posits, behavior may be learned through several mechanisms, including social interaction, reinforcement, imitation, and attitudes (Bandura,
In addition to parental smoking that may affect adolescent smoking cessation through social interaction and imitation, parenting practices may reinforce smoking or non-smoking, and may shape adolescents’ attitudes toward smoking and smoking cessation. Previous studies have examined smoking-specific parenting, in association with smoking initiation and continuation (Chassin, Presson, Todd, Rose & Sherman, 1998; Huver, Engels, & De Vries, 2005; Jackson & Henriksen, 1997), but not with smoking cessation. Moreover, the operationalizations of smoking-specific parenting scales usually exclude parenting that specifically addresses smoking cessation. We therefore developed and tested an instrument for smoking cessation-specific parenting (SCSP), which assessed parenting practices aimed at motivating and pressurizing adolescents to quit smoking. We found that if parents engaged in this type of parenting, their children were more ready to quit smoking (chapter 3). The association between SCSP and readiness to quit appeared to be both direct, and indirect through smoking-specific cognitions. Adolescents with parents who engaged in SCSP perceived smoking to have fewer advantages and quitting to have more advantages than adolescents with parents who engaged in SCSP to a lesser extent. These cognitions were also associated with readiness to quit.

When subjecting the concept of SCSP to a longitudinal test, we found that SCSP also predicted readiness to quit one year later, showing that involvement of parents in this type of parenting beneficially contributes to adolescents’ readiness to quit (chapter 4). However, SCSP did not predict actual cessation one year later. The EMA study also demonstrated that SCSP did not predict who would lapse or relapse after quitting (chapter 5). If anything, the associations between SCSP and (re)lapse – albeit that they were not significant – seemed to point to a counterproductive effect. We also found that expected parental support and parental norms about whether their child should quit smoking or not did not predict lapse or relapse either. However, particularly in the case of expected parental support, the use of a measure that assesses an expected response restricts a clear interpretation of the role of parental support in the quitting process of adolescents. Parents may not fulfil adolescents’ expectations about the provision of support, of which the disappointment may be an additional stressor. We also measured received support after the EMA period, but the sample size was too small to test whether discrepancies in expectations versus actual experiences were relevant to relapse.

It was encouraging, however, to find that parenting strategies may still be beneficial if parents smoke themselves. Although parents may feel hypocritical or not credible when trying to persuade their child to quit smoking while they smoke themselves (and our data do suggest so, considering that parents who smoked on average enforced less smoking cessation-specific
parenting), we found that the positive association between smoking cessation-specific parenting did not differ as a function of parental smoking status. Chapter 5 also showed that expected parental support was not correlated with parental smoking, which suggests that adolescents expect their parents to support them in quitting irrespective of whether their parents smoke or not. Conclusively, different mechanisms may be differentially operational along the various stages of the smoking cessation continuum, and the present thesis suggests that this applies to the influence of parents as well.

Considering environmental factors, the focus of the present thesis relied more on parents than peers. The knowledge that this thesis adds regarding peer influence is that best friends’ smoking was not associated with readiness to quit smoking among daily smoking adolescents, also not indirectly via cognitions (though the indirect processes seemed to differ according to asthma status, as we will discuss under ‘asthma-specific findings’ of this thesis). Best friend’s smoking was also not associated with smoking specific-cognitions and nicotine dependence (chapter 13). Recent findings on the same data in which a sample was used that included monthly and weekly smokers next to daily smokers revealed that best friend’s smoking status in fact was associated with adolescents’ readiness to quit, and nicotine dependence (Kleinjan et al., 2009). Apparently, the role of best friend’s smoking status differs among subpopulations of adolescent smokers, where the more regularly smoking adolescents are least affected by their best friend’s behavior. Indeed, peer smoking has been found to be associated with earlier stages of smoking (e.g., initiation and continuation; Flay, Hu, Siddiqui et al., 1994), but has been found to be unassociated with actual cessation (Kleinjan et al., 2009). Combining this thesis’ findings on parents and best friends, overall, it seems that the influence of the environment declines as adolescents progress further along the smoking cessation continuum.

Cognitions

Among a plethora of other definitions, the term ‘cognition’ as used in the field of psychology refers to the capacity of processing information, applying knowledge, and changing preferences. Cognition, or cognitive processes, can be conscious or unconscious, and involve the processing of concepts such as beliefs, knowledge, desires, preferences and intentions of individuals. As outlined in Chapter 1, cognitions play a prominent role in both general health behavior theories and models of smoking relapse. The present thesis examined the predictive value of individual differences in the pros of smoking and quitting, perceived social norms regarding smoking, and self-efficacy in adolescents’ readiness to quit, actual
smoking cessation, and relapse after quitting. Dynamic effects of day-to-day variations in self-efficacy were examined in relation to lapse and relapse after quitting as well.

Starting with the earlier phase of smoking, we found that although cognitions (pro-smoking attitudes, social norms, and self-efficacy) predicted progression to higher levels of smoking, they did not explain variance in smoking reduction (chapter 1). Also, in determining which factors are related to readiness to quit, we found that despite that the pros of smoking and quitting were significantly associated with readiness to quit cross-sectionally (chapter 3), prospective analyses revealed that these cognitions did not predict readiness to quit one year later, nor actual smoking cessation one year later (chapter 4). It is known that adolescents regularly shift between the stages of readiness to quit (stages of change) (Pallonen, 1998), and a one-year interval may therefore be too wide to test the effects of cognitions. In addition, smoking-related cognitions are still in the process of developing and maturing during adolescence (Chambers, Taylor, & Potenza, 2003; Clark, Thatcher, & Tapert, 2008; Goldstein, & Volkow, 2002). Thus, these cognitions themselves may be subject to substantial change, which could account for the absence of effects of cognitions on smoking cessation outcomes over time. Alternatively, it is possible that cognitions play a more important role in the earlier stages along the smoking continuum (such as initiation and progression), but are overruled by other factors in more advanced stages of smoking. Nicotine dependence, for example, has been shown to be robustly related to adolescents’ quit attempts and actual cessation, above and beyond parental and peer smoking, and readiness to quit (Kleinjan et al., 2009).

However, the above postulated explanation that the absence of cognitive effects on adolescent smoking cessation outcomes may be attributable to the length of the measurement interval does not explain why individual differences did not predict relapse outcomes in the EMA study (chapters 6 and 7). Here, the pros of smoking and quitting and self-efficacy were assessed only two weeks prior to the target quit day. These cognitions did not discriminate lapsers from abstainers, nor lapsers from those who experienced a mild relapse. The pros of smoking and self-efficacy did predict heavy relapse, but these effects diminished in a multivariate analysis including baseline smoking status. This, again, suggests that the intensity of smoking (and the attendant level of physical tolerance) may overrule cognitions in adolescents who have a substantial history of smoking and who smoke on a daily basis.

However, cognitions can be viewed from both a static and dynamic perspective. Both theory and prior studies among adults that have demonstrated that self-efficacy is volatile (Bandura, 1997; Gwaltney, Shiffman, Norman et al., 2001), fluctuating over time in response
to changing internal and external contexts (Gwaltney, Shiffman, & Sayette, 2005). One might therefore expect that changes in self-efficacy should provoke lapses and relapse and the literature on adults supports this notion (Gwaltney, Shiffman, Balabanis, & Paty, 2005; Shiffman, Engberg, Paty et al., 1997; Shiffman et al., 2000). Thus, self-efficacy can be considered to be a proximal precipitant of relapse and should be responsive to external and internal momentary states. Briefly, the findings in the present thesis show that these assumptions apply to adolescent daily smokers as well. We found that day-to-day variations in self-efficacy indeed predicted the first lapse, and progression to relapse, above and beyond baseline levels of self-efficacy and concurrent smoking after quitting (chapter 7). Self-efficacy was also found to be associated with several affect-motivational states and external contexts, such as urge to smoke, negative affect, seeing others smoke, alcohol consumption and stress (chapter 8). This shows that cognitions do play a role, in fact, an important role in the adolescent quitting process, but demonstrating their significance is obviously contingent on the assessment method used. Future research is strongly recommended to take into account daily variations in smoking- and abstinence-related cognitions, in particular self-efficacy.

**Nicotine dependence and withdrawal effects**

Despite that little is known about the impact of nicotine dependence on adolescents’ smoking cessation, recent work has shown that nicotine dependence is a hindrance to successful smoking cessation among adolescents, often above and beyond environmental and motivational factors (e.g., Horn, Fernandes, Dino & Kalsekar, 2003; Kleinjan et al., 2009; Prokhorov et al., 2001). The present thesis takes these insights a step further in showing that individual differences in nicotine dependence are indeed associated with readiness to quit smoking (chapter 13), but they do not necessarily explain all relapse milestones (such as the first lapse, and mild relapse) (chapter 10). Intensity of smoking - which is a core component of the behavioral dimension of nicotine dependence - also did not differentiate abstainers from smokers at the 2-month follow-up (chapter 6). These discrepancies with previous studies may be explained by the fact that the aforementioned studies used a wider range of adolescent smokers including monthly, weekly, and daily smokers. The sample of participants in our EMA study was rather homogeneous with only daily smokers included, and it is possible that we found limited support for the effect of nicotine dependence on relapse outcomes because of a restricted range of variation. The differences may also be attributable to the fact that we used a relatively short follow-up (two months after the end of the EMA period, i.e., almost three months after the target quit day), and as mentioned earlier, only about 3–5% of self-
quitters will achieve prolonged abstinence at 6 to 12 months post-quit (Hughes et al., 2004). It is thus possible that the level of nicotine dependence differentiates those who will continue their abstinence after three months from those who will eventually relapse.

However, we did find an effect of baseline levels of craving and nicotine dependence on ‘heavy relapse’ (chapter 10). The multidimensional nicotine dependence scale we used included three dimensions: 1) behavioral aspects of nicotine dependence that are indicative of physical tolerance (when, where, and how much one smokes), 2) craving (frequency of urges to smoke), and 3) withdrawal symptoms experienced during abstinence (negative affective symptoms, such as trouble concentrating and restlessness). When we examined the differential effects of the subscales on heavy relapse, it appeared that only the behavioral subscale predicted heavy relapse. The finding that the subscale of withdrawal which assesses negative affective symptoms did not predict heavy relapse is in line with our findings that daily changes in negative affect did not predict subsequent lapse or relapse risk. Thus, it seems that not all aspects of nicotine dependence predispose adolescents to heavy relapse risk, and taking the dimensions together in one mean score might obscure findings on relapse outcomes, at least among daily smokers. It might be useful for future studies to test subscales separately, and to test the simple measure of smoking intensity as well.

When people are deprived of nicotine, several aversive states arise, which are known as ‘withdrawal’ symptoms or ‘abstinence symptoms’ (Footnote 1). These symptoms include among others cigarette craving and states of negative affect, and are universally observed among both adults (Hughes, 1992), and adolescents (Hurt, Croghan, Beede et al., 2000; Killen, Ammerman, Rojas et al., 2001; Riedel, Robinson, Klesges et al., 2003). Among adults, the most typical pattern of withdrawal symptoms shows a strong increase during the first week of deprivation after which symptoms gradually revert to an equal or even lower level than that at baseline (Hughes, 1992). Our findings show that withdrawal symptoms indeed peak when adolescents achieve 24 hours of abstinence (chapter 9), but the extent to which they peak and the pace with which they decline seem to differ from those among adults (these differences will be discussed in more detail under the section ‘Differences between adolescents and adults’ further along this chapter). Important to note here is that a very recent study examined withdrawal in adolescent smokers following 24 hours of abstinence, in which the authors compared those who smoked 1-3 cigarettes per day with those who smoked 4-5 cigarettes per day (Rubinstein, Benowitz, Auerback, & Moscicki, 2009). They found that both at the assessment points of 12 hours and 24 hours (of deprivation/after having quit), those who smoked 1-3 cigarettes per day experienced a mean decrease in withdrawal as opposed to
those smoking 4-5 cigarettes per day, who experienced increases in withdrawal. In our EMA study, 11.9% of the sample smoked 1-5 cigarettes per day, and the rest of the sample smoked more heavily. It is possible that the group of ‘lighter’ smokers included in the EMA study has suppressed the natural history of the withdrawal symptoms as described in chapter 9. It is possible that if the growth curves of these two groups (i.e., those who smoked 1-5 cigarettes per day versus those who smoked more) were to be modeled separately, the curves of the more heavily smoking adolescents would resemble the natural history of withdrawal among adults more so than we demonstrated in this thesis. Unfortunately, our sample was not large enough to test this.

As prior studies among both adolescents and adults have shown, craving was the most salient withdrawal symptom among craving, negative affect, and hunger. On participants’ actual quit day, craving peaked much higher than negative affect and hunger, and had almost reverted to pre-quit levels of craving after one week. The decline seemed to be quadratic, and both the pre-quit and post-quit intercepts of craving predicted abstinence at the last week of the EMA period, which suggests that individual differences in craving perhaps do matter in explaining abstinence. It is also possible that those who were anticipating difficulties in quitting had increases in craving at the very start of the study and these effects of the craving intercepts may therefore also reflect anticipatory reactions. Daily variations in craving also predicted the first lapse and relapse into smoking the next day (chapter 10), which is in line with research among adults (Doherty, Kinnunen, Militello, & Garvey, 1995; Ferguson, Shiffman, & Gwaltney, 2006). Negative affect showed much less vigorous peaks upon quitting and both pre-quit and post-quit symptoms of negative affect were mild. Daily changes in negative affect also had no impact on lapse and relapse risk (chapter 10). To our knowledge, the findings on withdrawal symptoms in the present thesis were the first to be drawn from a study that used ecological momentary assessment in an adolescent sample large enough to conduct both between-person and within-person analyses (Gwaltney, Bartolomei, Colby, & Kahler [2008] conducted a similar pilot study among 13 adolescents, and Smith, Cavallo, McFetridge, Liss & Kishnan-Sarin [2008] used only weekly assessments of withdrawal). However, much more research is needed to a) replicate the findings presented in this thesis, and b) answer the questions that the present findings raise.

For example, while the present thesis contributes substantially to a better understanding of the natural history and dynamic effects of withdrawal symptoms among adolescents, future research is needed to elucidate the heterogeneity in symptoms. By averaging across individuals, a consistent and stereotypical pattern is often found (Piasecki,
likely because of ‘washing out’ idiosyncrasies of individuals. Piasecki and colleagues (2003a, 2003b, 2003c), however, demonstrated that there is striking variability in individual withdrawal profiles (as pertains to intensity and duration of symptoms) among adults. This strong variability in individual profiles suggests that any given quitter cannot be assumed to display the same aggregate pattern. The clinical implications that were outlined by the authors in this respect may have importance for adolescents who aspire to quit smoking as well: “Educate smokers preparing to quit about the variability in withdrawal symptoms and convey clearly the expectation that a “bumpy ride” is common” (p. 11). The authors also described that a question very frequently posed by aspiring quitters related to how long withdrawal will last. If clinical workers would provide an answer based on the ‘typical’ duration (which can be derived from aggregated growth curves), it might be of a shorter duration than the individual experience of the person. This expected duration may be set as a benchmark that people in part base their motivation on (“If I can just get through these first seven days of withdrawal, I’ll be nearly out of the woods”). Subsequently, enduring withdrawal past the benchmark given by the clinician may have detrimental effects on the quitter’s motivation to maintain abstinence.

Although no such variability in withdrawal profiles over time has been demonstrated for adolescents as of yet, we do expect such heterogeneity to apply to this age group as well, especially considering the volatility of behaviors and feelings and hormonal processes in adolescence (Buchanan, Eccles, & Becker, 1992; Chambers et al., 2003). Given that adolescents seem overly optimistic about the quitting process (Balch, 1998), we recommend that clinicians educate adolescents motivated to quit that the intensity and duration of withdrawal varies across individuals, and to prepare them for the possibility of prolonged and fluctuating withdrawal, in particular craving.

**External stimuli**

Although external stimuli (or external contexts) have hardly been examined among adolescents who are attempting to quit smoking, we had hypothesized that adolescents’ abstinence and their self-efficacy to refrain from smoking would be challenged by being exposed to external stimuli. The external stimuli included in the EMA study of the present thesis included seeing others smoke, experiencing a stressful event, and consuming alcohol or coffee. Such was investigated in the light of the regulatory feedback model of relapse (Niaura, 2000; Niaura, Rohsenow, Binkoff et al., 1988), which assumes that affect states and smoking cues trigger physiological activation, urge to use the drug of interest, and outcome.
expectations. The latter three are supposed to subsequently affect coping attributions and self-efficacy expectations. The outcome of this entire process is thought to determine whether someone will (re)lapse or will remain abstinent. We found that, during both abstinent and lapsed intervals, seeing others smoke, experiencing a stressful event, and drinking alcohol were related to lower self-efficacy (chapter 8). Coffee consumption did not seem to play a significant role in self-efficacy before or after lapsing. In addition, alcohol consumption on a given day was strongly related to the first lapse into smoking that day (chapter 11). It therefore seems fruitful to advise adolescents to abstain from alcohol while attempting to quit smoking, or even more so, to avoid settings such as parties and bars. The latter follows from our finding that seeing others smoke is related to lower self-efficacy to remain abstinent, and from prior findings among adults that showed that merely the sight of images related to alcohol increase craving to smoke (Scharf, Tindle, Kirchner, Butera, Ferguson, & Shiffman, unpublished data), and craving, in turn, was found to predict lapse and relapse in the present thesis.

Given the results presented in this thesis, can the dynamic regulatory feedback model of relapse by Niaura and colleagues (1988, 2000) be supported and extended to the adolescent population? First of all, not all of our findings that relate to this model were based on longitudinal analyses. Therefore, we cannot determine for all variables whether the directionality as assumed in this particular model applies to adolescent smoking relapse as well. The results do suggest the interrelatedness of factors in several ways. Negative affect and contextual cues were indeed related to urges to smoke, and urges to smoke (or craving) were related to lower self-efficacy. Moreover, drops in self-efficacy and in urge to smoke were related to the first lapse and relapse the next day. The dynamic regulatory feedback model asserts that urges should precede self-efficacy, but we have not tested this as of yet. We also found that a lapse decreased self-efficacy, but again, it is not known whether this effect operated via a renewed cycle of instigating negative affect that in turn led to urges (which is suggested by the model), and subsequently to lower self-efficacy. Conclusively, none of our results directly challenge Niaura’s model, but at least partly lend support to its assertions. The directionality of several paths warrants further study.

Differences between adolescents and adults

What clinical workers, designers of prevention and intervention programs, and policy makers will want to know is to what extent the adult smoking cessation process and the underlying mechanisms – and consequently, the existing programs for adults – are
generalizable to adolescents. First of all, we emphasize that strict inferences about differences between adolescents and adults cannot be made on the basis of the present findings – or any other study currently available –, because no study to date included both adolescents and adults using an identical research design. Differences in designs between our studies and those of others among adults prohibit concrete comparison. However, based on our findings resulting from the EMA study, there are some aspects that at least seem to differ between these age groups. First of all, the emergence and natural history of withdrawal symptoms (or abstinence symptoms, Hughes, 2007) seem to differ among adolescents in the sense that symptoms appeared to peak less vigorously on the quit day, which is in line with another study on adolescents’ withdrawal symptoms after quitting (Smith et al., 2008), albeit that Smith and colleagues used weekly assessments.

Negative affect also seemed to pose less problems among adolescents compared to adults, which became apparent in both the natural history and dynamic effects of negative affect: negative affect did not peak strongly to begin with, and declined quite quickly (chapter 9). Whereas adults’ levels of negative affect remained stable across the three weeks after cessation in the study by McCarthy and colleagues (2006) (the slope coefficient was positive but not significant), the post-quit slope among adolescents in our study was significant and negative. Decreases in negative affect also did not predict lapse and relapse risk the next day (chapter 10), as opposed to findings among adults (Kassel, Stroud, & Paronis, 2003; McCarthy et al., 2006; Shiffman, Paty, Gnys, et al, 1996). We have suggested in the relevant chapter (chapter 10) that these differential effects of negative affect may be due to adolescents in general being vulnerable to more variable and intense moods than adults (Buchanan et al., 1992). It is also possible that quitting smoking carries more psychological weight among adults, considering that they have tried to beat the habit more often than adolescents. The forethought of failure may therefore prompt more negative affect among adult smokers. Adult smokers also may be more attached to smoking as it has become a part of their lives for a much longer time, which may cause the banishment of their habit to instigate stronger experiences of negative affect than among adolescents. Further, although the peak in craving on the quit day was substantial and therefore comparable to the development of craving after quitting among adults, the adolescents in our study seemed to revert to their baseline craving levels more quickly than is usually observed among adults (this was the case even when we controlled for those who had relapsed quickly). This observation notwithstanding, daily variations in craving did predict lapse and relapse into smoking the next day, in agreement with results among adults (Shiffman et al., 1997).
Additionally, there seemed to be several differences in the associations between situational factors and situational self-efficacy. After the first lapse, for example, both the contexts of consuming alcohol and seeing others smoke were related to self-efficacy independent of all other situational factors (chapter 8). In contrast, Gwaltney, Shiffman, and Sayette (2005) found that the influence of seeing others smoke on adults’ self-efficacy after a lapse was largely accounted for by changes in urge to smoke. This might suggest that the pathways between cue exposure and self-efficacy (and by implication relapse – given the significant effect of self-efficacy on (re)lapse) differs between adolescents and adults. To date, there is little evidence to support this notion, although Traylor, Bordnick, & Cartner (2008) found that young adults (ages 19 to 24) who were exposed to smoking cues in virtual reality did not revert to pre-exposure levels of craving compared to (older) adults in studies using a similar design. Future studies should elucidate whether adolescents veritably respond differently to smoking cues using designs that isolate the cues in question (for example, seeing someone smoke) from other cues (such as drinking, and stress), preferably using designs identical to those conducted among adults to allow for valid comparison.

**Asthma and smoking cessation**

Among individuals with asthma, current smoking is associated with adverse effects on different indices of asthma control, symptom severity, and the use of health resources. In addition, therapeutic response to inhaled corticosteroids is worse in smokers with asthma than in non-smokers with asthma (Thomson & Chaudhuri, 2009). The health benefits of smoking cessation among persons with asthma are substantial (Chaudhuri et al., 2006; Tønnesen, Pisinger, Hvidberg et al., 2005), yet there is almost no empirical study on which factors facilitate successful smoking cessation among persons (both adults and adolescents) with asthma in particular. One of the aims of the present thesis was therefore to examine whether mechanisms underlying adolescent smoking cessation would differ as a function of asthma status. The main findings show that adolescents with high symptom severity and indication of asthma developed higher levels of nicotine dependence over time than those with fewer or no symptoms or those who did not have asthma (chapter 12). Adolescents with asthma also seemed more ready to quit and were more likely to have made an unsuccessful quit attempt compared to non-asthmatic peers (chapters 12 and 13). Additionally, adolescents’ levels of nicotine dependence and craving were not dependent on asthma status, but among those with asthma, craving seemed more strongly related to readiness to quit and their smoking-specific cognitions appeared to be more strongly related to their best friend’s smoking than cognitions...
of those without asthma (chapter 13). (Unpublished data on asthma-specific factors and
figures that have not been included in the thesis because sample sizes were too small are
provided in Appendix I).

The finding that adolescents with asthma progressed more quickly to higher levels of
nicotine dependence might be explained by the fact that affective and anxiety disorders are
more common among people with asthma (Goodwin, Fergusson, & Horwood, 2004), and that
the idea that smoking is relaxing is more strongly endorsed among adolescents with asthma
than by those without asthma (Zbikowski, Klesges, Robinson, & Alfano, 2002). Symptoms of
nicotine dependence are feelings of restlessness, nervousness and anxiety that individuals
experience when being deprived of smoking, and it is possible that adolescents with asthma
are more easily dependent on nicotine because of the assumed relaxing effects of smoking.
Alternatively, given that asthmatic smokers attempt to quit more frequently, perhaps they
quickly realize they are addicted and are therefore more likely to acknowledge the symptoms
of addiction on surveys than are healthy children.

A more positive finding involved the distribution of readiness to quit among youth
with asthma, as they appeared to be more ready to quit than their non-asthmatic peers (chapter
13). They also seemed to undertake more attempts to quit smoking (chapter 12). Adolescents
with asthma might be well aware that smoking provides even more risks to their health than to
that of healthy peers. Indeed, Van de Ven, Van den Eijnden, and Engels (2006) demonstrated
that the risk of affection of the lungs to oneself as caused by smoking was more strongly
endorsed by adolescents with asthma than without. This awareness might explain why
adolescents with asthma are more motivated to quit and actually undertake more quit
attempts. However, chapter 12 suggests that adolescents with asthma may be less successful
in quitting, given that only current smokers were included in the follow-up analyses. To verify
whether adolescents with asthma are veritably less effective quitters warrants a longitudinal
test of asthma status on smoking cessation in a sample of adolescents who are smokers at
baseline (chapter 12 included only baseline non-smokers). Unfortunately, we lacked statistical
power to perform such a test (see also the Appendix I).

Lastly, it was notable that we found few differences between adolescents with and
without asthma in the prevalence of smoking by the social environment (parents and friends),
mean scores on smoking-specific cognitions and nicotine dependence, or in the processes that
relate to readiness to quit (chapter 13, and Appendix I). The observation that adolescents with
asthma did not differ from peers without asthma in many domains suggests that many of the
findings (and the attendant implications for intervention programs) in the present thesis are
generalizable to adolescents with asthma. The parts where we did find indication of differences related to the association between craving and readiness to quit, and the associations between best friend’s smoking and the smoking-specific cognitions. Briefly, these associations were stronger among adolescents with asthma. This suggests that factors related to psychophysiological aspects of smoking (in this case, craving) and social-environmental factors (e.g., best friend’s smoking) may be differentially related to the motivation to quit, and thus perhaps to actual smoking cessation. More research is needed to replicate and extend the present results on smoking cessation outcomes among adolescents with asthma. Given that we included a very large sample (N = 10,265 at T3) and still found our sample to be too small to test actual cessation among adolescents with asthma, future research is encouraged to recruit even larger baseline samples if one wants the sample to be representative, or to accept selection to a certain degree and to make specific efforts to recruit adolescents with asthma.

Limitations

Biochemical verification and reports by proxy

The limitations that all three studies in this thesis have in common are that no biochemical verification of either smoking or abstinence was used, and that reports on others’ behavior (e.g., smoking by parents and friends, parenting practices) involved reports by proxy. Some studies that used saliva cotinine and carbon monoxide breath samples to verify abstinence indicated that around 15% of the adolescents that reported to have quit smoking still appeared to be smoking (Sussman, Dent, Burton, Stacy, & Flay, 1995; Sussman, Dent, Lichtman, 2001), suggesting that biochemical verification would provide more accurate rates of cessation. However, other studies have shown that self-report indices of smoking are reliable and comparable to biochemical verification (Barnea et al., 1987; Dolcini, Adler & Ginsberg, 1996; Patrick, Cheadle, Thompson et al., 1994; Stacy, Flay, Sussman et al., 1990). A possible risk of using biochemical validation is that teenagers may metabolize nicotine differently (e.g., more quickly) than adults (Sussman, 2002). Further, some researchers suggest that use of this procedure may discourage participation in cessation programs (Lotecka & MacWhinney, 1983), but this has not been tested soundly and should not discourage researchers from applying biochemical validation by definition.
In addition, in all studies, respondents were assured of strict confidentiality of their reports, which should enhance reliability as well (Velicer, Prochaska, Rossi, & Snow, 1992). In the case of the EMA study, we strongly emphasized with the participants that failure to achieve 24 hr abstinence on the target quit day would not be condemned as ‘failure’ by the research team. We stressed that we were interested in the natural history of quit attempts, which might include failure to achieve abstinence on the target quit day and which might include relapse. We regard the figure of 27.5% of the participants not reporting 24 hours of abstinence on the target quit day to indicate that participants did not feel the need to falsely report abstinence. As for the reports by proxy on parenting and opinions of parents and friends, there has been debate in the literature regarding the validity of reports of parents and children on parenting styles and behaviors, because both the accounts of parents and children about each others’ behavior are subjective and may provide a distorted view (Brown, Mounts, Lamborn, & Steinberg, 1993). Although this should be acknowledged, and improvement in research design could be achieved by including parents’ reports in addition to those from adolescents, it has been argued that the subjective experience of adolescents may be more important to their development than parents’ and peers’ actual behavior (Fuligni & Eccles, 1993; Steinberg, Lamborn, Dornbusch, & Darling, 1992). Regarding others people’s substance use, it seems that adolescents are capable of adequately estimating parental smoking behavior (Harakeh, Engels, De Vries, & Scholte, 2006; Vink, Willemsen, Engels, & Boomsma, 2003).

**Attrition**

The findings from the study in which we have analyzed the large national longitudinal dataset may have restricted generalizability due to attrition of some of the schools involved (chapter 4). As reported in more detail elsewhere (Kleinjan et al., 2009), attrition analyses showed that there may have been a under-representation of male smokers in lower educational settings. Because lower educational level has been found to be related to higher levels of nicotine dependence and lower levels of readiness to quit (e.g., Hu, Davies, & Kandel, 2006), the findings on readiness to quit may not be entirely generalizable to males in lower education.

**Limitations of the EMA study specifically**

Several limitations specific to the EMA study have already been described in the relevant chapters. Briefly, these include the use of paper diaries as replacement for electronic reports, the possibility that reactivity effects to the intensive self-monitoring may have
occurred serving as an intervention, the fact that not all participants achieved 24 hours of abstinence on the target quit day, and the observation that drop-outs had higher scores on nicotine dependence and intensity of smoking. First of all, some studies provide pessimistic results as to the reliability of paper diaries through the risk of forward- and back-filling where multiple assessments are completed all at once (Stone, Shiffman, Schwartz, Broderick, & Hufford, 2002), and undoubtedly this has occurred in our EMA study. Although we do not know the extent to which this may have occurred, we were reassured by the finding that the majority of paper diary records (60.5%) were subsequently entered on-line on the same day and, further, were not bunched together at the end of the day. Moreover, analyzing the data with exclusion of daily assessments generally provided similar results, and all results were well interpretable. Nonetheless, electronic recording does away with concerns about timely compliance, and we recommend that future EMA research among adolescents – on whatever topic – use palmtops or mobile phones (such as PDAs). Fortunately, as technology advances, better and cheaper means become available for intensive psychological assessment as well.

We already elaborated on the potential ‘reactivity’ effect in our discussion of the prevalence figures above, but would like to complete this with the following notes. Although it is indeed certainly something to bear in mind in interpreting the results, EMA literature shows little evidence of it (Shiffman et al., 2008). Stone and colleagues (2003a), for example, found little support for shifts in pain occurring as a result of momentary monitoring. Moreover, a recent more stringent test of reactivity among smokers who embarked on a quit attempt revealed that reactivity does not seem to affect abstinence from smoking, and only affected a few smoking-related constructs, namely anxiety, difficulty concentrating, and sleep disturbance (Rowan, Cofta-Woerpel, Mazaset et al., 2007). In the present thesis, of these constructs only ‘difficulty concentrating’ was included, but constituted one item of a six-item scale. Second, one could think that filling out a questionnaire could function as a behavioral coping response in tempting situations, thereby off-setting any risk of smoking, which could colour the present results. However, urges to smoke are episodic, and not constantly present (Shiffman et al., 1996), and because the study included three fixed time intervals per day, it is likely that participants did not always experience temptation or urge episodes exactly during those assessment windows. Finally, there is no way of eliminating this effect – if present – if we want to study fluctuations in thoughts, feelings and behavior, and may need to be considered as inherent to this particular research method.
Next, both the duration of the assessment windows and the wording of some questions may have restrictions. The experience of a stressful event, for example, was required to be reported on as experienced ‘since the last recording’. It is possible that in the case where participants had missed one or more assessments, they have aggregated their experience of stress over this time span, instead of referring to the time of day that actually preceded the current recording (e.g., stress during the morning when completing the afternoon assessment). Further, alcohol consumption was reported over the past 30 minutes. Using such a short time span, it is likely that many events of alcohol consumption have been missed. In retrospect, it would have been better to ask whether alcohol had been consumed since the last recording (thereby including a question on whether or not the previous recording had been missed), and if so, how long ago it was, and how much drinks one had had. The latter is also advisable given that aside from the link between the event of drinking and the first lapse (as found in the present thesis), there may be a dose-response relationship between the quantity of alcohol use and the first lapse, or relapse.

In addition, the wording of some of the withdrawal symptom items included in the daily questionnaire may not entirely reflect the intended constructs. One item of craving and one item of negative affect, for example, were assessed by means of questions that asked to what extent participants were ‘bothered by’ the desire to smoke – or in case of negative affect, by negative moods such as anger, frustration, and irritability. While desire to smoke and negative moods may occur, it is unsure whether people are bothered by it, and as such, these items may not entirely reflect the core concept. This issue pertained to only two out of eight items, and it is reassuring that identical questions were successfully applied in adult relapse studies (McCarthy et al., 2006), and that our results resemble prior studies on withdrawal symptoms in adolescents (Smith et al., 2008). Nonetheless, we recommend to improve operationalization of withdrawal symptoms in future research.

Suggestions for future research

Several suggestions for future research that can be derived from the studies included in this thesis are already discussed in our reflection on the main findings. We will complete these recommendations by the following more general suggestions for future research.
Dynamic effects and situational factors

If one thing has become evident in the present thesis, it is for certain the idea that we cannot fully understand the process of smoking cessation and relapse among adolescents unless we take into account a) the day-to-day variations in both internal and external factors, and b) the interrelatedness of the situational factors involved. As we have been able to demonstrate this importance for several constructs, such as self-efficacy, craving, and negative affect, we recommend that other factors be approached in a dynamic fashion as well. For example, as we argued in chapter 5, on parents and adolescents’ relapse, it might be the change in behavior of parents rather than their usual behavior (i.e., their smoking status and smoking-related habits as they are prior to the child’s quit attempt) that may contribute to the outcome of teenagers’ cessation trials. In addition, by examining the situational correlates of factors that appear to play a significant role in the relapse process, it became apparent that the interplay of factors is complex. Gaining insight into this complexity and the intertwinement of factors could provide several entries or caveats for clinical practice on which to focus when supporting adolescents in their quit attempt. If self-efficacy needs to be targeted, for example, it might be useful to simultaneously focus on factors that seem to decrease self-efficacy, even if they are not directly related to relapse. It is therefore essential to determine how situational factors affect one another. Given the above, evidently, we encourage researchers to include ecological momentary assessment (EMA) in their research designs to examine adolescent smoking cessation and relapse. The use of EMA would also be necessary to distinguish singular lapses from relapse, which are demonstrated to be different types of milestones by both the present thesis as research among adults and therefore need separate consideration (Shiffman, Scharf, Shadel et al., 2006).

Improvement in research design for EMA studies

Several steps can be taken to improve the design of the present EMA study for future research. Although one should bear in mind that intensive assessment can be a burden to participants, extending the pre-quit period (in the present thesis this was 7 days) with several days might be advisable. The first few days, the study and its procedures and specificities are new to participants, and their ratings still need to ‘calibrate’. It is therefore common practice to not include those first two or three days in the analysis. For this reason, one might extend the pre-quit interval with two or three days. Also, to capture even more variation in ratings of behavior and mood, one might consider using more daily measurements. This should be determined depending on the variables of interest, where examining highly fluctuating states
(such as mood) requires more assessments than when the researcher is merely interested in whether or not a lapse occurred that day (for an example of a very intensive study on daily anxiety, affect, and activity in teenagers [25 to 30 assessments per day], see Henker, Whalen, Jamner, & Delfino, 2002). The additional advantage of administering more assessments than three per day is that it provides more opportunity to examine daily temporal patterns and to better test causal relationships within days. Chandra, Shiffman, Scharf, Dang, and Shadel (2007), for example, aggregated each day’s ratings of smoking, craving, and negative affect into eight 2-hr blocks. They then examined lagged longitudinal relationships between successive 2-hr time blocks.

Further, although the interval-contingent method we used allowed participants to choose a convenient moment of reporting, using random prompts is also an ideal feature to include in a EMA design, because participants will not be able to anticipate assessments (which may colour reports), and it allows for a broader range of temporal variation to be captured. Additionally, future EMA studies on adolescent smoking relapse could require participants to initiate a report when they are at the end of a so called ‘temptation episode’ (i.e., when they experience acute increases in urge to smoke or when they feel they have come to the brink of smoking regardless of subjective urges; cf. Gwaltney et al., 2008; Shiffman et al., 1996), and right after they have lapsed. Next to gaining insight into all characteristics of craving episodes and their associations with relapse, this will help to a) determine which factors discriminate temptation situations from lapse and relapse situations, and b) allows for even more proximal measurement of the factors associated with the first few lapses. Lastly, and more practically, researchers are recommended to use iPhones as an alternative to both hand-held palmtops and paper-and-pencil diaries. The use of palmtops requires advanced software engineering, which can be very expensive. Moreover, if the data are not downloaded every day, data will be lost when the devices fail. Using iPhones with access to internet provides a tool for EMA studies that is easy to carry, which allows for more extensive questions and answers than in the case of using mobile phone text messages, and can accommodate random prompting. Moreover, data that are entered via the internet are immediately downloaded into an online database, which prevents data from being lost if the device stops working.

**Coping responses**

The present thesis has shown that daily increases in urge to smoke and decreases in self-efficacy predict first lapses and relapse into smoking after adolescents have quit. In
addition, affect-motivational states (urge to smoke and negative affect) and external contexts (stress, seeing others smoke, and alcohol consumption) are associated with lower self-efficacy. Of adults, it is known that they attempt to combat these challenges by engaging in a coping response. Coping strategies refer to the specific efforts, both behavioral and psychological, that people employ to master, tolerate, reduce, or minimize stressful events (Jannone & O’Connell, 2007). Research suggests that engaging in some kind of coping strategy during highly tempting episodes prevents smoking in those situations among adults (O’Connell, Hosein, Schwartz, & Leibowitz, 2007; O’Connell, Schwartz, Gerkovich, Bott, & Shiffman, 2004; Shiffman, Patty, Gnys, Kassell, & Hickcox, 1996), and adolescents (Jannone & O’Connell, 2007). Jannone and O’Connell (2007) found adolescents to show surprisingly strong similarities in the use of coping strategies as compared to adults. Both the average number of coping strategies used in temptations and in lapse episodes were highly similar, although in general, adults used coping strategies more in lapses than adolescents. “The teenagers often said they did not even try a coping strategy, they just smoked” (Jannone & O’Connell, 2007). The latter remark is striking, and yet in line with prior studies that suggest that adolescents enter their quit attempts relatively unprepared and not well thought through (Balch, 1998)

The study by Jannone and O’Connell (2007) has been the first to shed more light on coping responses among adolescents who attempt to quit smoking, and their findings indicate that adolescents do benefit from engaging in coping responses. However, some characteristics of this particular study demonstrate why further research on coping responses among adolescents is needed. Briefly, their sample was relatively small, the smoking rate of the participants is not reported, and respondents were included in an 8-week smoking cessation program where they were taught several coping strategies. It is not known to what degree adolescents apply coping techniques when they embark on an unassisted quit attempt without prior education on coping techniques. It is also not known whether daily smoking adolescents differ from less frequent smokers in their coping responses while attempting to quit. Among adults, for instance, the level of nicotine dependence is associated with the use of specific strategies (O’Connell et al., 1998). Another issue that needs to be addressed in future research is whether the type and frequency of coping responses is dependent on the stage of cessation. Adults, for example, showed the highest average number of coping responses during the first three days after quitting (O’Connell et al., 1998). It is recommended that future research on adolescent smoking cessation and relapse assess coping responses in real-time, thereby distinguishing temptation episodes from lapse episodes.
Suggestions for prevention and intervention

In his review of 66 adolescent tobacco use cessation trials, Sussman (2002) listed eight major theoretical components on which current adolescent tobacco programs are based. These theoretical foci are as follows: 1. Social influence-oriented (to combat social influences that serve to promote or maintain teen tobacco use), 2. Cognitive-behavioral (instruction in cognitive-behavioral self-monitoring and coping skills to quit and maintain tobacco use cessation [e.g., smoking diary, stress coping]), 3. Motivation enhancement (techniques to clarify desire for change and reduce ambivalence toward change, e.g. motivational interviewing), 4. Response-contingent reinforcement (reinforce quit-behavior by offering extrinsic rewards such as money or prizes), 5. Supply reduction (arrange the social environment such that tobacco is more difficult to obtain or use [e.g., price increases or restricted access]), 6. Addiction/recovery-derived (use of means to ease physical effects of withdrawal, or emphasis on recovery from addiction), 7. Stages-of-change (techniques directly derived from the Transtheoretical Model of change [e.g., tailored cost and benefit information, treating contemplation to quit and quit strategies as involving distinctly different processes of change]), and 8. Affect clarification (techniques to clarify and remove conflicted affect about smoking cessation) (Sussman, 2002, p. 42-43). The present thesis mainly provides feedback on the strategies 1, 2 and 6; social influence-oriented, cognitive-behavioral, and addiction/recovery-derived, and some recommendations have already been provided in the discussion of the main findings above.

Before moving to the completion of these recommendations, we would like to make the more general remark that, to date, there is no strong evidence for most of the existing adolescent cessation programs (Mermelstein, 2003). In their very recent Cochrane review of tobacco cessation interventions for young people, Grimshaw and Stanton (2008) concluded that there is not yet sufficient evidence for any of the existing interventions to recommend their widespread implementation. They also reported that if any, complex approaches are the most promising, particularly when they incorporate elements that are sensitive to adolescents’ stage of motivation to quit (stage of change). Although nicotine replacement therapy (with or without additional application of bupropion) is currently understudied in adolescents, existing studies evidence of little effectiveness (Grimshaw & Stanton, 2006). Cognitive-behavioral interventions (e.g., Not on Tobacco program, NOT; Horn, Dino, Kalsekar, & Mody, 2005) suggest some effectiveness, but not in a convincing manner. Lastly, the effectiveness of
motivational interviewing is difficult to judge because this technique is usually combined with other intervention components and specific effects can therefore not be isolated, although one study indicated that motivational interview techniques in telephone counselling was not effective (Lipkus, McBride, Pollak et al., 2004). We do note that many of the trials seem to be underpowered to detect clinically important effects, mostly as a result of losses to follow up which seems more problematic among adolescents than among adults (Grimshaw & Stanton, 2009).

Also, although smoking cessation programs might include techniques aimed at preventing relapse, specific relapse preventions as available for adults do not seem to have been developed for adolescents as of yet. However, a review of existing relapse prevention programs for adults demonstrated that the evidence to date does not support the implementation of skills training or other specific interventions either (Lancaster, Hajek, Stead, West & Jarvis, 2006). All in all, the above provides a relatively pessimistic view on the current state of knowledge on what intervention strategies effectively help people, young and old, to quit smoking. It is clear that relapse prevention is an important area for future study. We need randomized controlled trials to test whether relapse interventions can aid adolescents in achieving prolonged abstinence, and which program components should be effective. Since the present thesis provides several of the first studies on micro-processes in smoking relapse among adolescents, we recommend that more research is needed to a) replicate the present findings, and b) explore other potential determinants of adolescent relapse, before developing adolescent-specific relapse programs. Based on the findings in the present thesis, we offer suggestions for several components that might be fruitful to include in prospective relapse programs for adolescents.

As mentioned earlier, what clinicians might convey to adolescents who want to quit smoking is that it is difficult to predict the extent to which and for how long one will experience withdrawal symptoms. This might help adolescents to shape a more realistic idea of what awaits them when they start to quit, and will hopefully encourage them to maintain abstinence once they are faced with peaks in craving and a longer duration of symptoms than expected. Further, while adolescents who are highly dependent might be less confident that they will succeed (Footnote 2), the present findings show that even the teenagers that smoke heaviest and who feel most dependent are not necessarily predisposed to lapse or mild relapse. This is something encouraging that might be conveyed to those adolescents as well. In addition, it seems important that adolescents are supported in maintaining high daily self-efficacy, as this was a strong predictor of lapse and relapse risk. Although existing programs
already include components that target self-efficacy, adolescent cessation programs tend to be brief and do not include longer term follow-up support by either the program or individuals in the social network of adolescents (Grimshaw & Stanton, 2009). The process of quitting, however, must be acknowledged to be a long-term process, and there is now substantial evidence from adults that more frequent contact over extended periods of time enhances long term success rates (Fiore, Bailey, Cohen et al., 2003). Despite that it has not yet been tested whether adolescents would also benefit of longer term support and inclusion of social partners in this process, it might well be useful to them. Further, the use of intensive self-monitoring may enhance quit rates, as both prior research and anecdotal reports of participants in our EMA study have suggested that this might aid cessation (Shiffman et al., 2008).

Another candidate avenue for stimulating and supporting adolescent smoking cessation could be the use of pharmacotherapy. In this thesis, we found that the effect of baseline smoking status on heavy relapse overruled the effects of baseline cognitions (pros of smoking and self-efficacy). Additionally, we found that daily increases in craving increased the risk of lapse and relapse the next day. Given that prior research shows that withdrawal symptoms seem to be successfully alleviated by using nicotine patches in adolescents (Smith, House, Croghan et al., 1996), one plausible opportunity for adolescent relapse prevention would seem to be the use of nicotine replacement therapy (NRT). However, studies on the effectiveness of NRT or bupropion on adolescent smoking cessation are small in number and have provided inconsistent findings (for an overview, see Grimshaw & Stanton, 2006). One of these reviewed studies showed that use of nicotine patches increased cessation rates, but the nicotine patch intervention was accompanied by cognitive-behavioral therapy (Moolchan et al., 2005). Given that we found daily variations in self-efficacy to strongly predict lapse and relapse the next day, a combination of program components directed toward enhancing daily self-efficacy and pharmacotherapy might prove successful, that is, if NRT will indeed be found to be useful in future studies. Future studies need to clarify if pharmacotherapy among adolescents can be effective, and if so, determine the optimal dose and substance (e.g., bupropion), and test through which mechanisms NRT facilitates adolescent smoking cessation. Critical tests of side-effects are warranted as well.

To conclude with some more general recommendations, we note that the literature indicates that smokers do not reuse strategies that have failed for them previously (Hughes, Goldstein, Hurt, Shiffman, 1999). Indeed, coping responses are observed to be used to a lesser extent among those who have a history of more quit attempts than those with fewer quitting experiences (O’Connell et al., 1998). Thus, it should be considered that it might be advised to
adolescents that they should save strategies that have been empirically proven successful for when success is more likely, or to persuade adolescents to reuse these strategies, given that the more coping techniques one uses, the higher the likelihood of success will be (O’Connell et al., 1998). Additionally, in recruiting adolescents for cessation programs, it has been observed that many are aware of smoking cessation methods, but they have low perceptions of these programs’ effectiveness, either due to their own disappointing experiences of interventions or those of others (Molyneux, Lewis, Coleman et al., 2006). Most adolescents are not aware that professional support is a possibility for them, although if they should receive this, it seems imperative that this assistance is non-directive, confidential, and non-judgmental (Molyneux et al., 2006).

**Concluding statement**

The present thesis contributes to a better understanding of the processes behind all stages of smoking cessation: Smoking reduction, readiness to quit, actual smoking cessation, prolonged abstinence, and relapse. It seems that the importance of various factors (e.g., social-environmental, cognitive, and physiological) is contingent on in which phase along the cessation continuum adolescents find themselves, where between-person differences in those factors seem to be more important in the earlier phases, and within-person differences seem more relevant during actual quit attempts. The findings in this thesis confirm the importance of examining static measures of individual characteristics assessed at single time-points, but also clearly point to the need to assess smoking cessation in a dynamic fashion, by using daily measures of relevant factors and examining within-person processes.
Footnotes

1. Although the terms ‘abstinence effects’ and ‘withdrawal effects’ are often used interchangeably, Hughes (2007) suggests that withdrawal effects should be distinguished from abstinence effects in that withdrawal effects typically follow a time-limited pattern. In this chapter, we will mostly refer to craving and negative affect as ‘withdrawal symptoms’ given that they were shown to peak upon achieving abstinence.

2. In neither one of our studies have we looked at baseline correlations (as assessed through the baseline questionnaire) between craving, nicotine dependence, and depressive symptoms on the one hand, and self-efficacy on the other. It appeared that all three factors were significantly associated with baseline self-efficacy in the sample that participated in the EMA study (craving: $r = -.50, p < .001$; nicotine dependence: $r = -.59, p < .001$; depressive symptoms: $r = -.31, p < .001$).
References


Appendix I

Unpublished results of asthma-specific factors
One of the aims of this thesis was to test whether there are asthma-specific precursors of adolescent smoking cessation outcomes, and whether smoking cessation-related processes might differ between adolescents with and without asthma. These results are outlined in chapters 12 and 13. The challenge we encountered in examining the role of asthma in the adolescents smoking cessation process is that we found that few adolescents manage to successfully quit. Although we had a very large sample (N = 10,265, and the prevalence of asthma in our sample was comparable to that in the national population, around 5%), we were also faced with the loss to follow-up of several schools and of those who had left school to continue higher education. Because of the fact that relatively few adolescents were found to have quit one year later and because we had losses to follow-up, the number of adolescents with asthma who had quit smoking was small. For the EMA study, we had intended to recruit at least 50 adolescents with asthma, but this did not prove to be feasible. Again, too few participants with asthma were included to perform analyses on asthma-related factors. In order to still have some information on the role of asthma in the adolescent cessation process, albeit with small sample sizes and limited statistical power, we decided to present unpublished data on asthma-specific factors and figures in the present appendix.

**Longitudinal national dataset**

**Medication compliance**

Among the total number of the 1,647 adolescents who smoked at least once a month at T3, 66 adolescents (4.1%) reported to have had asthma or to have taken asthma medication in the past 12 months. Their medication compliance (Brooks et al., 1994) is listed in Table 1 below. At T4, 843 participants reported to be smoking at least once a month. A number of 42 participants (5.0%) reported to have had asthma in the past 12 months. At T4, another scale for medication adherence was used, with questions very similar to the Brooks scale but with 5 answering categories ranging from 1 ‘always’ to 5 ‘never’, with a high score being indicative of high compliance (Horne, 2004). The mean score was 3.6 (SD = .89).
Table 1. Percentages for medication compliance at T3 (N=36).

<table>
<thead>
<tr>
<th>Measure</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compl1</td>
<td>61.2</td>
<td>38.8</td>
</tr>
<tr>
<td>Compl2</td>
<td>48.5</td>
<td>51.5</td>
</tr>
<tr>
<td>Compl3</td>
<td>77.8</td>
<td>22.2</td>
</tr>
<tr>
<td>Compl4</td>
<td>19.4</td>
<td>80.6</td>
</tr>
<tr>
<td>Compl5</td>
<td>83.1</td>
<td>16.9</td>
</tr>
<tr>
<td>Compl6</td>
<td>36.9</td>
<td>63.1</td>
</tr>
</tbody>
</table>

Further, as can be seen in Table 2, the T3 correlations between the compliance items and nicotine dependence and readiness to quit showed that none of the compliance items were correlated with nicotine dependence or readiness to quit. At T4, medication adherence was not significantly correlated with nicotine dependence ($r = .06, p = .727$), or readiness to quit ($r = -.10, p = .597$) either.

Table 2.

<table>
<thead>
<tr>
<th>Measures</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Compl1</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Compl2</td>
<td>.60***</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Compl3</td>
<td>.13</td>
<td>-.02</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Compl4</td>
<td>.13</td>
<td>.25*</td>
<td>.09</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Compl5</td>
<td>.16</td>
<td>.28*</td>
<td>-.13</td>
<td>.19</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Compl6</td>
<td>-.08</td>
<td>-.29*</td>
<td>.19</td>
<td>.21</td>
<td>.08</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Nicotine dependence</td>
<td>.04</td>
<td>.03</td>
<td>.19</td>
<td>.20</td>
<td>-.10</td>
<td>.21</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>8 Readiness to quit</td>
<td>-.17</td>
<td>.03</td>
<td>.18</td>
<td>.15</td>
<td>.03</td>
<td>-.05</td>
<td>-.21†</td>
<td>-</td>
</tr>
</tbody>
</table>

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, † $p < .01$. Compliance items 5 and 6 were recoded before computing the correlations, so that a higher score represented more compliance with medication.
**Smoking-specific cognitions**

On T3, adolescents with and without asthma who smoked at least once a month did not significantly differ in average scores on the pros of smoking ($t(1510) = -0.02, p = .985$), the pros of quitting ($t(1502) = -0.75, p = .455$), and self-efficacy to refrain from smoking ($t(1422) = -0.57, p = .568$). The two groups also did not differ on levels of craving ($t(1511) = -1.27, p = .205$), and depression ($t(1620) = -1.54, p = .124$), as assessed through the baseline questionnaire (see also Chapter 13). At T4, there were no differences between adolescents with and without asthma in mean scores on all these variables either.

**Smoking cessation**

To examine whether adolescents with asthma would show better quit rates than those without asthma, we selected those respondents who reported to be smoking at least once a month at T3, and who completed T4 as well. Out of the 606 participants who completed both T3 and T4, and who reported to smoke at least once a month, 30 participants (5.0%) indicated at T3 that they had had asthma in the past 12 months. Having asthma at T3 did not predict whether someone had quit or decreased one’s smoking rate one year later (OR = .52, $p = .284$, CI = .15 – 1.73), but we acknowledge that we may lack statistical power here to detect a significant effect.

**Ecological Momentary Assessment (EMA) study**

Given that smoking is the number one cause of triggering and exacerbating asthma (NHLBI, 1997), and because smoking cessation reduces asthma symptoms and bronchial hyperreactivity (Tønnesen et al., 2005), we recruited adolescents with asthma into the EMA study as well. Twelve participants indicated to have asthma and were given a peak expiratory flow (PEF) meter. A peak flow meter is a device that measures air flowing out of the lungs, called peak expiratory flow rate, as a person with asthma forcefully blows into the device. Participants with asthma were instructed to report their PEF scores in the mornings and evenings, which provided a total number of 14 pre-quit and 42 post-quit assessment opportunities per person. Below are the figures of the natural history of average daily PEF scores during the quit attempt of participants with asthma who were enrolled in our EMA study. The peaks indicate where the lapse and relapse (if they occurred) took place. If no peaks are depicted in the figures, this means that this person remained abstinent throughout the entire EMA period. Participants 172 and 175 dropped out of the study before the last study day (day 28).
Participant 10: Actual quit day was day 8.

Participant 25: Actual quit day was day 7.

Participant 30: Actual quit day was day 1. (Participant 30 had misunderstood the study protocol and achieved 24 hours of abstinence as of study day 1)
Participant 33: Actual quit day was day 8.

Participant 84: Actual quit day was day 9. The second lapse also occurred on day 10.

Participant 129: Actual quit day was day 9.
Participant 164: Actual quit day was day 8. The first lapse coincided with the onset of the mild relapse.

![Graph showing PEF score for Participant 164 with mild relapse indicated.]

Participant 171: Actual quit day was day 8.

![Graph showing PEF score for Participant 171 with first and second lapse indicated.]

Participant 172: Actual quit day was day 9.

![Graph showing PEF score for Participant 172.]

Participant 175: Actual quit day was day 8.

Participant 185: Actual quit day was day 10. The first lapse, second lapse, and mild relapse coincided with the onset of the heavy relapse.

Participant 186: Actual quit day was day 8. The first and second lapse coincided with the onset of the mild relapse.
General impression of PEF scores

What we observe is that for some participants, the PEF score seemed to increase right after smoking (by means of a lapse or relapse) participants 10, 30, and 185, yet for others, the PEF scores decreases upon smoking (participants 33, 84, 129, 164, and 171). Unfortunately, we cannot verify whether these drops and increases are meaningful. Although each person showed daily variability in PEF scores, there was an overall increase in PEF score (i.e., the score at the last day compared to the score at the first day) among most participants (participants 10, 25, 33, 129, 164, 172, and 185). Others’ PEF scores remained relatively stable over time (participants 30, 171, 175, and 186). For one person, the overall PEF scores seemed to decrease (participant 84)
References


Publications

(in order of appearance in this thesis)


Van Zundert, R. M. P., Kuntsche, E., & Engels, R. C. M. E. In the heat of the moment: Alcohol consumption during the process of smoking cessation is strongly related to the first lapse into smoking among adolescents. (Submitted).

Nederlandse samenvatting

Ondanks dat de prevalentie van roken onder zowel volwassenen als adolescenten langzaamaan afneemt in veel westere landen, vormt roken wereldwijd nog steeds de nummer één te voorkomen doodsoorzaak. Wanneer jongeren roken vermindert dit direct al hun longgroei, hun algehele fitheid en vergroot dit het risico op ademhalingsproblemen. Op de langere termijn veroorzaakt roken hartklachten, verschillende vormen van kanker en longemfyseem. Ondanks deze grote gezondheidsrisico’s en ondanks het feit dat veel jongeren en volwassenen op de hoogte zijn van deze risico’s blijft een groot aantal mensen roken. Terwijl wetenschappelijk onderzoek zich voorheen voornamelijk richtte op hoe je kunt voorkomen dat mensen beginnen met roken, is er de laatste twee decennia meer aandacht gekomen voor onderzoek naar de factoren die een rol spelen bij het stoppen met roken. Dit is nodig gebleken omdat mensen veel moeite hebben met stoppen (circa 95% valt uiteindelijk terug) en omdat preventie inspanningen niet of onafdoende effectief bleken.

Hoewel er extra aandacht ontstond voor het proces van stoppen onder rokers, werd er min of meer aangenomen dat het voor adolescenten makkelijker zou zijn om te stoppen met roken dan voor volwassenen (bijvoorbeeld omdat ze nog niet zo lang rookten) en dat de mechanismen die een rol spelen bij het stopproces gelijk zouden zijn voor volwassenen en adolescenten. Beide aannames blijken niet helemaal juist te zijn. Zo is het percentage jongeren dat terugvalt na een stoppoging zeker zo hoog als dat onder volwassenen en blijken jongeren op een andere manier tot hun motivatie om te stoppen te komen en gaan ze dit proces vaak ook minder doordacht in. Het is echter van belang dat
we meer inzicht krijgen in welke factoren succesvol stoppen bevorderen aangezien er aanzienlijke voordelen zijn wanneer jongeren zo vroeg mogelijk weer stoppen. De belangrijkste voordelen zijn dat de schade die al merkbaar wordt in de adolescentie (zoals de afname in longgroei) beperkt blijft en dat een kortere periode van roken vaak gerelateerd is aan een lagere mate van nicotineafhankelijkheid. Dit is gunstig omdat een sterke mate van nicotineafhankelijkheid het stoppen met roken aanzienlijk bemoeilijkt. In dit proefschrift wordt dan ook gekeken naar factoren die het verloop en de uitkomst van de daadwerkelijke poging tot stoppen met roken van jongeren beïnvloeden en naar factoren die de aanloop daar naartoe voorspellen. Ondanks dat roken extra schadelijk is voor de gezondheid van mensen met astma blijkt de prevalentie van roken onder jongeren met astma vergelijkbaar te zijn met die onder jongeren zonder astma. In dit proefschrift worden dan ook bevindingen van enkele studies besproken waarin gekeken wordt naar astma-specifieke factoren in het proces van stoppen met roken onder jongeren. Deel 2 van dit proefschrift zal deze artikelen aangaande de rol van astma bij het stoppen met roken beschrijven.

Deel 1 van het proefschrift beschrijft studies naar diverse factoren die mogelijk een invloed hebben op stoppen met roken – en alle daaraan gerelateerde processen zoals de motivatie om te stoppen met roken en het verminderen van het aantal gerookte sigaretten. De volgorde van de hoofdstukken loopt daarbij synchroon met de stadia van het stopproces: eerst gaan we in op determinanten die zowel het continueren van roken als het reduceren of verhogen van de frequentie van roken voorspellen (hoofdstuk 2). Vervolgens wordt bekeken welke factoren de motivatie om te stoppen met roken voorspellen om daarna het daadwerkelijke stoppen en terugval in kaart te brengen. Dit
proefschrift richt zich op potentiële factoren uit verschillende invalshoeken. Zo wordt er gekeken naar de invloed van omgevingsfactoren, zoals het gedrag van vrienden en ouders, en de opvoeding die ouders geven. Daarnaast worden er ook demografische persoonlijke kenmerken (zoals leeftijd, opleiding en geslacht), psychosociale persoonlijke kenmerken (zoals attitude ten aanzien van roken en stoppen met roken en in welke mate jongeren er vertrouwen in hebben dat ze effectief kunnen stoppen met roken [eigen-effectiviteit], en psychofysiologische persoonlijke kenmerken (zoals nicotine afhankelijkheid en de drang om te roken [craving]) in acht genomen. In Deel 2 van dit proefschrift hebben we enkele processen gerelateerd aan stoppen met roken verder uitgediept voor jongeren met astma.

Binnen deze studies hebben we zowel gekeken naar factoren die tussen mensen verschillen (wat men ‘individuele verschillen’ of ‘tussen-personen variatie’ noemt, zoals bijvoorbeeld leeftijd en geslacht) als naar verschillen binnen personen (wat men ook wel ‘binnen-personen variatie’ noemt). De variatie binnen een persoon is gelegen in het feit dat niet alle persoonlijke kenmerken en omstandigheden elke dag hetzelfde zijn. Mensen kunnen bijvoorbeeld van dag tot dag verschillen in de mate waarin ze verlangen naar een sigaret, en juist deze dagelijkse variaties kunnen een invloed hebben op het al dan niet succesvol kunnen stoppen met roken. De dagelijkse variaties in gevoelens en gedrag van jongeren die een stoppoging ondernemen was tot op heden nog niet onderzocht. Om deze microprocessen te onderzoeken hebben we een steekproef van 176 dagelijks rokende jongeren onderzocht die allen een serieuze stoppoging ondernamen. Vanaf een week voor de stopdatum tot aan drie weken na de stopdatum werden zij dagelijks gevolgd en beantwoordden zij drie keer per dag dezelfde vragen. Hiermee hebben we meer inzicht
gekregen in de dagelijkse fluctuaties in gevoelens, cognities en gedrag die een rol spelen bij het stoppen met roken door jongeren. Hoofdstukken 5 tot en met 11 zijn gebaseerd op deze data. Daarnaast hebben we longitudinaal vragenlijstonderzoek onder ruim 10.000 Nederlandse adolescenten (zowel rokers als niet-rokers) uitgevoerd. Deze vragenlijsten gingen in op psychologische, omgevings- en verslavingsfactoren die van belang kunnen zijn voor het verklaren van rookgedrag onder adolescenten. Hoofdstukken 3, 4, 12 en 13 zijn gebaseerd op deze longitudinale data. Hoofdstuk 2 is gebaseerd op longitudinale data van 397 adolescenten uit een ander longitudinale onderzoek.

Deel 1: Voorspellers van stoppen met roken onder adolescenten

*Wat zorgt ervoor dat jongeren na het experimenteren met roken doorgaan met roken, en wat maakt of ze vervolgens hun rookgedrag verminderen of vermeerderen? (Hoofdstuk 2).*

Wanneer we de cognities van de Theorie van Gepland Gedrag (attituden ten aanzien van roken, sociale norm over roken en eigen-effectiviteit) als uitgangspunt nemen voor het voorspellen van het continueren, c.q. verminderen of vermeerderen van roken, dan zien we dat deze factoren slechts een kleine rol spelen in het verminderen van rookgedrag maar dat ze relevant zijn voor het intensiever gaan roken bij jongeren. Interacties tussen de verschillende variabelen geven inzicht in cumulatieve risico- of protectieve factoren. Zo vormt een combinatie van een pro-roken attitude en pro-roken norm van de sociale omgeving een extra risico dat jongeren meer gaan roken (dat wil zeggen, meer dan wanneer een jongere zelf een pro-roken attitude heeft, maar de directe sociale omgeving
niet). Wanneer jongeren daarentegen juist een hoge mate van eigen-effectiviteit ervaren in combinatie met een negatieve attitude ten aanzien van roken is de kans groter dat ze minder gaan roken of stoppen na te hebben geëxperimenteerd met roken.

Wat zijn de belangrijkste factoren en onderliggende mechanismen in het proces van de motivatie om te stoppen met roken bij jongeren? (Hoofdstuk 3, 4 en 13).

In hoofdstukken 3 en 4 hebben we gekeken naar de invloed van opvoeding die specifiek gericht is op stoppen met roken op de motivatie van jongeren om te stoppen met roken. We hebben hierbij ook gekeken wat de invloed is van het rookgedrag van ouders zelf, zowel op de motivatie van jongeren als op de relatie tussen opvoeding en motivatie. Het bleek dat wanneer ouders druk op hun kinderen uitoefenen om te stoppen met roken en hen wijzen op de voordelen van stoppen, jongeren meer gemotiveerd zijn om te stoppen met roken, zelfs nog een jaar later. Bovendien hangt de opvoeding gericht op stoppen met roken samen met cognities die jongeren hebben aangaande roken: wanneer ouders dit type opvoeding uitoefenen, zien jongeren minder voordelen in roken, zien ze meer voordelen in stoppen en hebben ze meer vertrouwen in hun vermogen om succesvol te stoppen met roken.

Deze cognities blijken op hun beurt weer samen te hangen met de motivatie om te stoppen met roken: jongeren die minder voordelen zien in roken en meer voordelen zien in stoppen met roken zijn meer gemotiveerd om te stoppen. Als we echter een jaar later kijken, zien we dat er geen langdurig effect is van deze cognities op motivatie. Wanneer daadwerkelijk stoppen de uitkomstmaat is, zien we bovendien dat noch de opvoeding gericht op stoppen noch de cognities van de jongere van invloed zijn op het succesvol
gestopt zijn een jaar later. Tot slot bleek het rookgedrag van ouders zelf op meerdere manieren relevant. Wanneer ouders zelf roken, zijn hun kinderen minder gemotiveerd om te stoppen met roken. Bovendien oefenen rokende ouders in mindere mate de opvoeding gericht op stoppen uit, wat indirect dus een negatief effect heeft op de motivatie van het kind om te stoppen met roken. Wanneer rokende ouders echter dit type opvoeding aanwenden hangt dit op dezelfde manier samen met hun kind zijn of haar cognities en motivatie als wanneer niet-rokende ouders dit doen. Dit kan gezien worden als een stimulering voor rokende ouders (die zich anders wellicht onthouden van dit type opvoeding vanuit een gevoel van hypocrisie) om toch druk uit te oefenen op hun kind en het te stimuleren om te stoppen met roken. Of een kind vervolgens al dan niet succesvol stopt lijkt niet afhankelijk te zijn van het rookgedrag van ouders.

Alhoewel we in hoofdstuk 13 gericht keken naar de rol van astma in de motivatie tot stoppen met roken onder jongeren, leverde deze studie ook veel informatie op voor jongeren in het algemeen. We keken of sociale omgevingsfactoren (rookgedrag van ouders en beste vriend(in) ) en psychofysiologische factoren (nicotine afhankelijkheid en de drang om te roken [‘craving’ genoemd] ) zowel direct samenhingen met de motivatie om te stoppen als indirect via rook-specifieke cognities (de voordelen van roken en stoppen met roken, en eigen-effectiviteit). Ondanks dat het roken door ouders samenhang met een lagere motivatie om te stoppen bij de jongere, gold dit niet voor het roken van de beste vriend. Nicotine afhankelijkheid en craving hing voor jongeren met en zonder astma samen met een lagere motivatie om te stoppen met roken. Bovendien zagen jongeren met een sterke nicotine afhankelijkheid en craving meer voordelen in roken en hadden zij een lager gevoel van eigen-effectiviteit om te kunnen stoppen.
Uit alle bovenstaande studies aangaande de motivatie om te stoppen met roken kan geconcludeerd worden dat bij het vormen van een motivatie om te stoppen met roken meerdere factoren binnen zowel de sociale omgeving als binnen het spectrum van psychosociale en psychofysislogische persoonlijke kenmerken een rol spelen.

Wat is de rol van ouders bij terugval na het stoppen met roken? (Hoofdstuk 5).

Nadat we op verschillende manieren de rol van ouders hebben bekeken in het proces van de motivatie om te stoppen en het stoppen met roken over langere tijd, rees de vraag of het rookgedrag van ouders en opvoeding gericht op stoppen met roken kan voorspellen of jongeren terugvallen nadat ze een serieuze stoppoging hebben ondernomen. We keken hierbij ook of de norm van ouders ten aanzien van stoppen met roken en de mate van steun die jongeren voorafgaand aan hun stoppoging verwachtten van hun ouders een rol speelden. Ondanks dat de rol van ouders evident was gebleken in eerdere fasen van het rookproces, vonden we geen enkel effect van ouderlijke factoren op de uitkomst van de stoppoging. We weten echter niet of en in welke mate ouders tijdens de stoppoging van hun kind hun opvoed- en rookgedrag hebben aangepast en dit kan veel verschil maken. Een ouder die normaal gesproken rookt waar zijn of haar kind bij is en die besluit om dit niet meer te doen kan in de hand werken dat de jongere aan minder verleiding wordt blootgesteld en kan als stimulerend voorbeeld functioneren. We bevelen dan ook aan dat onderzoek naar de invloed van ouders op stoppen met roken bij jongeren de oudervariabelen op een dagelijkse basis bekijkt.
Welke rol spelen cognities bij terugval na het stoppen met roken? (Hoofdstukken 6, 7 en 8).

Waar we in eerdere hoofdstukken keken naar cognities in relatie tot de motivatie om te stoppen met roken en de kans dat iemand succesvol stopt, gingen we in hoofdstukken 6 tot en met 8 in op de rol van cognities op terugval na het stoppen. Cognities werden bekeken in het licht van zowel individuele ‘tussen-personen’ verschillen als intra-individuele ‘binnen-personen’ verschillen waarbij de dagelijkse variatie in cognities tevens in beschouwing werd genomen. De cognities zoals onderzocht in hoofdstuk 6 omvatten de door de jongere gepercipieerde voordelen van roken en de voordelen van stoppen met roken, alsmede hun gevoel van eigen-effectiviteit om gestopt te blijven. Hier zagen we dat de mate waarin adolescenten de voordelen van roken en stoppen onderschreven niet bepalend was voor de uitkomst van hun stoppoging. Ook hun gevoel van eigen-effectiviteit waarmee ze de stoppoging ingingen bleek niet relevant. De enige significante voorspeller van terugval (en dan alleen ‘zware’ terugval) was de intensiteit van roken. Het maakt kennelijk niet uit met welke attitudes ten aanzien van roken, stoppen met roken en hun eigen-effectiviteit het stopproces ingaan, de factoren die succes bepalen liggen blijkbaar elders.

Waar die dan liggen bleek in hoofdstuk 7. In deze studie keken we naar de veranderingen in eigen-effectiviteit van dag tot dag (situationele eigen-effectiviteit). We vonden een behoorlijk sterk effect van een lage eigen-effectiviteit op de ene dag op terugval de andere dag. Dit effect bleef zelfs overeind nadat we controleerden voor roken op de dag dat eigen-effectiviteit werd gemeten als voorspeller van terugval de andere dag. (Dit gold natuurlijk alleen voor de jongeren die op zijn minst alweer één sigaret hadden
gerookt). Aangezien situationele eigen-effectiviteit zo’n belangrijke factor bleek te zijn voor terugval, gingen we dieper in op welke factoren de eigen-effectiviteit verlagen of verhogen. We onderzochten in dit verband verschillende externe en interne factoren (ook drie keer per dag gemeten), zoals de drang om te roken (craving), negatieve stemming, andere mensen zien roken, alcohol consumptie en stress, en we keken wat de samenhang met eigen-effectiviteit was. We vonden dat wanneer jongeren sterk de drang hebben om te roken, alcohol consumeren, anderen zien roken, in een negatieve stemming verkeren of wanneer ze stress ervaren, dat ze een lagere mate van eigen-effectiviteit hebben.

Samenvattend laten hoofdstukken zes, zeven en acht zien dat cognities wel degelijk een rol spelen in terugval bij jongeren, maar dat dit afhankelijk is van de manier waarop we cognities onderzoeken.

*Wat is de rol van psychofysiologische factoren bij terugval na het stoppen met roken? (Hoofdstukken 9 en 10).*

Eerder in dit proefschrift vonden we al dat nicotine afhankelijkheid en de drang om te roken (craving) sterk gerelateerd zijn aan de motivatie om te stoppen met roken.

Vervolgens bekeken we ook de rol van deze variabelen in terugval na een serieuze stoppoging. Bovendien zijn ontwenningsverschijnselen vaak deels een gevolg van nicotine afhankelijkheid die optreden na het stoppen. Ook gevoelens van craving kunnen persisteren na het stoppen met roken. We onderzochten het verloop (groeicurves) van ontwenningsverschijnselen (craving, negatieve stemming en honger) over de hele periode van de stoppoging. We keken daarbij eveneens of bepaalde kenmerken van het verloop voorspellend waren voor de uiteindelijke uitkomst van de stoppoging. Hierna werd
onderzocht of de dag-tot-dag variatie in craving en negatieve stemming terugval op de andere dag kon voorspellen.

Wanneer we het verloop van ontwenningsverschijnselen bekeken (hoofdstuk 9), zagen we dat - over de hele groep genomen -, de ontwenningsverschijnselen sterk toenamen op de stopdag, dit gold met name voor craving. Een significante afname in symptomen was zichtbaar gedurende de eerste week na de stopdag. Vervolgens namen de symptomen geleidelijk aan verder af totdat ze twee weken na de stoppoging over het algemeen op hetzelfde niveau waren als voor de stoppoging. Verder bleek dat hoe sterker jongeren voor en tijdens de stopdag last hadden van craving, des te groter de kans was dat ze niet abstinent meer waren tijdens de laatste week van het onderzoek. Hoe sterk de craving, negatieve stemming en honger waren voor en na de stoppoging, en met welke snelheid deze afnamen bleek niet te voorspellen of jongeren twee maanden na het einde van de studie nog steeds gestopt waren. De bevindingen suggereren dat succesvol stoppen met roken onder dagelijks rokende jongeren niet sterk afhangt van de manier waarop ontwenningsverschijnselen verlopen voor, tijdens en na een stoppoging.

De dagelijkse variatie in ontwenningsverschijnselen blijkt echter wel van belang. We onderzochten of de verschijnselen craving en negatieve stemming op de ene dag terugval op de andere dag konden voorspellen (hoofdstuk 10). Voor craving bleek dit duidelijk het geval. Wanneer jongeren sterke craving ervoeren op de ene dag, was de kans dat ze de andere dag weer een sigaret zouden roken, of dat ze een periode van drie dagen achtereen roken zouden ingaan, aanzienlijk groter. Dit bleek niet het geval te zijn voor negatieve stemming, ondanks dat dit onder volwassenen een sterke predictor is van terugval. Het effect van dagelijkse craving bleef van kracht wanneer gecontroleerd werd
voor nicotine afhankelijkheid en het roken van een sigaret op dezelfde dag dat craving werd gemeten (wat op zichzelf een sterke voorspeller is van terugval). Individuele verschillen in nicotine afhankelijkheid en depressieve symptomen zoals gemeten aan het begin van het onderzoek (baseline) voorspelden niet welke jongeren zouden terugvallen. Alleen in het geval van een ‘zware’ terugval (dat wil zeggen, drie dagen achtereenvolgens weer minimaal vijf sigaretten per dag roken na te zijn gestopt), bleek nicotine afhankelijkheid een relevante factor. De bevindingen van deze studie doen twijfelen aan de opvatting dat een negatieve stemming onder jongeren een belangrijke rol speelt bij terugval (zoals dat het geval is bij volwassenen) en benadrukken het belang van het kijken naar dynamische effecten zoals dag-tot-dag variatie in ontwenningsverschijnselen.

*Welke rol speelt het gebruik van alcohol wanneer jongeren een poging doen om te stoppen met roken? (Hoofdstuk 11).*

Uit veel studies blijkt dat roken en drinken vaak hand in hand gaan. De jongeren uit de dagboekstudie werden elke keer dat ze het vragenlijstje invulden gevraagd of ze een alcoholisch drankje genuttigd had in de afgelopen 30 minuten. We keken vervolgens of de dagen waarop jongeren weer een sigaret rookten (een ‘lapse’) of een zwaardere terugval vertoonden van een paar dagen achtereenvolgens weer roken (‘relapse’) dezelfde dagen waren als waarop jongeren alcohol hadden gedronken. We vonden dat de eerste sigaret die jongeren weer rookten na ten minste 24 uur te zijn gestopt, vaak gerookt werd op de dag dat ze alcohol hadden gedronken. Dit gold niet voor zwaardere terugval. Bovendien vonden we dat het effect van alcohol consumptie op de eerste lapse nog sterker was voor de jongere adolescenten dan voor de oudere groep. Deze studie geeft aan dat het drinken
van alcohol tijdens het stoppen met roken door jongeren een sterke risicofactor is voor het mislukken van de stoppoging. Er zou ons inziens dan ook aandacht aan alcohol consumptie besteed moeten worden bij het begeleiden van jongeren in het proces van stoppen met roken.

Deel 2: De rol van astma bij het stoppen met roken door jongeren

_Hoe verhoudt het hebben van astma zich tot stoppen met roken onder jongeren?
_(Hoofdstukken 12 en 13)._

Zoals eerder genoemd, is het aantal rokers onder jongeren met astma ongeveer even hoog als dat onder jongeren die deze ziekte niet hebben. Bovendien gaan astmatische jongeren even vaak als niet-astmatische jongeren meer roken. Sterker nog, uit onderzoek blijkt dat jongeren met astma sneller meer gaan roken dan niet-astmatische jongeren. In hoofdstuk 12 onderzochten we of dit mogelijk veroorzaakt werd door een snellere ontwikkeling van nicotine afhankelijkheid onder jongeren met astma. We keken ook of jongeren met astma of astmatische symptomen meer stoppogingen hadden ondernomen over tijd in vergelijking met jongeren zonder astma. Uit deze studie bleek dat jongeren met veel astmasymptomen in dezelfde tijdsspanne hogere niveaus van nicotine afhankelijkheid ontwikkelden dan jongeren met minder zware symptomen of zonder astma. Bovendien hadden jongeren met veel astmasymptomen vaker een stoppoging ondernomen in de afgelopen 12 maanden. Deze effecten werden deels gemedieerd door nicotine afhankelijkheid.
De afhankelijkheid van nicotine an sich bepaalt voor jongeren met astma echter in gelijke mate de motivatie om te stoppen met roken vergeleken met jongeren zonder astma, zo bleek in hoofdstuk 13. Deze studie toonde ook aan dat de drang om te roken (craving) bij jongeren met astma sterker gerelateerd was aan de motivatie om te stoppen dan bij jongeren zonder astma. Daarnaast waren jongeren met astma over het algemeen meer gemotiveerd om te stoppen met roken dan gezonde jongeren. Uit bovenstaande studies concludeerden we dat het aanpakken van nicotine afhankelijkheid en craving in beide groepen jongeren van belang is. Bovendien is het een positief gegeven dat jongeren met astma meer gemotiveerd zijn om te stoppen en hier kan op ingespeeld worden in interventies voor stoppen met roken onder jongeren met astma.

Tot slot hebben we de bevindingen van alle studies uit het huidige proefschrift samengevat en besproken in het laatste hoofdstuk (hoofdstuk 14). Onze algemene conclusies zijn dat de mate waarin verschillende factoren belangrijk zijn (zoals sociale omgevingsfactoren, cognitieve en psychofysiologische factoren) afhankelijk is van in welke fase van het stopproces jongeren zich bevinden. Verschillen tussen personen lijken vooral belangrijk in de vroegere stadia, terwijl verschillen binnen personen (zoals de dag-tot-dag variaties) meer relevant lijken te zijn gedurende het daadwerkelijke stoppen. De resultaten in dit proefschrift onderschrijven het belang van het onderzoeken van statische maten van individuele karakteristieken op enkele momenten, maar laten ook duidelijk zien dat het belangrijk is om stoppen met roken bij jongeren op een dynamische manier te onderzoeken door dagelijkse metingen te gebruiken van relevante variabelen en door te kijken naar variatie binnen personen. We hebben tot slot in dit laatste hoofdstuk de
beperkingen en implicaties van de studies in dit proefschrift besproken en aanbevelingen voor toekomstig onderzoek en preventie- en interventieprogramma’s bediscussieerd.