Contextual Correlates of Adolescents’ Self-Efficacy After Smoking Cessation

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Recent research has shown that daily changes in self-efficacy predict lapses and relapse into smoking after quitting among adolescent daily smokers, 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 adolescent daily smokers were monitored daily during 1 week prior to and 3 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. 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 negative associations between self-efficacy and negative affect and drinking alcohol were found to be stronger. These results show that adolescents’ self-efficacy during a quit attempt may be responsive to affect-motivational states and external contexts, both before and after lapsing.

Keywords: smoking cessation, relapse, self-efficacy, adolescents

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 & Adams, 1977; Bandura, 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, 2010). In addition, adults’ self-efficacy seems responsive to affect-motivational states (e.g., craving and negative affect), and external contexts (e.g., seeing others smoke, drinking alcohol or coffee; Gwaltney, Shiffman, & Sayette, 2005). However, predictors of adolescent smoking relapse are largely unknown, since studies on smoking relapse are conducted almost exclusively among adults. Two recent studies among 15 to 19-year-olds identified individual differences in prequit baseline self-efficacy to predict heavy relapse (Van Zundert, Boogerd, Vermulst, & Engels, 2009), and found momentary self-efficacy after cessation to be an important predictor of lapse and relapse into smoking the next day among adolescents (Van Zundert et al., 2010). These two studies, however, did not examine the correlates of self-efficacy. Given that empirical knowledge of the adolescent smoking relapse process is scarce and given that momentary self-efficacy seems to be a strong predictor of adolescent relapse, it is important to determine which factors are associated with the levels and variations in self-efficacy in this particular age group. In the present study, it will be examined how momentary 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 momentary 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-motivational states and drug-related external contexts (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 or craving). The process of physiological and subjective reactions to presentations of drug-related contexts 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 again affect self-efficacy, making self-efficacy ‘the final common pathway to lapsing’ (Gwaltney, Shiffman, Balabanis, & Paty, 2005).

Although peaks in craving and external situations such as seeing others smoke may be short-lived and highly transient in nature, their impact via decreased self-efficacy may last longer. A study on naturalistic craving episodes showed that the average duration of craving episodes was 6 to 10 minutes (Heishman, Singleton, & Moolchan, 2003). Though short in duration, the median interval of craving frequency was 6 to 10 episodes per day. Thus, episodes of craving frequently place demands on one’s self-control to resist smoking throughout the day. The self-control strength model (Muraven & Baumeister, 2000) proposes that individuals possess a limited self-control resource known as ‘self control strength’ and that this strength is drawn upon any time a person exerts self-control to override, inhibit or stop a thought, emotion, urge, or behavior. Repeated use of this resource is thought to lead to its depletion which in turn results in poorer self-control performance, such as alcohol intake (Muraven, Collins, Shiffman, & Paty, 2005) and smoking lapse (Muraven, 2010). Given that self-efficacy has been found to predict poor self-control performance over time (e.g., lapse or relapse the next day; Gwaltney et al., 2001, Gwaltney, Shiffman, Balabanis, & Paty, 2005; Van Zundert et al., 2010) it is thus possible that situational variables have a momentary effect on self-efficacy, which in turn leads to relapse over time.

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, Shadell, Britt, & Abrams, 2002), and in an ecological momentary assessment study (Gwaltney, Shiffman, Balabanis, & Paty, 2005). Urge to smoke seems to be negatively associated with self-efficacy when individuals have achieved abstinence, but also after a person has lapsed. The same applies to negative affect; negative affect seems to be 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, Shiffman, Balabanis, & Paty, 2005). Although urge to smoke and negative affect are significantly correlated, their associations with self-efficacy seem to exist independent of each other (Gwaltney, Shiffman, & Sayette, 2005). To date, it is unknown how urge to smoke and negative affect are associated with momentary self-efficacy to abstain from smoking 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, Shiffman, and Sayette (2005). This association, however, disappeared after controlling for urge to smoke. 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 (Shiffman, Paty, Gnyys, Kassel, & Hickcox, 1996), and adolescents (Van Zundert, Kuntsche, & Engels, 2011), both alcohol and coffee consumption do not seem to be related to self-efficacy among adults (Gwaltney, Shiffman, & Sayette, 2005). Lastly, although adolescents report to smoke for reasons of coping with stress (Kassel, Stroud, & Paronis, 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.

The present study used data from an ecological momentary assessment (EMA) study in which 134 adolescent daily smokers embarked on a quit attempt and reported on their affect-motivational states and external contexts three times a day during 1 week prior to, and 3 weeks after achieving at least 24 hours of abstinence. The main purpose of this study was to examine the within-person associations between momentary self-efficacy and the affect-motivational states and external contexts. It was hypothesized that higher ratings of craving1 and negative affect, as well as seeing other people smoke, experiencing a stressful event, and consuming alcohol or coffee would be associated with lower momentary self-efficacy to maintain abstinence, before and after lapsing (if lapsing occurred). Because the within-person associations between affect-motivational states, external contexts, and momentary self-efficacy may differ according to individual characteristics, we also examined whether between-person differences in age, sex, and baseline questionnaire self-efficacy moderated the within-person associations. It is possible, for example, that the hypothesized negative association between craving and momentary 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 whether the within-person associations were moderated by concomitant smoking. Since craving and negative affect are heightened under conditions of nicotine deprivation (Hughes, 2007), the associations between affect-motivational states and momentary self-efficacy may be different under smoking circumstances compared to nonsmoking occasions.

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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.
Method

Participants

Participants (n = 134) were Dutch adolescent daily smokers recruited for the study by means of community advertisements and newspaper articles. The recruitment materials included an invitation to adolescent daily smokers who were highly motivated to quit smoking to take part in the study. 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. Given that no cessation program was delivered in this study, participants were allowed to use any given self-help cessation technique, including nicotine replacement therapy (NRT). Upon completing the study, only three participants indicated using NRT.

Of the 176 participants who were initially 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, Boogerd et al., 2009; Van Zundert et al., 2010). Briefly, prior attrition analyses on these data showed that excluded participants were marginally more nicotine dependent and smoked more cigarettes per day at baseline (Van Zundert, Boogerd, et al., 2009), but that they did not differ in smoking rates during the first week of ad lib smoking, nor in relapse rates. Excluded subjects also did not differ according to age, sex, and whether they quit in the past 12 months (yes or no) from those included.

The following descriptive statistics pertain to the 134 participants included in the present analyses. 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%), preuniversity 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 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%). Among those who reported to have made a quit attempt in the past 12 months (83.7%), the average number of prior quit attempts in the past 12 months was 1.9 (SD = 1.2). When asked whether they had experienced a period of successful cessation in the past 12 months (of any given duration), 63.7% reported such a period. The large majority of those who reported a period of abstinence (93.4%) had not remained abstinent for 1 week (in fact, for 69.7% the period did not even last 3 days). The mean level of nicotine dependence (on a scale from 1 to 4; measured with a multidimensional scale including the modified Fagerström Tolerance Questionnaire (mFTQ; Fagerström, & Schneider, 1989), and the Hooked on Nicotine Checklist (HONC; DiFranza et al., 2002) as constructed by Kleinjan and colleagues (2007) was 2.63 (SD = .49). Written consent from the participants and their parents was not obligatory. 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 1 week prior to the beginning of the EMA period during which they were monitored daily. Participants were monitored for a total of 4 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. Participants received a remuneration of 40 euros for completing the baseline questionnaire, the daily questionnaires during the entire monitoring period, and the posttest questionnaire, and they received an additional 10 euros for completing the 2-month follow-up. 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 12 p.m.), 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 assessment and in the past 30 minutes, motivation, self-efficacy, withdrawal symptoms, and external contexts (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 online. 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. Sixty-one percent of the data entries used in the present analyses were from paper diaries. 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 from the analyses in which both paper and real-time assessments were used (Van Zundert et al., 2010). All data were collected between October 2006 and March 2007.

Measures

Momentary self-efficacy. At each assessment (which occurred three times a day), 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 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).” Response categories were recoded so that a higher score represents high self-efficacy. Cronbach’s alpha observed in this sample was .80.

Sex. Males were assigned a value of 1 and females 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 six 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 10 items has been successfully applied in prior EMA research on smoking relapse among adults (McCarthy, Piasecki, Fiore, & Baker, 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 (computed by calculating Cronbach’s alpha for each assessment and then taking the average alpha across all assessments, cf. Van Zundert, Boogerd, et al., 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 dummy coded such that “nobody” was represented by the value 0, and all other categories were assigned the value 1. “Stress” was assessed by the question “Has a stressful situation occurred since the last recording?” (“no” = 0, “yes” = 1). 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” = 0, “yes” = 1). Thus, all external contexts were dichotomous variables of which a higher score indicated the presence of the relevant context.

Concomitant smoking. Concomitant smoking was assessed by means of the question “Have you smoked in the past 30 minutes?” (“no” = 0, “yes” = 1).

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’ momentary 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 momentary self-efficacy. The first lapse was defined as the first occurrence of smoking, even if only a puff, after achieving 24-hr abstinence. 2 Relapse was defined as smoking at least five cigarettes per day for three consecutive days (e.g., Shiffman, Hickcox, Paty, Grays, Kassell et al., 1996, Shiffman et al., 2000; Van Zundert, Nijhof, et al., 2009). Correlations were computed by calculating the correlations between variables for each assessment and then computing the average correlations across all assessments. Subsequently, modeled after Gwaltney, Shiffman, & Sayette (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 sample for the latter analysis consists only of those 94 adolescents (out of 134) who experienced at least one lapse during the monitoring period. 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. Missed assessments appeared to be random, that is, not systematically linked to time of day or study day, and were not imputed.

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. The levels distinguished in the present study are the “between-person level” at which one can examine between-person differences (in individual characteristics, such as age), and the “within-person level” at which one can study within-person differences (in the repeatedly measured variables such as craving and negative affect). Cross-level interactions refer to interaction analyses where a variable of one level (e.g., sex from the between-person level) is used to explain variance in an association between variables on another level (e.g., between craving and self-efficacy on the within-person level).

First, we tested whether affect-motivational states and external contexts were univariately related to momentary self-efficacy during the abstinent interval after which we tested a multivariate model in which all affect-motivational states and external contexts were included simultaneously. We then tested whether the within-person associations were moderated by the between-person level factors baseline self-efficacy, sex, and age (cross-level interactions). The cross-level interactions were tested in multivariate models which included all within-person associations and one interaction term per model. Next, we analyzed the lapsed interval. Again, the associations between affect-motivational and external contexts and momentary self-efficacy were examined both univariately and multivariately. In the lapsed interval, concomitant smoking was included as a within-person moderator of these univariate within-person associations. As with the abstinent interval, we

2 The cut-off score of 24-hour abstinence was chosen over others potential cut-off scores such as for example 7-day abstinence because the large majority of our sample smoked more than five cigarettes per day. We reasoned that a minimum of 7-day abstinence would have been too stringent and not feasible for all participants. This assumption was supported by prior analyses on these data showing that the average number of days between achieving 24-hour abstinence and the first lapse was 4 days (SD = 3.37; Van Zundert et al., 2010).
tested whether the individual characteristics baseline self-efficacy, sex, and age moderated the multivariate within-person associations (cross-level interactions). In each of the analyses, we assessed random effects (i.e., all of the associations were allowed to vary across individuals and across situations), and the variables were entered into the equation as grand mean centered (Raudenbush et al., 2006).

For the interaction terms involving two interval scales, the values were standardized before being multiplied. The interaction terms involving at least one dichotomous or dummy coded variable did not include standardized scores. 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 (“lappers”), and 27 persons (20.1% of 134) experienced a relapse (“relapser”). Pearson and Spearman correlations between independent variables were computed. Briefly, within both the abstinent and the lapsed interval, the external contexts were significantly but modestly interrelated, whereas craving and negative affect were relatively strongly correlated (see Table 1). Craving and negative affect were significantly associated with seeing others smoke and stress, but only very modestly in the case of alcohol and coffee consumption. (Please note that almost all of the correlations with alcohol and coffee consumption were very small but became significant because of the very large number of data points). 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 seeing others smoke.

Table 1

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

Note. 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.

Between-Person Level Factors

Baseline questionnaire ratings of self-efficacy were not significantly associated with momentary self-efficacy during abstinence (B = .18, SE = .14, T-ratio = 1.39, p = .196), but they did predict momentary self-efficacy after lapsing (B = .53, SE = .18, T-ratio = 2.85, p = .006). Sex was not related to levels of momentary self-efficacy during abstinence and lapsed intervals (B = .11, SE = .16, T-ratio = 0.67, p = .501, and B = -.01, SE = .27, T-ratio = 1.35, p = .3650, respectively). 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 both significantly related to lower momentary self-efficacy in the univariate analyses (see Table 2). In the multivariate analyses, the association between negative affect and self-efficacy decreased to nonsignificance, whereas the association between craving and self-efficacy remained significant.3

External contexts. Of the external contexts, seeing others smoke, drinking alcohol, and experiencing a stressful event were all related to lower self-efficacy (see 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 (see Table 2).

Cross-level interactions. The between-person level factors baseline self-efficacy, sex, and age did not moderate the multivariate within-person associations between momentary self-efficacy and the affect-motivational and external contexts (coefficients ranged between -.00 and .12 for the affect-motivational states, and between .00 and .24 for the external contexts).

Lapsed Interval

Concomitant smoking. Concomitant smoking (i.e., having smoked in the past 30 minutes) was strongly related to lower self-efficacy (B = -1.72, SE = .14, T-ratio = -12.66, p < .000).

Affect-motivational states. After having experienced the first lapse into smoking, craving and negative affect were still significantly negatively related to momentary self-efficacy in the univariate analyses (see Table 3). Concomitant smoking did not moderate the association between negative affect and momentary self-efficacy, whereas it did moderate the association between craving and momentary self-efficacy (see Table 3). More specifically, this association appeared to be nonsignificant when including smoking assessments only (B = -.03, SE = .05, T-ratio = -.69, p = .491), but was significant when including nonsmoking assessments only (B = -.30, SE = .04, T-ratio = -8.82, p < .000).

3 Because craving and negative affect have been shown to peak on the quit day (Van Zundert, Boogerd, et al., 2009a), we also tested whether results would be identical when associations were tested excluding the quit day. Results (not reported) were identical.
When included in a multivariate analysis, the association between negative affect and self-efficacy decreased to nonsignificance, whereas the association between craving and self-efficacy remained significant, also after entering concomitant smoking as a covariate to the multivariate model (adjusted B = −.26, SE = .03, T-ratio = −7.41, p < .001).

**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 momentary self-efficacy after the first lapse into smoking (see Table 3). These associations remained significant in the multivariate model. However, when concomitant smoking was included in the multivariate in a next step, the associations between external contexts and self-efficacy were no longer significant. Concomitant smoking did not moderate the univariate associations between the external contexts and momentary self-efficacy.

**Cross-level interactions.** Whereas we did not find any significant cross-level interaction effects in the abstinent interval, several interaction effects became apparent in the lapsed interval. Baseline self-efficacy and age generally did not moderate the multivariate associations between affect-motivational and external contexts and momentary self-efficacy, with the exception of the interaction between coffee consumption and baseline self-efficacy. The interaction coefficient was positive, indicating that the negative association between coffee consumption and self-efficacy was stronger among those with high baseline self-efficacy levels (B = 2.35, SE = .021, T-ratio = 11.0, p < .001). Further, sex seemed to determine the associations between momentary self-efficacy and negative affect (B of the interaction = −.25, SE = .11, T-ratio = 2.35, p = .021), and alcohol consumption (B = −.30, SE = .04, T-ratio = −7.41, p < .001) in the lapsed interval. Given that both interactions were negative and that the initial associations between negative affect, alcohol consumption, and momentary self-efficacy were negative as well, the magnitude of these two negative associations was stronger for girls than for boys.

**Abstinent versus lapsed interval.** To test whether the apparent differences between the abstinent and the lapsed interval were significant, we analyzed the potential moderating effect of interval (abstinent vs. lapsed) on the associations between affect-motivational states and external contexts among those who experienced at least one lapse [0 = abstinent interval, 1 = lapsed interval]. Only the association between craving and momentary self-efficacy significantly differed per interval (interaction effect:

### Table 2

Univariate and Multivariate Within-Person Associations Between Affect-Motivational States, External Contexts, and Momentary Self-Efficacy (Abstinent Interval, N = 134)

<table>
<thead>
<tr>
<th>Affect-motivational states</th>
<th>Univariate associations with self-efficacy</th>
<th>Multivariate associations with self-efficacy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
</tr>
<tr>
<td>Craving</td>
<td>−.25***</td>
<td>.03</td>
</tr>
<tr>
<td>Negative affect</td>
<td>−.26***</td>
<td>.04</td>
</tr>
<tr>
<td>External contexts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seeing others smoke</td>
<td>−.15**</td>
<td>.04</td>
</tr>
<tr>
<td>Stress</td>
<td>−.48***</td>
<td>.09</td>
</tr>
<tr>
<td>Alcohol</td>
<td>−.30</td>
<td>.13</td>
</tr>
<tr>
<td>Coffee</td>
<td>−.11</td>
<td>.07</td>
</tr>
</tbody>
</table>

Note. B = Unstandardized regression coefficient; T = T-ratio; SE = standard error.

* p < .05. ** p < .01. *** p < .001.

### Table 3

Univariate and Multivariate Within-Person Associations Between Affect-Motivational States, External Contexts, and Self-Efficacy, and Interactions With Concomitant Smoking (Lapsed Interval, N = 94)

<table>
<thead>
<tr>
<th>Affect-motivational states</th>
<th>Univariate associations with self-efficacy</th>
<th>Multivariate associations with self-efficacy</th>
<th>Interactions with concomitant smoking</th>
</tr>
</thead>
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<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>T</td>
</tr>
<tr>
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<td>.04</td>
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</tr>
<tr>
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<td>−5.27</td>
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<tr>
<td>External contexts</td>
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<td></td>
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<td>Seeing others smoke</td>
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<td>−6.34</td>
</tr>
<tr>
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</tr>
<tr>
<td>Coffee</td>
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<td>−0.02</td>
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</table>

Note. B = Unstandardized regression coefficient; T = T-ratio; SE = standard error.

* p < .05. ** p < .01. *** p < .001.
Discussion

The present study examined within-person correlates of momentary self-efficacy among adolescent daily smokers 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 momentary self-efficacy when participants were still abstinent, but also after they had lapsed. Associations between the within-person factors and momentary self-efficacy did not largely depend on individual characteristics such as baseline self-efficacy and age, nor on the type of interval (abstinent or lapsed). Among girls, however, the negative associations between self-efficacy and negative affect, seeing others smoke, and alcohol consumption were found to be stronger.

Baseline Self-Efficacy Versus Momentary Self-Efficacy

Given that traditional research has mainly relied on static (i.e., one-time) ratings of self-efficacy to predict smoking relapse after quitting, it seems crucial to examine to what extent baseline ratings concur with momentary self-efficacy ratings when smokers are in the midst of a quit attempt. Although baseline self-efficacy ratings were significantly related to momentary 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 (Balch, 1998; Stanton, 1995). 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 momentary self-efficacy scores.

However, methodological issues may be at play here as well, precluding definitive 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 et al., 2001), this scale may not cover all dimensions of self-efficacy as a trait vulnerability. In addition, the content of the baseline self-efficacy measure may refer to an expectancy of self-efficacy rather than actual self-efficacy to remain abstinent (which was measured by the momentary self-efficacy measure). The baseline and momentary self-efficacy measures may therefore be less comparable to one another. The effect of using one particular static measure of self-efficacy over the other is reflected in the additional analyses that showed modest though important differences in the associations between baseline self-efficacy and momentary self-efficacy ratings depending on the measure used for the baseline assessment. 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 and External Contexts

Craving and negative affect appeared to be negatively related to self-efficacy which is in line with findings among adults (Gwaltney, Shiffman, & Sayette, 2005). As two prior studies found that adolescents’ craving was high after quitting, but negative affect was not (Smith, Cavallo, McFetridge, Liss, & Krishnan-Sarin, 2008; Van Zundert, Boogerd, 2009), it is important to know that if adolescents do experience elevations in negative affect after quitting, self-efficacy is lower as well. Seeing others smoke, experiencing a stressful event, and consuming alcohol were related to lower self-efficacy. Coffee consumption did not seem to play a significant role in self-efficacy. Given that decreases in self-efficacy predict lapse and relapse among adolescents (Van Zundert et al., 2010), it seems that external stimuli may pose a significant

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4 Univariate association between craving and self-efficacy in the abstinent interval for lapsers only: B = -.26, SE = .04, T-ratio = -6.63, p < .000.

5 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 non-significance of the association between baseline self-efficacy and momentary 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 momentary 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. Concluding, the associations seem to be reversed when the one “core-item” is used: baseline questionnaire self-efficacy was not associated with momentary 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 momentary self-efficacy after the first lapse, whereas the one-item instrument self-efficacy was not significantly associated with momentary self-efficacy after lapsing. When this one-item baseline self-efficacy measure was used to perform the cross-level interactions, results were identical to those obtained when using the 12-item scale baseline self-efficacy measure as predictor (that is, none of the interactions in either one of the intervals was significant, except for the interaction between baseline self-efficacy and coffee consumption in the abstinent interval).

6 As an additional analysis, we tested lagged effects (i.e., predicting self-efficacy at one assessment by affect-motivational states and external contexts from the previous assessment) and found that craving, seeing others smoke, stress, and alcohol consumption predicted the next assessment’s self-efficacy, but these effects disappeared after controlling for prior self-efficacy (i.e., self-efficacy as measured at the assessment preceding the target self-efficacy assessment) (except for alcohol use). Thus, craving, seeing others smoke and stress may predict absolute levels of subsequent self-efficacy, but they do not seem to instigate a change in self-efficacy. It is still possible that these variables do instigate changes in self-efficacy but only when measured more closely in time to the self-efficacy assessment.
threat to adolescents’ prolonged abstinence for at least 3 weeks after quitting and after the first lapse. As among adults (Gwaltney, Shiffman, & Sayette, 2005), seeing others smoke was significantly negatively associated with self-efficacy. Seeing others smoke also remained related to lower self-efficacy after controlling for concomitant smoking, 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 after controlling for concomitant smoking. These findings concur with the dynamic regulatory feedback model of drug relapse (Niaura et al., 1988), 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.

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 the within-person variables (aside from concomitant smoking), and remained significantly associated with self-efficacy in the multivariate analyses, 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 momentary self-efficacy. Concurrent smoking did not moderate the within-person associations, except for the one between craving and momentary 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 the situational variables craving and concomitant smoking \(r = 22\)). Smoking may satisfy craving for the one, but may incite more craving for the other. In addition, lapsing itself decreases self-efficacy among adults (Shiffman et al., 1997), and adolescents (Van Zundert et al., 2010). 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 affect-motivational states and external contexts. This is in contrast with findings among adults, where individual differences in prequit 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, Shiffman & Sayette, 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 the external contexts also did not appear to depend on participants’ age either. Although a previous study indicated that the association between alcohol consumption and the first lapse is stronger for younger adolescents (Van Zundert et al., 2011), the present findings suggest that interventions targeting the situational correlates of self-efficacy should be equally suitable for all adolescents in the age range of 15 to 19.

Lastly, we found that both negative affect and alcohol consumption were more strongly related to lower self-efficacy among girls than boys. Although higher levels of negative affect seem more common among females than males (Piccinelli & Wilkinson, 2000), it is not clear why stronger negative affect was associated with lower self-efficacy among girls. Prior studies have found that certain symptoms of negative affect (guilt, shame, sadness, and self-hostility) are more pervasive and more salient to girls than to boys (Stapley & Haviland, 1989), and that girls ruminate more than boys (Papadakis, Prince, Jones, & Strauman, 2006). It is therefore possible that negative affect affects other areas (such as self-efficacy) to a higher degree among girls than it does among boys. However, given that we do not know whether self-efficacy preceded negative affect and the intake of alcohol or vice versa (although they might influence each other bidirectionally in a downward spiral), it is also possible that a decrease in self-efficacy or the forethought at failure has stronger emotional repercussions for girls.

The First Lapse: Before Versus After

Whereas empirical research on adolescent smoking cessation has principally focused on final end point outcomes (such as continuous long-term abstinence), the present study demonstrates that some processes before the first lapse may differ from those at play thereafter. Although the results of the univariate within-person associations were largely the same within the abstinence and the lapse interval—and this counted for both the interrelatedness of all independent variables as well as the univariate within-person associations between independent variables and self-efficacy—the association between craving and self-efficacy was significantly
stronger in the lapsed period. It is, however, challenging to determine whether the cross-level interactions significantly differed per interval (because of lack of statistical power to test this), although the results may suggest a difference in this process as well (females’ negative affect and drinking was more strongly related to lower self-efficacy than males’). Future research on adolescents’ quit attempts is thus recommended 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. First, 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., 2010). Despite the foregoing, using electronic diaries alone (and not offer paper diaries as a backup option for participants) 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 et al., 1994). Lastly, given that momentary self-efficacy and its correlates were assessed simultaneously, we cannot make 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, 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. However, to determine the causality of states and contexts that are highly transient in nature such as for example craving (e.g., Heishman et al., 2003), one would need to use a design in which craving and self-efficacy are assessed each 15 minutes (during a given time period, e.g., 2 hours), and then examine lagged effects. The current design with 3-hr intervals is not suitable to test this. Alternatively, indications of causality can be derived from controlled laboratory studies in which one of the two variables is manipulated. These potential limitations notwithstanding, the present study is one of the first (see also Gwaltney et al., 2008, for a pilot study) to monitor adolescent daily smokers several times a day during their quit attempt, and to examine the intertwining of adolescents’ momentary self-efficacy with affect-motivational states and external contexts.

Conclusion

The present study shows that adolescents’ momentary 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 affect-motivational states and external contexts and adolescents’ momentary self-efficacy. All in all, the present findings testify to the complex and dynamic nature of the interplay between internal and external conditions and momentary self-efficacy, and advocate a dynamic approach of the adolescent relapse process and its determinants.

References


Van Zundert, R. M. P., Kuntsche, E., & Engels, R. C. M. E. (2011). 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. Manuscript submitted for publication.

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