Reactivity to environmental smoking
Effects of the exposure to parental and movie smoking

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General introduction

Tobacco use remains one of the leading preventable causes of premature death (World Health Organization, 2012). In the Netherlands each year, almost 20,000 people die due to the most prevalent diseases related to smoking (e.g. lung cancer, COPD, cardiovascular diseases and other kinds of cancer) (Stivoro, 2012b). However, tobacco use and consumption not only influences the mortality of the individual, but also produces a cost to society as a whole. The morbidity rate that accompanies tobacco use is an important economic factor that should not be underestimated and also emphasizes the need for prevention of and intervention in tobacco use.

Although the prevalence of smoking among Dutch adults has shown a general decline between 1958 and 2011 to 25%, just this year the number of smokers slightly increased to 26% (Stivoro, 2012a). In addition to the large number of people who already use tobacco, the prevalence of adolescents who initiate smoking remains high. In 2012, 18% of Dutch youth (aged 10 - 20) reported smoking in the past four weeks (Stivoro, 2012c). For prevention and intervention purposes, it is important to consider factors that predict the initiation of smoking in adolescents, and factors that maintain the habit of smoking in people who already smoke. Environmental smoking is considered to play an important role in both the initiation and the continuation of smoking. However, it is expected that environmental smoking affect these stages of smoking differently. Exposure to smoking in the environment - for instance by parents, peers or in the media - might influence children's and adolescent's ideas and understanding of smoking which, in turn, might predispose them to initiate smoking. With regard to the continuation of smoking, environmental smoking cues (e.g. seeing someone smoke) might evoke smokers' craving and their actual smoking behaviour.

This dissertation aims to investigate the effects of environmental smoking on smokers and non-smokers. As it is expected that smokers and non-smokers are affected differently by environmental smoking and that different underlying mechanisms might explain these effects, the effects on smokers and non-smokers have been investigated and discussed separately. Part one focuses on smokers and examines whether and how smokers are affected by smoking cues in movies. In the second part the effects of environmental smoke exposure - exposure to parental smoking and movie smoking - on non-smoking children are examined.
Part I
Exposure to movie smoking: Effects on smokers
Chapter 1

Introduction
Previous research has emphasized the role of environmental smoking cues in the continuation and relapse of smoking. Often referred to as cue-reactivity, it has been shown that smokers show smoking-related responses when they are exposed to cues that are associated with past smoking behaviour (e.g. Carter & Tiffany, 1999). It is assumed that smokers have learned an association between smoking cues and their own smoking behaviour (e.g. Carter & Tiffany, 1999). Through classical conditioning, smoking cues that have repeatedly been present at the time of drug administration can become conditioned stimuli and can elicit conditioned responses. In cue-reactivity paradigms, when smokers were re-exposed to those cues (mostly in a laboratory setting), they reported strong subjective feelings of craving, modest physiological responses, shorter latency and increased smoking behaviour, and biases in attentional processing of smoking-related cues (Carter & Tiffany, 1999; Droungas, Ehrman, Childress, & O’Brien, 1995; Field & Cox, 2008; Payne, Schare, Levis, & Colletti, 1991).

One of the objectives of cue-reactivity research is the identification of smoking cues that trigger the greatest smoking-related responses in order to reduce or extinguish cue-reactivity among smokers and to prevent cue-induced relapses (Conklin, 2006). Cues that have produced reactivity in smokers include interoceptive and exteroceptive cues. Interoceptive cues represent internal states and include affective cues (e.g. negative affect, stress), somatic cues (e.g. hunger, pain), and cognitive cues (e.g. knowledge about the availability of the substance). Exteroceptive cues can be differentiated between proximal cues (cues which are most proximal to smoking behaviour; e.g. smoking paraphernalia) and distal cues (e.g. environments in which smoking occurs). Exteroceptive cues, and especially proximal cues, have been presented in cue-reactivity studies in different modalities such as in-vivo, imaginal, audio, video, virtual reality, and pictorial cues (Brandon, Vidrine, & Litvin, 2007; Carpenter et al., 2009; Conklin, 2006). One form of exteroceptive smoking cues, smoking cues in movies, has rarely been subject of such research. Like other environmental cues, smoking cues in movies could also elicit smoking-related reactions in smokers.

Gaining insight into the effects of dynamic smoking cues in movies on smokers is important for at least two reasons. First, despite the downward trend of smoking images in movies (especially since 2005), tobacco images are still prevalent in popular movies (U.S. Department of Health and Human Services, 2012). Also, the role of media in people’s lives has become increasingly significant; watching movies is one of the most popular leisure time activities (Roberts, 2000; Roberts, Foehr, & Rideout, 2005; Sargent et al., 2001). Therefore, people are often automatically exposed to numerous tobacco images in films (potentially on a daily basis).

Second, the nature of dynamic smoking cues in movies differs from other exteroceptive smoking cues used in previous cue-reactivity studies. The cue-reactivity paradigm often uses explicit proximal smoking cues (e.g. pictorial or in-vivo smoking cues) to induce strong smoking-related responses. For example, assessing the efficacy of novel treatments requires the induction of strong smoking-related responses in order to compare the reactivity of smokers who received the treatment and smokers who did not receive the treatment. In contrast to those cues, smoking cues in movies are less explicit and subtler since they are embedded in a narrative. Therefore, it is questionable whether the results of traditional cue-reactivity studies can be generalized and transferred effectively to cues embedded within the context of a film. Since, in real life, such cues could also become associated with smokers’ smoking and elicit smoking-related responses, research is required that specifically focuses on dynamic smoking cues in movies.

Although some studies have investigated whether smoking cues in movies evoke smoking-related responses in smokers, this has not been examined systematically. A strong response by smokers as a result of exposure to smoking cues in movies could suggest adaptations to the development and the implementation of effective intervention programs and to the policy regulations controlling portrayal of tobacco in movies. Effects of smoking cues in movies on smokers’ reactivity would call for enhancing awareness among the public about the effect smoking cues in movies might have. Moreover, such findings could call for stricter control over smoking cues in movies and would suggest changes to the regulation of the movie rating system. The Dutch movie rating system currently does not take smoking into account when evaluating movies. At this point, the rating of movies is based on several content labels like ‘violence’ and ‘alcohol and drugs’ but does not include a separate label for smoking. Also, the criterion (label) ‘alcohol and drugs’ does not include the presence of tobacco use in movies.
Theoretical perspective

Contemporary addiction theories are based on or have incorporated classical conditioning in explaining the continuation of substance use (Niaura et al., 1988; Robinson & Berridge, 1993; Siegel, 1975; Steward, De Wit, & Eikelboom, 1984; Tiffany, 1990; Wikler, 1948). These theories share the assumption that stimuli that have repeatedly been paired with previous substance use eventually become conditioned stimuli and develop the ability to elicit conditioned responses. Conditioning models can vary in their view of the nature and form of the conditioned responses and there are different interpretations of how conditioned stimuli motivate substance use. Withdrawal/negative reinforcement models suggest that symptoms of withdrawal maintain substance use. They assume that conditioned responses are consistent with withdrawal-like responses and that people continue substance use in order to obtain relief from unpleasant withdrawal symptoms (Siegel, 1975; Wikler, 1948). In contrast, positive reinforcement models state that conditioned responses are consistent with the rewarding effects of the substance (Stewart, et al., 1984; Wise & Bozarth, 1987).

The Cognitive Processing Model of Drug Craving (Tiffany, 1990) interprets conditioned responses as automated cognitive processes. This model states that over time and with practice, substance use becomes largely automatized in substance users. Substance use (the performance of automatic action schemata), which is triggered by cue-reactive associations, is supposed to be enacted under a low level of consciousness and requires little or no effort. Once automatic action schemata have been developed, the automatic response to substance-related stimuli maintains substance use.

The following theories further develop the models that are based on learning processes by including neurobiological mechanisms and taking biases in cognitive processing into account when explaining the maintenance and relapse of substance use. The Incentive Sensitization Theory (IST) (Berridge & Robinson, 1998; Robinson & Berridge, 1993; Robinson & Berridge, 2001) proposes that addiction is driven more by users’ desire for a substance (‘wanting’), than by users’ subjective pleasure from it (‘liking’). Different neural mechanisms are responsible for the ‘wanting’ versus the ‘liking’ of a substance. Robinson and Berridge (1993) suggest that through classical conditioning substance-related cues acquire incentive motivational properties. Repeated cigarette smoking causes a neural sensitization in the reward systems of the brain, leading to a stronger dopamine release each time one smokes. Cues that are often paired with smoking thus become associated with its pleasurable outcome. This leads to an attribution of incentive salience to the perception and mental representation of those cues. As a result, cues become attractive, desired and capable of capturing attention automatically. Those cues can further induce incentive salience (‘wanting’) by activating the mesolimbic dopamine system and an urge to smoke, which may foster automatic approach tendencies (e.g. Franken, 2003; Robinson & Berridge, 1993). These incentive processes are primarily responsible for ‘wanting’, not ‘liking’ the substance. It is assumed that the incentive value of the substance (‘wanting’) increases during the transition from experimental to problematic substance use while its hedonic effects (‘liking’) remain stable or decrease.

The IST (Robinson & Berridge, 1993, 2003) proposes that the sensitivity of the dopamine system differs among individuals. One factor that might contribute to individual differences in susceptibility to the motivational properties of substance-related cues is genetic predisposition. In particular the DRD4 gene might contribute to individual differences in sensitivity to the rewarding properties of smoking. The DRD4 gene encodes the D4 dopamine receptors in several brain areas, including those associated with positive reward from smoking (the incentive salience-related brain areas). The DRD4 gene is associated with differences in dopamine binding potential and may therefore influence variation in the experience of reward after smoking (Brody et al., 2006). Activity at D4 dopamine receptors can be seen as relevant to the attribution of incentive salience and therefore to the initiation of craving (Berridge & Robinson, 1998; Hutchison, McGeary, Smolen, Bryan, & Swift, 2002; Larsen et al., 2010; Robinson & Berridge, 2001).

Franken (2003), who broadly agrees with the IST (Berridge & Robinson, 1998; Robinson & Berridge, 1993; Robinson & Berridge, 2001), explicitly describes three ways in which attentional focus can contribute to substance use and relapse. First, substance users are more likely to detect and become aware of substance-related cues in the environment through an automatic selection process. Second, substance users find it difficult to draw attention away from the cue once it is detected and automatically processed. The attentional processing is enhanced and may trigger other cognitive processes like memory bias and substance-related expectancies. Third, attentional processing limits cognitive resources, which are required to process competitive cues. This model further extends previous theories by suggesting that attentional bias and
craving have reciprocal effects on each other. Once a smoker is exposed to a smoking-related cue, (s)he experiences craving, which in turn leads to increased attention to the substance-related cues. This mutual activation continues until the substance is finally sought out and administered. Overall, these models suggest that smoking-related cues can contribute to the maintenance of substance use. It is assumed that smoking-related cues lead to attentional focussing, which elicits subjective cravings and promotes substance use. Smoking cues in movies might lead to direct responses, particularly when smokers associate a specific cue with their smoking behaviour. This would imply that smoking characters grab smokers’ attention, which may lead to craving and the subsequent lighting of a cigarette.

**Empirical findings**

In this section, the empirical results for the effects of smoking cues in movies on smokers’ reactivity will be discussed. First, the empirical basis for the effects of smoking cues in movies on actual smoking behaviour is demonstrated. Then, the results of the different possible underlying mechanisms - craving, attention and the role of the DRD4 polymorphism - will be discussed.

**Effects of smoking cues in movies on smoking behaviour**

Only two experimental studies have thus far tested the influence of smoking cues in movies on smokers’ actual smoking behaviour. In the first experiment, young adult smokers were exposed to an 8-minute movie montage of five different movies either with or without smoking cues (Shmueli, Prochaska, & Glantz, 2010). A 10-minute recess in which the participants had the opportunity to smoke followed the movie screening. It was found that smokers who were exposed to the movie clip with smoking cues were more likely to smoke after watching the clip than those exposed to the clip without smoking cues. Moreover, it has been found that smokers in the experimental condition were more likely to smoke within 30 minutes after leaving the laboratory (Shmueli, et al., 2010). There are two points of discussion that deserve attention. First, whether smoking behaviour is assessed while watching a movie or afterwards may affect subsequent results. To assess whether smoking cues in movies have

a direct effect on immediate smoking behaviour, it might be more effective to give smokers the opportunity to smoke during the exposure to movie smoking. Second, the exposure to a longer, more representative movie clip, instead of a short montage of different movies, would represent a more realistic and naturalistic context.

In a second study, smokers were exposed to a longer clip, a 60-minute James Bond movie, either with or without James Bond smoking (the no-smoking James Bond movie *The Living Daylights* and the smoking James Bond movie *Dr. No*), and were allowed to smoke while watching the movie (Harakeh, Engels, Vohs, van Baaren, & Sargent, 2010). This study found no effect of the portrayal of smoking in movies on the frequency and quantity of cigarettes smoked while watching a movie. It cannot be ruled out that the lack of effect arose due to the use of two different movies in the experimental and control condition. A montage of two clips derived from the same movie could prevent a possible difference in viewer responses caused by different emotions and enjoyment of the movie.

The empirical evidence on the effects of smoking cues in movies on smoking behaviour is scarce and the few studies that have been conducted focus on adult smokers. However, adolescent smokers might be particularly susceptible to the portrayal of smoking in movies, not only because their exposure to different types of media has increased (Roberts, 2000; Roberts, et al., 2005), but also because adolescents in particular might be susceptible to the influence of media role models (Giles & Maltby, 2004).

Moreover, the onset of tobacco use takes place primarily during adolescence, making it a crucial age. Nicotine dependence can develop quickly among novice smokers (DiFranza & Wellman, 2005), and the progression from use to dependence often takes place during adolescence (Kassel, 2000). Additionally, the adolescent regulatory executive system has not yet fully developed (Steinberg, 2007; Wiers et al., 2007a), nor has psychosocial abilities that improve decision making and moderate risk taking (e.g. impulse control and delay of gratification). Therefore, adolescent smokers might encounter more challenges regulating or inhibiting cue-induced appetitive response tendencies elicited from exposure to environmental smoking cues. As the exposure to smoking portrayal in movies might be relevant to the development of addiction in adolescent novice smokers, the effect of smoking cues in movies on immediate smoking behaviour should be tested in this specific age group.
To summarize, further research could overcome limitations of previous research by using a representative segment of a movie and the montage of the same movie in both conditions. Also, smoking behaviour should be assessed while watching a movie in order to test direct effects of smoking cues in movies on immediate smoking behaviour. The findings among adult smokers cannot be generalized and applied to adolescent smokers without caution, as adolescent smokers differ from adult smokers with regard to their smoking history and developmental stage of addiction. Therefore, two studies presented in this dissertation examined whether dynamic smoking cues in movies affect immediate smoking behaviour while watching a movie, one among adult smokers (Chapter 2), and one among adolescent novice smokers (Chapter 3).

**Effects of smoking cues in movies on craving**

The effects of smoking cues in movies on smokers’ cravings have rarely been researched. Hines, Saris and Throckmorton-Belzer (2000) examined the effect of viewing smoking in films on craving by showing short video clips of six different movies. They showed that male, but not female smokers, had a higher current desire to smoke if the film characters they had viewed smoked. However, in using only short video clips of 3 minutes each, this study did not show a representative segment of a movie. As mentioned previously, the exposure to a longer segment of an existing contemporary movie, which enables participants to involve themselves psychologically in the narrative and identify with characters, represents a more naturalistic, and therefore more ideal, setting.

An experiment by Shmueli et al. (2010) (described above), in which smokers were exposed to either a smoking or a non-smoking movie clip and had the opportunity to smoke afterwards, found no difference in craving between smokers in the two conditions. However, in this study participants’ baseline craving was not controlled for. Unlike cue-induced or episodic craving, which is evoked by environmental smoking cues, background craving is stimulated by withdrawal states, appears steadily throughout the day, and fluctuates slowly (Ferguson & Shiffman, 2009; Munafò & Hitsman, 2010; Shiffman, Paty, Gwaltney, & Dang, 2004). In order to investigate the effects of smoking cues on cue-induced craving, it is necessary to also take into account participants’ background craving and to give due consideration to both components of craving. In addition, it must be noted that in this study craving was assessed after a recess during which participants were given the opportunity to smoke. Therefore, the result in this study might be affected by differences in baseline craving and by differences in smoking behaviour (during a recess) between conditions.

In a third study, a cross-sectional correlational study in a movie theatre, smokers were requested to report their craving when leaving the movie theatre (Sargent, Morgenstern, Isensee, & Hanewinkel, 2009). The exposure to a movie with smoking content was associated with a greater urge to smoke. However, without experimental manipulation it cannot be ruled out that the found effect was caused by factors other than smoking movie exposure; causal interpretations are therefore impossible.

Overall, previous research found mixed results in the effects of smoking cues in movies on smokers’ craving. Further research could be improved by an experimental design and by participants’ exposure to a representative segment of a movie. Controlling for baseline craving would enable us to take the different components of craving into account when investigating the effects of smoking cues in movies on smokers’ reactivity. Therefore, two of the presented studies in this dissertation investigated whether dynamic smoking cues in movies evoke urges to smoke among smokers (Chapters 4 and 5).

**Effects of smoking cues in movies on smokers’ attention**

Research has indicated that smokers have an attentional bias for smoking-related cues (for an overview see Field & Cox, 2008). To assess biases in the attentional processing of smoking-related cues, a wide range of measures have been used, including indirect measures, like the Stroop task and the visual probe task, as well as direct measures, such as eye movement paradigms. Direct measures of the attentional processing (i.e. eye-tracking paradigms) are considered to be a preferred method for investigating attentional biases. Compared with indirect measures, eye-tracking paradigms provide a direct measure of attention and do not infer attentional processes on the basis of reaction times (Field, Munafò, & Franken, 2009b). Moreover, indirect measures suffer from problems with low internal consistency and test-retest reliability (Ataya et al., 2012). While most eye-tracking research used pictorial cues to assess smokers’ attention to environmental smoking cues, no study has assessed smokers’ attention to dynamic smoking cues in movies. The lack of research...
in assessing dynamic cues provides an opening for the development of a new method capable of assessing attentional biases for dynamic smoking cues. Therefore, one study presented in this dissertation examined whether smokers have an attentional bias for dynamic smoking cues in movies (Chapter 6).

The role of the DRD4 polymorphism

Persons with certain genetic markers are thought to be more susceptible to environmental smoking cues. Several studies have found evidence that the DRD4 polymorphism could play a role in the process of neural sensitization (Hutchison, et al., 2002; Larsen, et al., 2010). With regard to smoking cues, one study supported the hypothesis that the variability in the susceptibility to smoking cues might be related to a genetic predisposition. Smokers carrying the DRD4 7-repeat allele reported an increase in craving after exposure to in vivo smoking cues compared to non-carriers (Hutchison, et al., 2002). So far, this has been the only experimental study that has tested whether DRD4 genotype affects cue-reactivity to environmental smoking cues in smokers. It remains unclear whether smokers carrying the DRD4 7-repeat allele are also susceptible to dynamic smoking cues in movies. Therefore, one of the presented studies in this thesis investigated whether the DRD4 VNTR polymorphism affects the reactivity to dynamic smoking cues in movies (Chapter 5).

Research methods

In this section we will describe the naturalistic approach we applied to our studies. To investigate the effect of smoking cues in movies on craving and smoking behaviour in adolescent and adult smokers, the same experimental paradigm was used in the studies presented in Chapters 2-5. In each study, daily smokers were assigned randomly to one of two different movie conditions. In the experimental condition, participants were requested to watch a representative segment of a movie with smoking scenes, while in the control condition they were exposed to a similar segment of the same movie without any portrayal of smoking.

Both movie segments were edited to achieve similar versions of the movie, one with smoking scenes and one without any portrayal of smoking. For the movie displayed in the experimental condition, several smoking scenes were selected from each original movie and integrated into an edited version. A comparable version was edited for the control condition without smoking scenes. We decided to edit two versions of the same movie instead of using two different movies in the experimental and control condition to make the ‘smoking’ and the ‘neutral’ stimulus material as comparable as possible. To rule out the possibility that any found effect (or lack thereof) could be explained by differences in the story, affective responses caused by the movie, and/or the enjoyment of the movie, several aspects were considered when editing the movie. First, the movie segments were manipulated in such a way that the two segments hardly differed with regard to the scenes and storyline. Second, the two segments were almost of the same length. Another important premise of the movie manipulation was to keep an intact, interesting and fluent storyline in order to make the movie experience as realistic as possible. In each study, movies were chosen based on the number of smoking scenes and suitability for the target group (young adults or adolescents). Moreover, in order to generalize findings, popular contemporary movies were used. Using a representative clip of an existing contemporary movie is advantageous since participants may be exposed to cues they are confronted with in every-day life and does not require the creation of smoking-related cues.

Each of the studies is conducted in a laboratory that was equipped with comfortable chairs and a big screen television in order to provide a more realistic movie experience and to create an atmosphere where participants could feel at home and relaxed. Figure 1 represents an image of one of the laboratories where the studies were conducted.

![Figure 1. Image of a laboratory where studies were conducted](image-url)
literature by using a naturalistic approach and may therefore give new perspectives on the measurement of cue-reactivity and enrich and sharpen the understanding of underlying mechanisms of responses to cue-exposure. To accomplish this, several studies investigated whether the exposure to smoking cues in movies affects smokers’ smoking behaviour, their craving and their attention to smoking cues.

The first part of this dissertation addresses the following research questions (in order of appearance):

- Do dynamic smoking cues in movies affect immediate smoking behaviour in adult smokers while watching a movie?
- Do dynamic smoking cues in movies affect immediate smoking behaviour in adolescent smokers while watching a movie?
- Do dynamic smoking cues in movies evoke urges to smoke among smokers after watching a movie?
- Do dynamic smoking cues in movies trigger craving among smokers while watching a movie? Does the DRD4 VNTR polymorphism affect the reactivity to dynamic smoking cues in movies?
- Do smokers have an attentional bias for dynamic smoking cues in movies and therefore fixate more quickly, more often and for longer periods of time on dynamic smoking cues than non-smokers?

Overview of part I

The objective of the first part of this dissertation is to investigate smokers’ reactivity to dynamic smoking cues in movies. Using experimental designs, smokers are either exposed to a movie with or without smoking characters and different smoking-related responses are assessed while or after watching the movie (Chapters 2-5). The first two studies (Chapters 2 and 3) aim to investigate the effects of smoking cues in movies on actual smoking behaviour, while the studies described in Chapters 4-6 are devoted to examining the possible underlying mechanisms craving and attention. In Chapter 2, we intend to gain insight into whether smokers who are confronted with smoking characters in movies smoke more cigarettes while watching than those confronted with non-smoking characters. Chapter 3, a replication of the previous study, investigated whether the same effect would be found in adolescent smokers and whether the found effect could

Participant's were not informed of the real aim of the experiment beforehand. They were invited to the Radboud University Nijmegen and told that they were participating in research on life-style of students/adolescents and celebrities. Not informing participants a priori that the target group consists only of smokers serves to overcome demand characteristics of traditional cue-reactivity studies. In the study presented in Chapter 6, we used an eye-tracking paradigm to investigate whether smokers, compared with non-smokers, have an attentional bias for dynamic smoking cues in movies. While watching a movie with smoking cues viewers’ attention was assessed by measuring their eye movements. Figure 2 represents an image of the set-up used in the study investigating smokers’ attention to smoking cues in movies.

Figure 2: Image of the experimental set-up of the eye-tracking study

Generally, using a naturalistic approach when investigating smokers’ responses to smoking cues in movies can make a valuable contribution to previous research. A naturalistic approach is certainly more suitable, as it reflects cue-exposure in real life more accurately and would increase ecological validity.

Objectives of part I

The objective of the first part of this dissertation is to investigate smokers’ reactivity to dynamic smoking cues in movies. Up to this point, research on whether smoking cues in movies evoke smoking-related responses in smokers has been scarce and leaves several unanswered questions. Therefore, this dissertation aims to provide a better understanding of whether the results of traditional cue-reactivity studies can be transferred effectively to cues embedded within the context of a film. The research adds to the existing literature by using a naturalistic approach and may therefore give new perspectives on the measurement of cue-reactivity and enrich and sharpen the understanding of underlying mechanisms of responses to cue-exposure. To accomplish this, several studies investigated whether the exposure to smoking cues in movies affects smokers’ smoking behaviour, their craving and their attention to smoking cues.

The first part of this dissertation addresses the following research questions (in order of appearance):

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be extended to smokers with different smoking histories and who are in a different stage of addiction.

Chapter 4 presents an experimental study on the effects of smoking cues in movies on smokers’ cravings. To gain more insight into the development of craving while watching a movie with smoking scenes, we extended the design of the study and assessed craving at four points of time: before and after the movie and twice in advertisement breaks during the movie. We also examined whether the DRD4 VNTR polymorphism affects the reactivity to dynamic smoking cues in movies (Chapter 5). Chapter 6 addresses whether smokers actually focus on dynamic smoking cues in movies. Compared to pictorial smoking cues, dynamic smoking cues in movies might be too subtle and too deeply embedded in the narrative to grab and hold smokers’ attention. Using an eye-tracking paradigm, it is investigated whether smokers, compared to non-smokers, show biases in attentional processing of dynamic smoking cues in movies.
Chapter 2
Effects of smoking cues in movies on immediate smoking behaviour

Published as:
Abstract

Introduction: The objective of this study was to investigate the effect of smoking cues in movies on immediate smoking behaviour. We tested whether smokers who are confronted with smoking characters in a movie smoke more cigarettes while watching than those confronted with non-smoking characters and whether this effect is less profound when smokers are more involved in the narrative (i.e. transportation).

Method: Using an experimental design, 60 daily smokers were assigned randomly to one of two movie conditions (smoking vs. non-smoking characters). Participants were exposed to a 72-minute movie clip and were allowed to smoke while watching the movie. Transportation and smoking habits were assessed with a questionnaire afterward.

Results: The results showed a significant interaction effect between movie condition and transportation on immediate smoking behaviour, indicating that smokers who were less transported smoked significantly more cigarettes when they were exposed to smoking characters compared with non-smoking characters.

Discussion: These results call for (a) increasing the awareness among people about the effect smoking cues in movies might have and (b) stricter control over smoking cues in movies.

Introduction

Media, such as soap operas, television series, and contemporary movies, often depict portrayals of tobacco use. Despite regulations of the U.S. government concerning the sponsoring of movies by the tobacco industry, the depiction of smoking portrayals in contemporary movies remains prevalent (Sargent & Heatherton, 2009; Titus, Polansky, & Glantz, 2009). While most studies on the effects of smoking exposure focus on initiation (Dalton et al., 2003; Sargent, et al., 2001), hardly any research has been directed at the effects smoking portrayals in movies might have on the continuation of smoking in established smokers (Harakeh, et al., 2010; Shmueli, et al., 2010). Different processes underlie the influence of smoking cues in movies on smoking initiation among adolescents and the continuation of smoking among established smokers. Whereas smoking-related cognitions such as attitudes, norms, and prototypes might constitute explanatory mechanisms in the stage of smoking initiation (Tickle, Hull, Sargent, Dalton, & Heatherton, 2006; Wills, Sargent, Stoolmiller, & Gibbons, 2007), processes of cue reactivity and imitation could possibly explain the effects of smoking cues in movies on smokers’ immediate smoking behaviour while watching a movie.

In their incentive sensitization theory, Robinson and Berridge (1993) suggest that through classical conditioning, substance-related cues acquire incentive motivational properties. As a result of the repeated pairing of a drug-induced dopamine release with environmental drug-related cues, these cues can eventually produce a conditioned increase in dopamine release. This response becomes more sensitized with the administration of each new substance, and the drug-paired cue seize one’s attention and strong subjective cravings for the substance might develop. Craving, in turn, also leads to increased attention to substance cues (Franken, 2003). This mutual activation continues until the substance is finally sought out and administered. Thus, smoking cues in movies might lead to direct responses, particularly when smokers associate a specific cue with a specific behaviour. This would imply that smoking characters grab smokers’ attention, which might lead to craving and the subsequent lighting of a cigarette. Studies that have been testing this theory in relation to smoking cues in movies show mixed results. In an experimental study, smokers were exposed to a 40-minute movie clip (either with or without smoking cues) and afterward asked to indicate their craving (Lochbuholer, Scholte, & Engels, 2009). No difference in craving between conditions was found. Another experimental study examined the effect of
viewing smoking in movies on craving by showing short video clips of six different movies (Hines, et al., 2000). The study showed that male, but not female smokers, had higher craving levels if the characters they had viewed smoked. In both studies, craving was assessed after watching the movie clips and not during or shortly after cue exposure. Assessing craving throughout the duration of the clip might lead to different results.

In addition to incentive sensitization theory, imitation is another possible mechanism that could explain the link between the exposure to smoking characters in movies and immediate smoking behaviour. Research demonstrates that people mimic each other’s behaviour in social interactions. If people perceive a certain behaviour, they will be more inclined to perform that specific behaviour themselves due to a strong “perception-behaviour link.” Perceiving someone performing a certain action activates the same regions of the brain that become active when the action is performed by the person himself (for an overview see Chartrand & van Baaren, 2009). With regard to smoking behaviour, experimental research has revealed that smokers imitate smoking behaviour in social interactions and adapt their smoking behaviour to that of other smokers (Harakeh, Engels, Van Baaren, & Scholte, 2007). So far, it is not clear whether smokers also imitate the smoking behaviour of smoking characters in movies. Imitation might occur regardless of whether the other person is present or depicted on screen (Chartrand & van Baaren, 2009).

Although there are a few experimental studies concentrating on the influence of smoking cues in movies on attitudes toward smoking (Pechmann & Shih, 1999), the association between smoking and the self (Dal Cin, Gibson, Zanna, Shumate, & Fong, 2007), and craving (Hines, et al., 2000; Lochbuehler, et al., 2009), even fewer experimental studies have focused on behavioural outcomes. Of those, Shmueli et al. (2010) examined the effect of viewing smoking in movies on smoking behaviour by showing an 8-minute movie montage of five different movies. They found that smokers who were exposed to the movie clip with smoking cues were more likely to smoke after watching the clip than those exposed to the clip without smoking cues. However, exposure to a longer segment, compared with a short movie clip, would represent a more realistic and naturalistic context. Moreover, measuring smoking behaviour at the moment of cue exposure and not afterward might be a promising way to assess the influence of smoking cues in movies on immediate smoking behaviour. In their study, Harakeh et al. (2010) did expose smokers to a longer clip, showing them a 60-minute James Bond movie with or without James Bond smoking and allowed the participants to smoke while watching the movie. In their experiment, however, movie condition did not affect the total number of cigarettes smoked. The lack of effect might be explained by the fact that the authors did not use a montage of the same movie in both conditions. By using different movies, even if the movies are comparable with regard to the main character and movie genre, other factors, such as emotions and enjoyment of the movie, might cause different responses in smokers. With regard to investigating the effect of smoking cues in movies, it is therefore essential to use a representative segment of a movie and to use a montage of the same movie in both conditions.

People watch movies for any number of reasons: to relax, to become distracted from everyday life, or to be entertained by being absorbed in a narrative (Green & Brock, 2000). Narratives are able to transport people into a state of involvement and absorption. Green and Brock have defined this process of transportation as “a convergent process, where all mental systems and capacities become focused on events in the narrative” (p. 701). This complete immersion into the world of the story may involve losing track of time and failing to observe events around the viewer by his or her consciously or unconsciously pushing real world facts aside. Therefore, the real world and real world facts may become inaccessible (Green, Brock, & Kaufman, 2004; Green et al., 2008). This could indicate that viewers who are highly transported might perform fewer actions in the real world. By investigating the effect of movies, it is therefore essential to consider individual differences in the magnitude of transportation.

Assessing the effects of smoking cues in movies on immediate smoking and their underlying mechanisms is not only important for the development and implementation of effective intervention programs but also in terms of policy regulations controlling tobacco portrayals in movies. If smoking cues in movies lead to an increase in smokers’ immediate smoking behaviour, smokers may find it more difficult to quit smoking, and moreover, watching movies with smoking scenes would increase the chance of relapse. The aim of the present study is therefore to investigate the influence of smoking cues in movies on smokers’ actual smoking behaviour while watching a movie. Using an experimental design, we exposed smokers either to a movie with or without smoking portrayal during which they had the opportunity to smoke. We predicted that smokers who were exposed to smoking characters in movies would smoke more cigarettes compared with those who were exposed to
non-smoking characters. Furthermore, we tested the moderation effect of transportation on the relationship between smoking exposure and smoking behaviour. We hypothesized that smokers who show little evidence of transportation in comparison with smokers, who experience higher levels of transportation, will be influenced by smoking cues in movies and thus smoke more.

Method

Sample and procedure

The sample consisted of 60 daily smokers (35% males) between the ages 16 and 51 years, with a mean age of 20.87 years (SD = 5.34). The participants were assigned randomly to one of two movie conditions. In the experimental condition, 30 smokers were exposed to the edited version of the movie in which several characters smoked. In the control condition, 30 smokers were exposed to the edited version of the same movie in which the smoking was completely edited out.

The participants were recruited through flyers around campus and the city centre and were invited to participate in research on lifestyle and celebrities in which they had to watch a movie and answer questions about the movie, the actors, and their own lifestyle. They were not informed about the real aim of the experiment. Through a pre-screening questionnaire, we selected daily smokers. To control for baseline craving levels, the participants were asked to refrain from smoking six hours prior to the experiment, which is a commonly used approach in cue-reactivity research (e.g. Sayette, Loewenstein, Griffin, & Black, 2008). Additionally, to conceal the real aim of the study, they were also asked to refrain from drugs and alcohol. A laboratory at the Radboud University Nijmegen was equipped with a comfortable leather chair and a big-screen television to create a setting in which the participants would feel comfortable and relaxed. In order to check whether the participants had fulfilled the requirement of six hours abstinence from smoking, they were given a carbon monoxide (CO) breath test using a smokerlyzer (Bedfont Scientific Ltd, Bedford, UK). Participants showed CO levels ranging between 0 and 13 parts per million (ppm; $M = 5.42; SD = 3.22$). If participants did not meet the <13 ppm cut-off, they were excluded from the study (e.g. Conklin, Robin, Perkins, Salkeld, & McClernon, 2008). Before watching the movie, the participants were requested to complete a questionnaire assessing, among distracter items, socio-demographic information and their current craving. After completing the questionnaire and providing a breath sample, the edited version of the movie Married Life (2007) was shown. Participants were told that we were interested in how people watch movies at home and that they would be allowed to smoke and consume drinks and nuts that were provided. During the movie, the behaviour of the participants was observed and recorded with a hidden camera. After the movie, the participants answered questions about their craving, their transportation, and their smoking habits. Afterward, participants were asked about the real aim of the study (none of whom guessed correctly). They were debriefed, thanked, and given €45 for their participation. The protocols for the study were approved by the Ethical Committee of the Faculty of Social Sciences, Radboud University Nijmegen.

Movie adaption

The contemporary movie, Married Life (2007), was edited to obtain two similar versions of the movie, one with smoking scenes and one without any portrayal of smoking. This particular movie was chosen because of the high number of smoking cues portrayed: All four main female and male characters smoke at least once during the movie. The version shown in the experimental condition contained 16 smoking scenes (= 7.04 min). Both versions were nearly identical in regard to story line and scenes; this controls for the fact that any effect (or lack thereof) cannot be explained by differences in the story and/or affective responses caused by the movie. First, the version used in the control condition was edited. All smoking cues were removed from the movie. About 15 min were cut from the movie, resulting in a length of 72 minutes. Next, the movie used in the experimental condition was edited. Fifteen minutes of movie material that did not contain any smoking cues were removed, mainly by removing material from those scenes that were also edited in the control condition. Both versions were the same length and did not differ with regard to the story line.
Measures

Smoking behaviour. During observation, we counted the number of cigarettes the participants smoked.

Smoking habits. Participants completed a questionnaire assessing their smoking history and current smoking patterns (e.g. age of initiation, number of cigarettes smoked per week).

Craving. We used a visual analog scale (VAS) (Smolka et al., 2006) and the four-item Questionnaire on Smoking Urges (QSU-4) (Carter & Tiffany, 2001) to measure craving. Using the VAS, participants were asked to indicate their desire to smoke at the moment of completing the questionnaire, ranging from 0 to 100. The QSU-4 measured craving using the following four items: (a) nothing would be better than smoking a cigarette right now, (b) I have an urge for a cigarette, (c) all I want right now is a cigarette, and (d) I crave a cigarette. Cronbach’s α is .84.

Transportation. To measure transportation, participants had to complete an adapted version of the Transportability Scale (Dal Cin, Zanna, & Fong, 2004). As we intended to measure transportation at a specific time in response to a specific narrative, participants were asked to indicate their level of agreement with regard to the movie they had been exposed to. Answers were measured on a 9-point scale ranging from “totally not agree” to “totally agree” for items, such as “I got mentally involved in the story” and “I could easily lose myself in the story.” Cronbach’s α is .84.

Results

All participants were daily smokers, smoking on average 74.14 cigarettes per week (SD = 39.48). Of the participants, 20% smoked 1-5 cigarettes/day, 33.3% smoked 6-10 cigarettes/day, 43.3% smoked 11-20 cigarettes/day, and 3.3% smoked 21-30 cigarettes/day. They had, on average, initiated smoking at the age of 14.18 years (SD = 2.49). Participants’ craving level prior to the experiment was on average 52.90 (SD = 22.89, QSU-4) and 76.88 (SD = 11.94, VAS). On average, participants smoked 2.69 cigarettes (SD = 1.1, range 0-6; experimental condition: M = 2.83, SD = 1.15 and control condition: M = 2.55, SD = 1.06) while watching the movie. Only one participant did not smoke at all during the experiment. The two groups did not differ with regard to the time the first cigarette was lit (p = .34). The scores for transportation ranged from 1.21 to 6.37 (experimental condition: M = 4.52, SD = .91 and control condition: M = 4.30, SD = 1.26).

Randomization and manipulation check

Randomization over the two conditions was successful. The two groups did not differ in terms of gender (p = .79), age (p = .07), baseline craving level (QSU: p = .11 and VAS: p = .71), the last time participants had smoked (p = .26), the CO level (p = .97), and the average number of cigarettes smoked per day (p = .100) and week (p = .87). The data indicated that the experimental manipulations were successful. In the experimental condition, 80% of the participants accurately recalled having seen at least three of the four main characters smoking. In the control condition, only one (3.3%) of the participants mistakenly recalled having seen one of the four characters smoking.

Tests of hypotheses

An analysis of covariance (ANCOVA) was conducted in order to test the effect of smoking cues in movies on immediate smoking behaviour. The independent variable was the experimental condition (movie with smoking scenes vs. movie without any smoking scenes), and the dependent variable was the number of cigarettes smoked while watching the movie. Participants’ transportation scores were used as covariate. The results showed a significant interaction effect between transportation and condition on the number of cigarettes smoked, F(1, 59) = 7.15, p = .01, η² = .113, indicating that smokers who are low in transportation smoke more cigarettes in the experimental condition than in the control condition, while there is no difference found for smokers high in transportation. The average number of cigarettes smoked per condition and transportation scores is shown in Figure 1.
exposed to smoking characters compared with non-smoking characters. Based on cue-reactivity and imitation theories, we expected that smokers who are exposed to smoking cues in a movie would smoke more cigarettes while watching the movie compared with those exposed to non-smoking characters.

Previous studies on the influence of smoking cues in movies on smoking behaviour among smokers have revealed mixed results. Shmueli et al. (2010) found that smokers were more likely to smoke after a short movie clip (i.e. 8 minutes) when they were exposed to smoking characters compared with non-smoking characters. The set-up of the exposure to a short movie clip is not comparable with that of the present study in which we used a 72-minute movie clip. The exposure to a short movie clip containing scenes from different movies is similar to the set-up of cue-reactivity studies (Carter & Tiffany, 1999), and therefore, a confirmation of these results is expected and not surprising. However, exposure to a longer movie clip may demonstrate additional and/or other factors that might influence the smoking behaviour causing different results. Harakeh et al. (2010) exposed smokers to a 60-minute movie with or without smoking scenes and found no direct effects on the number of cigarettes smoked while watching. As was previously mentioned, the lack of effect might be explained by factors other than smoking cues, as two different movies were used in the experimental and control condition in that study.

Cue-reactivity and imitation processes are not necessarily distinct processes but might function parallel or complement each other. In general, the lighting of the first cigarette while watching a movie could be explained by cue-reactivity as well as by imitation. Once smoked - and when craving levels might be low and need time to develop again - imitation might be more appropriate to explain the continuation of smoking. In the present study, smokers’ increased craving levels due to deprivation might explain the lighting of the first cigarette. Because smokers continue smoking irrespective of being exposed to a movie with or without smoking cues, imitation might not play an important role in this context. Imitation might primarily occur on a micro level, and for example, people might match their puffing to that of the actors. Experiments with a larger sample size provide the opportunity to examine these underlying mechanisms.

Discussion

The present study examined the effect of smoking cues in movies on immediate smoking behaviour among daily smokers and tested whether these cues have the same effects in smokers who differ in their level of transportation. Using an experimental design in which we exposed smokers to the same movie either with or without smoking cues and allowed the participants to smoke while watching the movie, an interaction effect between condition and transportation on smoking behaviour was found. Smokers who were less transported smoked significantly more cigarettes when they were exposed to smoking characters compared with non-smoking characters.

In a second ANCOVA, participants’ scores on baseline craving, gender, age, CO level, and smoking frequency per day and week were also introduced as covariates in the model. After adjusting for these variables, the interaction effect between transportation and condition remained significant, \( F(1, 48) = 7.45, p = .009, \eta^2 = .134 \). In conclusion, smoking cues in movies have an influence on the number of cigarettes smoked but only when smokers show lower levels of transportation.

![Figure 1. Average number of cigarettes smoked per condition by transportation.](image)

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Based on cue-reactivity and imitation theories, we expected that smokers who are exposed to smoking cues in a movie would smoke more cigarettes while watching the movie compared with those exposed to non-smoking characters.

Previous studies on the influence of smoking cues in movies on smoking behaviour among smokers have revealed mixed results. Shmueli et al. (2010) found that smokers were more likely to smoke after a short movie clip (i.e. 8 minutes) when they were exposed to smoking characters compared with non-smoking characters. The set-up of the exposure to a short movie clip is not comparable with that of the present study in which we used a 72-minute movie clip. The exposure to a short movie clip containing scenes from different movies is similar to the set-up of cue-reactivity studies (Carter & Tiffany, 1999), and therefore, a confirmation of these results is expected and not surprising. However, exposure to a longer movie clip may demonstrate additional and/or other factors that might influence the smoking behaviour causing different results. Harakeh et al. (2010) exposed smokers to a 60-minute movie with or without smoking scenes and found no direct effects on the number of cigarettes smoked while watching. As was previously mentioned, the lack of effect might be explained by factors other than smoking cues, as two different movies were used in the experimental and control condition in that study.

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Furthermore, a moderating factor, transportation, has been tested in our experiment. We found that smokers who were less transported smoked
significantly more cigarettes when they were exposed to smoking characters compared with non-smoking characters. Being highly transported means having full attention for the events in the narrative and therefore focusing less on the real world and real world facts (Green & Brock, 2000; Green, et al., 2004; Green, et al., 2008). Highly transported people might therefore perform less behaviour in the real world. It might also be the case that they do not want to interrupt their immersion by performing a certain behaviour, such as smoking. The performance of behaviour in the real world might be less interrupting for smokers who are less transported. Another explanation might be that smokers who are less transported are bored and therefore search for distraction. As they participated in an experiment and were asked to watch the movie, smoking was a possible distraction while watching the movie. While being highly transported seems to have a temporary effect on smoking during the movie, this study was not designed to measure whether high transportation also affects smoking behaviour after the movie has ended. In fact, given that previous research on transportation shows that transportation increases story-consistent beliefs (Dal Cin, et al., 2004), it could be the case that highly transported smokers actually smoke more after the movie. Due to participants’ involvement in the film, the influence of smoking cues in movies might not emerge during cue exposure but might lead to a delay in the expression of the effect. Thus, it is possible that transportation does not necessarily prevent smokers from smoking more or weaken the effect of smoking cues in movies but that the effect of the cues emerges (only) after cue exposure. This needs to be clarified in future research, as the current study aimed at investigating the effects of smoking cues in movies while watching.

The study strengths include the exposure of smokers to a representative movie clip and the assessment of smoking while watching the movie instead of afterward. Although the present study extends previous research by investigating the effect of transportation, it has some limitations. First, our sample was relatively small, and replication with larger samples is needed. Still, it should be stressed that we had substantial variation in the outcome measurement enough to find significant effects. Also our sample size is not smaller than those employed in other observational behavioural experiments (Harakeh, et al., 2010; Shmueli, et al., 2010). Second, although our sample consisted of daily smokers only, the sample was still diverse in respect of smoking habits. Five of the 60 participants had a CO-level less than two after a six-hour period of smoking deprivation. However, after controlling for smoking habits in the analysis, the interaction effect between transportation and condition remained significant. If we were to focus only on occasional smokers, different and probably smaller effects might be found (Field, et al., 2009b). Future studies are needed to reveal whether different types of smokers and smokers with different smoking history are affected in the same way. Third, it seems that individuals differ in their susceptibility to smoking cues in movies, so that smoking cues in movies affect smokers differently. We tested a moderation effect of transportation but did not examine other factors that might also influence this association. Certain individual differences such as genetic disposition or personality characteristics (e.g. transportability) and characteristics of the movie should therefore be considered in future studies with larger samples.

The present study found that images of smoking in movies influence the smoking behaviour of smokers when they are less transported into the narrative. This finding provides suggestions for interventions on smoking cessation. Interventions for quitters should take into account that smoking cues in movies, in line with other environmental smoking cues, might stimulate smokers to smoke. Our results also emphasize the need of making smokers aware of the effect smoking cues in movies can have and suggest changes in the regulation of the movie rating system. Regarding the Netherlands, we suggest extending the Dutch movie rating system by integrating a warning label for smoking. So far, the rating of movies is based on several content labels like “violence” and “alcohol and drugs” but does not include a separate label for smoking. In addition, to enhance the awareness of the effect of smoking cues in movies, the depiction of anti-smoking advertisements before and during movies could counteract the effect of smoking cues in movies on smokers (Harakeh, et al., 2010). Given that smoking in movies influences smoking behaviour among smokers and considering the health risks associated with smoking, this study provides further arguments for an adaption of the regulations controlling smoking in movies.
Chapter 3

Does the exposure to smoking cues in movies affect adolescents’ immediate smoking behaviour?

Published as:
**Abstract**

*Introduction:* Various studies have demonstrated that environmental smoking cues elicit smoking-related responses in smokers. However, cue reactivity studies among adolescent smokers are scarce. Therefore, the aim of this study was to examine the effect of smoking portrayal in movies on immediate smoking behaviour in adolescent smokers.

*Method:* A total of 65 adolescent daily smokers (between the ages of 16 and 18 years) were exposed to a one-hour movie clip, with or without smoking characters, and were allowed to smoke while watching the movie.

*Results:* The exposure to smoking cues in movies had no effect on immediate smoking behaviour. This association was not affected by several smoking- and movie-related variables.

*Discussion:* No influence of smoking cues in movies on immediate smoking behaviour in adolescent daily smokers was found. More experimental research on the effects of environmental cues on adolescent smokers in different stages of addiction is needed.

**Introduction**

Previous research has demonstrated an association between the exposure to smoking cues in movies and smoking initiation (Dalton, et al., 2003; Hanewinkel & Sargent, 2007, 2008; Jackson, Brown, & L’Engle, 2007; Sargent et al., 2005; Sargent, et al., 2001; Thrasher, Jackson, Arillo-Santillan, & Sargent, 2008; Titus-Ernstoff, Dalton, Adachi-Mejia, Longacre, & Beach, 2008; Wills, et al., 2007) and established smoking (Dal Cin, Stoolmiller, & Sargent, 2012; Dalton et al., 2009; Sargent et al., 2007) in adolescents. Adolescents with a greater exposure to smoking cues in movies were more likely to initiate smoking and to progress to later stages of smoking. These studies indicate an impact of smoking portrayal in movies on different developmental stages of smoking. However, experimental research on the effects of movie smoking exposure on smokers has been scarce. The few studies that have been conducted focus on adult smokers, whereas the direct effect of smoking cues in movies on adolescent novice smokers with a shorter smoking history remains unclear. Findings among adult smokers cannot be generalized without caution to adolescent smokers as they differ with regard to their smoking history and developmental stage of addiction. Therefore, the current study focuses on the exposure to smoking cues in movies and aims to examine the effect of movie smoking exposure on adolescents’ immediate smoking behaviour.

Experimental-observational research on smoking cues in movies and immediate smoking behaviour in adult smokers showed mixed results (Harakeh, et al., 2010; Lochbuehler, Peters, Scholte, & Engels, 2010; Shmueli, et al., 2010). Thus far, three studies have tested smokers’ responses to either a movie clip with or without smoking scenes, all among adult smokers. When smokers were exposed to an eight-minute movie clip, participants in the experimental condition smoked significantly more cigarettes after the movie than participants in the control condition (Shmueli, et al., 2010). In the two other experiments, smokers were allowed to smoke while watching the movie. While being exposed to a 60-minute movie clip, one experiment did not show a difference between conditions in the number of cigarettes smoked (Harakeh, et al., 2010). However, two different movies were used in the two conditions, which might explain the lack of findings (Harakeh, et al., 2010). In the third experiment, two versions of the same movie were edited in order to produce a smoking and a non-smoking version of the same movie. The results showed that smokers who were less transported (i.e. psychologically involved in the
Insight into the influence of smoking cues in movies on adolescents is important for at least two reasons. First, the role of media in adolescents’ lives has become more significant. Not only because their exposure to different types of media has increased (Roberts, 2000; Roberts, et al., 2005), but also because adolescents in particular might be susceptible to the influence of media role models (Giles & Maltby, 2004). As smoking portrayal in movies is prevalent and watching movies is among the most popular leisure time activities (Roberts, 2000; Roberts, et al., 2005; Sargent, et al., 2001), the exposure to smoking portrayal in movies might be highly relevant to the development of addiction in adolescent novice smokers. Second, the onset of tobacco use takes place primarily during adolescence. Smoking prevalence rates increase most steeply between the ages of 13 and 16, and it is this in particular age range that a shift from trying and experimenting with cigarettes to more regular smoking is most likely to be observed (Stivoro, 2012c). Among novice smokers, nicotine dependence can develop quickly (DiFranza & Wellman, 2005) and the progression from use to dependence often takes place during adolescence (Kassel, 2000). Moreover, adolescents might be particularly susceptible, as their regulatory executive system has not been fully developed (Steinberg, 2007; Wiers, et al., 2007a). Psychosocial abilities that improve decision making and moderate risk taking (e.g., impulse control and delay of gratification) are not fully developed until well into young adulthood. Therefore, adolescent smokers might encounter more challenges regulating or inhibiting cue-induced appetitive response tendencies elicited from exposure to environmental smoking cues.

Research on the influence of different environmental smoking cues on adolescent smokers can provide additional insights into how smoking patterns become entrenched in adolescents, and may subsequently help to understand the development of habits and dependence and the difficulties of smoking cessation in this specific age group. Therefore, the current study aims to examine the effect of smoking portrayal in movies on immediate smoking behaviour in adolescent smokers. In an experimental study, adolescent smokers were either exposed to a one-hour movie clip with smoking characters or to the same movie clip without smoking characters. Both groups were allowed to smoke while watching the movie. In this first study on into the influence of smoking cues in movies, we hypothesized that the exposure to a movie with smoking characters would lead to smoking more cigarettes than the exposure to the same movie without any smoking characters. Furthermore, we tested moderation effects of various smoking-related and movie-related variables.

Methods

Sample and procedure

We requested and were granted permission by schools to approach smoking students in schoolyards in Nijmegen and asked if they would engage in an experiment about smoking (parental consent is not necessary as smoking in the Netherlands is legal from the age of 16 years). A total of 65 adolescent smokers (53.8% female) between the ages of 16 and 18 years (M = 16.86 years; SD = .68), who were smoking outside their schools were invited to participate in two independent studies. They were told two cover stories: first that they were participating in a study on tobacco marketing in which they had to give their opinion on various cigarette package designs, and second that they were participating in research on lifestyle and celebrities. In this study they would watch a movie and answer questions about the movie, the actors and their own lifestyle. By asking adolescents to participate in these two studies while they were actually smoking, we were able to recruit smokers without informing them about the real aim of the (second) experiment. To ensure that participants would see the two experiments as independent, a different research assistant conducted the second experiment. When the participants arrived at the lab, they were welcomed by the first research assistant and, as part of the first experiment, asked to go outside to smoke a cigarette, to control for baseline craving levels (Drobes & Tiffany, 1997). After their return to the lab, they were requested to give their opinion on two cigarette packages and answer questions assessing their smoking habits and craving. This cover experiment was conducted in order to avoid participants linking cigarette smoking to the real experiment. To ensure that participants would see the two experiments as independent, a different research assistant conducted the second experiment.

Participants were randomly assigned to one of two movie conditions. In the experimental condition, 34 adolescent smokers were exposed to the edited version of the movie in which several characters smoked. In the control
condition, 31 adolescent smokers were exposed to the edited version of the same movie in which the smoking was completely removed (for similar approaches see Lochbuehler, et al., 2010; Lochbuehler, et al., 2009). A laboratory was equipped with a comfortable leather chair and a big-screen television to create a setting in which the participants would feel comfortable and relaxed. Participants were told that we were interested in how people watch movies at home and that they would be allowed to smoke and consume drinks and nuts, all of which were provided. Then, the edited version of the Dutch movie Het Schnitzelparadijs (2005) was shown. During the movie, the behaviour of the participants was observed and recorded with a hidden camera. After watching the movie, the participants were requested to complete a questionnaire. Afterwards, participants were asked about the real aim of the study (none of whom guessed correctly). They were debriefed, thanked and given €20 for their participation. The protocols for the study were approved by the Ethical Committee of the Faculty of Social Sciences, Radboud University Nijmegen.

**Movie adaption**

The Dutch movie Het Schnitzelparadijs (2005) was edited in order to show two similar versions of the movie, one with smoking scenes and one without any portrayal of smoking. The version shown in the experimental condition contained 14 smoking scenes (= 5.42 min). Both versions were nearly identical with regard to story line and scenes and were the same length (65 min). Details on how movie clips are edited for this purpose can be found elsewhere (Lochbuehler, et al., 2010; Lochbuehler, et al., 2009). This particular movie was chosen for two reasons: it was likely that adolescents would like the movie and it was a Dutch film, so no subtitles were necessary.

**Measures**

**Smoking Behaviour.** During observation, we counted the number of cigarettes the participants smoked.

**Smoking habits.** Participants completed a questionnaire assessing their smoking history and current smoking patterns (e.g., age of initiation, number of cigarettes smoked per day and week).

**mFTQ.** The modified Fagerström Tolerance Questionnaire was designed to assess nicotine dependence in adolescents and was adapted from the adult version (Fagerström Tolerance Questionnaire; FTQ) to make it more suitable for adolescent smokers (Fagerstrom, 1991; Prokhorov, Pallonen, Fava, Ding, & Niaura, 1996). The eight original items of the FTQ are derived from the theoretical notions of reliance on nicotine (Fagerstrom, 1991; Prokhorov, et al., 1996) and capture behavioural aspects of nicotine dependence (Kandel et al., 2005). Alpha is .70.

**HONC.** The HONC is a 10-item instrument designed to measure loss of autonomy over tobacco use (DiFranza & Wellman, 2005). For the HONC, we used multiple response choices instead of the dichotomous yes-no category described by DiFranza et al. (2005). The multiple response choices are based on O’Loughlin (2002); multiple response choices were provided for each item to provide better insight into the degrees of lost autonomy. Alpha is .84.

**Craving.** We used the four-item Questionnaire of Smoking Urges (QSU-4) (Carter & Tiffany, 2001) to measure craving. The QSU-4 measured craving on a scale from 0 – 100 using the following four items: (i) nothing would be better than smoking a cigarette right now; (ii) I have an urge for a cigarette; (iii) all I want right now is a cigarette; and (iv) I crave a cigarette. Alpha is .92 (before the movie) and .93 (after the movie).

**Transportation.** To measure transportation, participants had to complete an adapted version of the Transportability Scale (Dal Cin, et al., 2004). As we intended to measure transportation at a specific time in response to a specific narrative, participants were asked to indicate their level of agreement with regard to the movie they had been exposed to. Answers were measured on a 9-point scale ranging from ‘totally not agree’ to ‘totally agree’ for items such as: ‘I got mentally involved in the story’ and ‘I could easily lose myself in the story’. Alpha is .82.

**Identification with movie characters.** Identification was measured with items based on the definition of identification of Cohen (2001). The scale consisted of 8 items. Participants were asked to indicate their level of agreement regarding their identification with the (male and female) main character using statements such as ‘I understand the reasons why he/she does what he/she does’, ‘I can feel the emotions that he/she portrayed’, ‘I want him/her to succeed in achieving his/her goals’. They gave their response by choosing
options ranging from 1 (‘completely disagree’) to 7 (‘completely agree’). Alpha is .83 (male main character) and .88 (female main character).

**Attractiveness.** The participants were required to rate the characters and the actors on 11 qualities related to attractiveness. Participants rated each character on the following qualities on a 5-point rating scale, with response categories ranging from ‘definitely not’ to ‘definitely yes’: physically attractive, sexy, in shape, sophisticated, wise, adventurous, cool, sociable, popular, desirable for a date, feminine/masculine (Hines, et al., 2000). Alpha is .88 (main male character) and .81 (main female character).

**Film appreciation:** Film appreciation was measured with 8 items (e.g., “I thought the film was interesting”) on a 4-point scale ranging from “definitely yes” to “definitely not” (Alpha is .72) (Engels, Hermans, van Baaren, Hollenstein, & Bot, 2009).

**Positive and negative affect.** Positive and negative affect was measured by using the Mood Form (Diener & Emmons, 1984), which consists of 9 items. Positive affect items are ‘happy’, ‘joyful’, ‘pleased’ and ‘enjoyment/fun’. Negative affect items are ‘depressed/blue’, ‘unhappy’, ‘frustrated’, ‘worried/anxious’ and ‘angry/hostile’. The participants were asked to indicate their current mood state on a seven-point scale ranging from ‘not at all’ to ‘extremely’. Alphas were .84 (for positive affect before the movie), .86 (for positive affect after the movie), .89 (for negative affect before the movie) and .68 (for negative affect after the movie).

### Results

**Descriptive statistics**

All participants were daily smokers; 26.2% smoked 1-5 cigarettes/day, 40.0% smoked 6-10 cigarettes/day, 32.3% smoked 11-20 cigarettes/day, and 1.5% smoked 21-30 cigarettes/day. The participants smoked on average 58.45 cigarettes per week (SD = 33.87). They reported, on average, to have initiated smoking at the age of 12.62 years (SD = 2.04). Participants’ craving level prior to the experiment was on average 19.41 (SD = 19.45) and they reported a mean score of .55 (SD = .26) on the mFTQ and a mean score of 2.40 (SD = .57) on the HONC.

On average, participants smoked 2.42 cigarettes (SD = 1.30, range 0-7). Four participants did not smoke at all during the experiment: two in the experimental and two in the control condition. The two groups did not differ with regard to the time the first (p = .41; experimental condition: M = 13.00 min; SD = 13.76; control condition: M = 10.36; SD = 9.78) and the second (p = .07; experimental condition: M = 30.13; SD = 12.32; control condition: M = 36.86; SD = 13.39) cigarette was lit. The average scores for the film-related variables can be found in Table 1.

<table>
<thead>
<tr>
<th></th>
<th>Smoking movie Mean</th>
<th>Non-smoking movie Mean</th>
<th>t</th>
<th>p</th>
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<td>.74</td>
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<tr>
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<tr>
<td>Negative affect after movie</td>
<td>.29</td>
<td>.14</td>
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</table>

Table 1. Independent samples t-test for several film-related variables per condition

**Randomization and manipulation check**

Randomization over the two conditions was successful. The two groups did not differ in terms of gender (p = .88), age (p = .64), baseline craving level (p = .49), the average number of cigarettes smoked per day (p = .57) and week (p = .31), the age they had initiated smoking (p = .90) and the positive (p = .13) and negative (p = .35) affect the participants had reported before watching the movie. The data indicated that the experimental manipulations were successful. In the experimental condition, 97.1% of the participants accurately recalled having seen characters smoking. In the control condition, five (16.1%) of the participants mistakenly recalled having seen one of the characters smoking.
Effect of smoking cues in movies on immediate smoking behaviour

An independent samples t-test was conducted in order to test the effect of smoking cues in movies on immediate smoking behaviour. The independent variable was the experimental condition (movie with smoking scenes vs. movie without any smoking scenes), and the dependent variable was the number of cigarettes smoked while watching the movie. No significant effect of smoking cues in movies on immediate smoking behaviour was found, $t(1,63) = .55$, $p = .59$. In the experimental condition, the participants smoked on average 2.50 cigarettes ($SD = 1.54$) and in the control condition, the participants smoked on average 2.32 cigarettes ($SD = .98$).

We conducted several ANOVAs to test possible interaction effects with gender, various smoking habits (e.g., daily and weekly smoking behaviour, time since age of initiation), nicotine dependence measures, craving, transportation, identification with the characters, attractiveness of the characters, film appreciation, positive and negative affect and whether they had seen the movie before. No interaction effects were found.

Discussion and conclusions

The goal of the current study was to examine adolescent smokers’ response to smoking cues in movies. To accomplish this, adolescent smokers were exposed to a movie with or without depictions of smoking and were allowed to smoke while watching the movie. We expected adolescent smokers confronted with smoking characters to light up more cigarettes than adolescent smokers confronted with non-smoking characters. However, the results showed no effect of smoking cues in movies on immediate behaviour in adolescent smokers.

Studies on the effects of smoking cues in movies on smoking behaviour in adult smokers revealed mixed results, dependent on the design of the study (length of movie exposure and the assessment of smoking behaviour during or after exposure to smoking characters). Explanations for the variant results between adolescent and adult smokers can, perhaps, be found within the assumptions of the dual process model (Wiers, et al., 2007a). The dual process model (Wiers, et al., 2007a), which is used to explain the development of addiction, is divided into an appetitive, approach-oriented system and a regulatory executive system. Repeated cigarette smoking causes a neural sensitization in the reward systems of the brain, leading to a stronger dopamine release every time one smokes. Further, through classical conditioning, cues that are often paired with smoking become associated with its pleasurable outcome. This leads to an attribution of incentive salience to the perception and mental representation of those cues. As a result, cues become attractive, desired and capable of capturing attention automatically, which may foster automatic approach action tendencies (e.g. Franken, 2003; Robinson & Berridge, 1993). The model proposes that the automatic link between cues and behaviour is influenced by the ability and motivation to control (Wiers, et al., 2007a). With regard to the appetitive, approach-oriented system, not much is known about the timeline of the development of incentive salience. It is still unclear how many pairings are needed to evoke sensitization and cue-induced appetitive response tendencies. It might be the case that smokers with a short smoking history, such as the adolescent smokers in our sample, have formed first associations, but are not yet completely susceptible to environmental smoking cues. This assumption is supported by the low levels of nicotine dependence measures (mFTQ and HONC), which indicate that the adolescents in our sample might still be in the earlier stages of the development of nicotine dependence. Therefore, it is possible that the reactivity to environmental smoking cues is not yet fully developed. Or in other words, adolescent smokers may not yet be sufficiently sensitized to be influenced by visual smoking cues.

With regard to the regulatory executive system, dual process models emphasize the role of the ability and motivation to control in regulating appetitive response tendencies. There are indications that adolescents might have more difficulties regulating appetitive response tendencies, as their regulatory executive system has not yet been fully developed (Wiers, et al., 2007a). The opportunity to smoke might play an important role, especially among adolescent smokers, who might not be permitted to smoke at home or on school grounds. Despite low craving levels due to smoking a cigarette before watching the movie as a first part of the experiment, it seems that if adolescent smokers get the opportunity to smoke, they do. In the previous similar study among adults, participants smoked on average the same number of cigarettes during the movie as the adolescents (Lochbuehler, et al., 2010), but adult smokers’ baseline craving levels were higher due to deprivation from smoking. Adolescents smoke the same amount as adults did even though they were not deprived. And contrary to adults, adolescents’ smoking behaviour in the
We tested the effect of several smoking- and movie-related variables on the association between smoking cues in movies and adolescents’ smoking behaviour. None of the variables had an influence on the relation. In a previous study among adults (Lochbuehler, et al., 2010), an interaction effect with transportation was found. It is important to note that scores on transportation in the current study did not deviate from scores in the adult study (Lochbuehler, et al., 2010), suggesting that adolescents are not less engaged in the movie. Differences in transportation or amount of cigarettes smoked during the experiment can thus be ruled out as explanations for the lack of effects in adolescents.

Another explanation for the lack of findings can be found in the dose of cue exposure. Longitudinal studies, which assessed cumulative exposure to smoking cues in movies, demonstrated an effect on nicotine dependence and established smoking in adolescents (Dal Cin, et al., 2012; Dalton, et al., 2009; Sargent, et al., 2007). The current experiment exposed smokers to a single movie. It may be that experiments allowing multiple exposures and the possibility to assess a dose-response relationship show different results.

Some limitations need to be mentioned. First, we expected to find medium to large effects in the current study based on previous research among adults with a similar design (Lochbuehler, et al., 2010). A priori power calculations indicated that a sample of 65 participants would be appropriately powered to detect a medium effect size. However, our sample size was not powered to detect a small population effect, which can therefore not be ruled out. Second, the sample of smokers could have been too heterogenic with regard to their smoking history and smoking habits. Although all participants in our sample reported being daily smokers, the duration of their daily smoking habit, and therefore their nicotine dependence levels, varied. Future studies should focus on more homogeneous samples. Third, it remains a challenge to control for baseline craving in experimental smoking cue-reactivity studies. In the current study, we have chosen to ask adolescents to smoke a cigarette before cue exposure. This might have had an influence on their background craving. Cigarette smoking and answering questions on smoking prior to watching the movie might have primed the smokers. However, smoking a cigarette before the movie did not prevent participants from smoking during the movie; on average two cigarettes were lit during cue exposure, regardless of condition. Moreover, in a study with a similar design (Lochbuehler, et al., 2010), the same number of cigarettes was smoked during the movie on average.

In conclusion, this study found no influence of smoking cues in movies on immediate smoking behaviour in adolescent daily smokers. To our knowledge, this is the first experimental study on the influence of smoking cues in movies on adolescents’ actual smoking behaviour. Cue reactivity studies among adolescent smokers are scarce. Experimental research in adolescent smokers is important, not only because they differ from adult smokers in smoking habits and history, but because they may also be in a different developmental stage of addiction. Further research on this target group calls for, and may assist in, understanding the progression of addition. The current study provides a beginning, but more experimental research on the effects of environmental cues on adolescent smokers in different stages of addiction is needed.
Chapter 4

Influence of smoking cues in movies on craving among smokers

Published as:
Abstract

Introduction: Research has shown that smoking-related cues are important triggers for craving. The objective of the present study was to test whether smoking cues in movies also function as triggers to evoke craving. To accomplish this, we conducted a pilot study in which we examined smokers’ reactivity to smoking cues from a particular movie in a common cue-reactivity paradigm using pictures. In the main study, we tested whether smokers who are confronted with smoking characters in a movie segment have a greater desire to smoke than smokers confronted with non-smoking characters.

Method: Using an experimental design, participants were assigned randomly to one of two movie conditions (smoking versus non-smoking characters). In a laboratory, that reflected a naturalistic setting, participants watched a 41-minute movie segment. A total of 65 young adults who smoked on a daily basis participated in the experiment. Craving was assessed before and after watching the movie.

Results: The pilot study revealed that pictures of smoking characters had strong effects on craving. However, when smokers actually watched a movie segment, no differences in craving were found between those who watched smoking characters and those who watched non-smoking characters. This finding was not affected by baseline craving, the time of the last cigarette smoked and daily smoking habits.

Discussion: No effect of smoking cues in movies on craving was found, in contrast with research supporting the cue-craving link. Thus, if replicated, this might indicate that smoking cues in such contexts do not affect smokers’ desire to smoke as expected.

Introduction

Tobacco images are prevalent in popular movies (American Lung Association of Sacramento Emigrant Trails, 2005). Despite the downward trend of smoking images in movies between 1996 and 2005, more than 60% of the top 100 box-office hits in 2005 depicted tobacco images (American Lung Association of Sacramento Emigrant Trails, 2005; Worth, Duke, Green, & Sargent, 2007). The average number of tobacco incidents per film for the top 50 films released in the period between 1994 and 2005 was 19.9 (Mekemson et al., 2004). Given that young adults spend a great deal of their spare time watching television and videos or DVDs (Roberts, 2000; Roberts, et al., 2005; Sargent, et al., 2001), young adults are often exposed automatically to tobacco images in films on a daily basis.

Research has demonstrated an association between smoking exposure in movies and smoking initiation among adolescents. The portrayal of smoking in movies has been linked to smoking experimentation in cross-sectional (Hanewinkel & Sargent, 2007; Sargent, et al., 2005; Sargent, et al., 2001; Thrasher, et al., 2008) and longitudinal studies (Dalton, et al., 2003; Hanewinkel & Sargent, 2008; Jackson, et al., 2007; Titus-Ernstoff, et al., 2008; Wills, et al., 2007). Underlying mechanisms of these effects could be explained partly by the Theory of Planned Behavior (TpB) (Ajzen, 1991). The TpB posits that a person’s behaviour is determined by their behavioural intention and that this, in turn, depends on the person’s attitude towards the behaviour, their subjective norm and their perceived behavioural control. Studies investigating mediating factors showed that the association between exposure to smoking in movies and intentions to smoke is mediated by positive expectancies (Tickle, et al., 2006; Wills, Sargent, Stoolmiller, Gibbons, & Gerrard, 2008) and one’s identification as a smoker (Tickle, et al., 2006). These concepts are related in turn to smoking onset.

Most attention in previous research has been paid to the effect of exposure to smoking in movies on smoking initiation. Very few studies have dealt with the effect that the depiction of smoking in movies could have on smoking in people who already smoke. Like other environmental cues, smoking cues in movies could also elicit physiological and subjective reactions in smokers. Research among smokers has shown that environmental cues are important triggers for craving. Cue-reactivity studies typically employ a paradigm in which smokers are exposed to both smoking and neutral cues to examine
craving may be a better predictor than smoking cognitions. It is therefore essential to test whether smoking cues in movies actually affect craving levels.

Understanding the effects of smoking cues in movies on smokers’ urge to smoke has important implications for smoking cessation and relapse avoidance. It has been documented that smoking cues play an important role in the process of smoking continuation and consequently in the process of smoking cessation. Using ecological momentary assessments, Shiffman et al. (2004) found craving to be the strongest predictor for smoking. Craving is a predictor for smoking lapses and is therefore related to a decreased likelihood of successful cessation (Killen & Fortmann, 1997; Shiffman, 2000). If smoking cues in movies evoke smoking urges and this, in turn, stimulates smokers to light a cigarette, smokers may find it more difficult to quit smoking and, moreover, watching movies with smoking scenes would increase the possibility of relapse. The aim of the present study is therefore to examine whether smoking cues portrayed in movies evoke urges to smoke among smokers. To accomplish this we first conducted a cue-reactivity study, using pictorial smoking and non-smoking cues derived from a movie, to explore whether the smoking cues function as stimuli to evoke urges to smoke. This set-up of the pilot study is in line with commonly used approaches in cue-reactivity research e.g. similar to (Conklin, et al., 2008). In the main study, we used an experimental design, in which we exposed smokers to a (representative) segment of an existing contemporary movie containing the same smoking cues as in the pilot study to investigate smokers’ subjective reactivity to smoking cues in movies. Both the pilot and the main study were intended to be used as a foundation upon which to compare the effects of pictorial and dynamic cues. For both studies, we hypothesized that smoking cues evoke stronger craving levels than non-smoking cues.

Method

Pilot study: cue-reactivity study

Sample and procedure

We conducted a within-subject cue-reactivity study to examine whether the smoking cues in the movie segment in the main study function as stimuli and evoke smoking urges. In this study, we used six smoking and six non-smoking
urge for a cigarette; (iii) all I want right now is a cigarette; and (iv) I crave a cigarette (Carter & Tiffany, 2001).

Main study: reactivity to smoking cues in movies

Sample and procedure

After having conducted the pictorial cue-reactivity study, we examined the subjective reactivity to smoking cues in a movie. The participants were assigned randomly to one of two different movie conditions, varying in respect of whether the main characters smoked or did not smoke. In the experimental condition, the participants were confronted with a 41-minute segment of the movie *Atonement* in which both main characters (acted by Keira Knightly and James McAvoy) smoked. In the control condition, the participants watched a 41-minute segment of the same movie without smoking scenes.

The sample consisted of 65 university students (43 female and 22 male), ranging in age from 18 to 42 years (M = 22.69; SD = 3.89). The participants were recruited from the Psychology and Educational Science subject pool. They were invited to a laboratory at the Radboud University Nijmegen and were told that they were participating in research on the lifestyle of students and celebrities and were thus not informed about the aim of the experiment. To create a cozy and relaxing atmosphere, we equipped one of our laboratories with a comfortable leather chair and a big-screen television. Before watching the movie clip, the participants were requested to complete a questionnaire assessing their craving and their smoking habits. One hour after the experiment the participants were called on their mobiles and asked whether they had smoked in the past hour.

In both conditions we used a segment of the movie *Atonement* to control for similarity with regard to the genre of the film. From this movie, two 41-minute clips were made, one showing exclusively non-smoking scenes and the other showing both male and female characters smoking in addition to pictures from the movie *Atonement*. Three smoking and three non-smoking pictures depicted the male character and three smoking and three non-smoking pictures depicted the female main character. Most of the smoking and non-smoking pictures portrayed shots from the same scene, the single difference being the presence of a cigarette. The six smoking and six non-smoking cues were combined in a 12-trial cue-reactivity paradigm. To control for order effects, four counterbalanced orders were developed for cue presentation (similar to Conklin, et al., 2008).

Thirty-one (12 male and 19 female) smokers between the ages 18 and 38 years (M = 23.97; SD = 4.50) participated in the cue-reactivity study. The participants were recruited through flyers around the campus. They were invited to a laboratory at the Radboud University Nijmegen and asked to refrain from tobacco use for 6 hours prior to the experiment. Before assessing the cue-reactivity, the participants were requested to complete a questionnaire assessing their smoking history and their current urge to smoke. Participants were given a carbon monoxide (CO) breath test using a smokerlyzer (Bedfont Scientific Ltd, Bedford, UK). If participants did not meet the <13 parts per million (p.p.m.) cut-off, they were excluded from the study (similar to Conklin, et al., 2008). After undergoing a practice trial, participants completed 12 automated cue-exposure trials, which followed a standard format: 20 seconds relaxation, 40 seconds picture viewing and post-trial craving ratings. Each response form instructed the participant to answer the ratings based on how he or she felt while viewing the picture in that trial. After completing the rating forms, participants clicked a button to start the next trial.

Measures

Participants completed a questionnaire assessing their smoking history and current smoking patterns (e.g. age of initiation, number of cigarettes per day). Furthermore, we used a visual analogue scale (VAS) (similar to Baumann & Sayette, 2006; Guthrie, Ni, Zubieta, Teter, & Domino, 2004; Smolka, et al., 2006) and the four-item Questionnaire of Smoking Urges (QSU-4) (Carter & Tiffany, 2001) to measure craving. Using the VAS, participants were asked to indicate their desire to smoke at the moment of filling in the questionnaire, ranging from 0 to 100. The QSU-4 measured craving using the following four items: (i) nothing would be better than smoking a cigarette right now; (ii) I have an urge for a cigarette; (iii) all I want right now is a cigarette; and (iv) I crave a cigarette.
non-smoking scenes. The movie segments were manipulated in such a way that the two segments were of the same length and did not differ with regard to the movie scenes and storyline. To control for differences between the two edited movie segments, independent *t*-tests were conducted. No differences were found between conditions in transportation, identification with the main characters and appreciation of the movie. In the movie segment used in the experimental condition, the female character as well as the male character smoked three times. In addition, other characters smoked three times. In total, smoking was portrayed for 203 seconds: 40 seconds of smoking by the female character, 40 seconds by the male character and 123 seconds by other characters. Afterwards, participants were asked about the aim of the study (none of them guessed the actual aim) and were debriefed.

Measures

Participants completed a questionnaire assessing their smoking history and current smoking patterns. Craving was assessed by using a VAS (similar to Baumann & Sayette, 2006; Guthrie, et al., 2004; Smolka, et al., 2006) (see pilot study).

Results

Pilot study

The participants smoked on average 67.4 cigarettes per week, had on average initiated smoking at the age of 14.7 years, and had an average CO-measurement of 4.6 p.p.m. A paired-samples *t*-test was conducted to evaluate whether smoking cues elicited urges to smoke (Figure 1 and Figure 2). The results showed an overall significant effect of the cue manipulation on craving [smoking versus non-smoking cues, *t*(30) = 3.61, *p* = .001 (QSU-4); *t*(30) = 3.24, *p* < .005 (VAS)], such that smoking-related cues evoked a greater urge to smoke (QSU-4: *M* = 43.16, *SD* = 24.15; VAS: *M* = 63.68, *SD* = 21.47) than non-smoking cues (QSU-4: *M* = 33.35, *SD* = 20.22; VAS: *M* = 56.53, *SD* = 22.93). The eta-squared statistic (QSU-4: *η*² = .30; VAS: *η*² = .26) indicated a large effect size (Cohen, 1992). There was a strong, positive relation between the two variables used to measure craving after smoking cue exposure (QSU-4 and VAS; *r*(31) = 0.64, *p* < .0001), and a strong positive relation between the two variables used to measure craving after non-smoking cue exposure (*r*(31) = .74, *p* < .0001). A repeated-measures analysis of variance (ANOVA) conducted on the smoking pictures revealed an increase of craving ratings over time [QSU-4: Wilks’ lambda = .70, *F*(5, 26) = 2.27, *p* > .05 (.08), *ƞ*² = .30; VAS: Wilks’ lambda = .44, *F*(5, 26) = 6.69, *p* = .000, *ƞ*² = .56], as shown in other studies (Cepeda-Benito & Tiffany, 1996; Rickard-Figueroa & Zeichner, 1985). In general, the results of the pilot study show that pictorial smoking cues from the movie Atonement function as stimuli to evoke craving.
Main study

The participants smoked on average 67.3 cigarettes per week and had on average initiated smoking at the age of 13.8 years. Participants’ average CO-measurement was 8.8. Randomization over the two conditions was successful. The two groups did not differ in terms of gender \((p = .61)\), baseline-craving level \((p = .25)\), the last time participants had smoked \((p = .22)\), the CO-level \((p = .18)\) and the average number of cigarettes smoked per day \((p = .10)\).

An analysis of covariance (ANCOVA) was conducted to evaluate the influence of smoking cues in movies on smokers’ desire to smoke (figure 3). The independent variable was the experimental condition (movie segment containing smoking cues versus movie segment without any smoking cues), and the dependent variable consisted of scores on craving assessed after the participants had watched the movie. Participants’ scores on baseline craving (assessed before the movie) were used as covariate. After adjusting for scores on baseline craving, there was no significant difference between the experimental \((M = 60.15; SD = 3.31)\) and control condition \((M = 62.51; \ SD = 3.31)\) on scores of craving after watching the movie \((F(1, 61) = .25, p = .62, \eta^2 = .004)\). There was a relationship between the pre-craving and post-craving scores, as indicated by a partial eta-squared value of .49. Adjustment for scores on baseline craving, the time of the last cigarette smoked and daily smoking habits did not affect the findings \((F(1, 59) = .62, p = .44, \eta^2 = .010)\).

We also tested differences between conditions on the number of cigarettes the participants had smoked within an hour after the experiment. An ANCOVA showed no significant difference between the conditions in the number of cigarettes smoked \((F(1, 55) = .12, p = .73, \eta^2 = .002)\) when corrected for participants’ scores on baseline craving. Correcting for scores on baseline craving, the time of the last cigarette smoked and daily smoking habits did not affect this finding \((F(1, 53) = .25, p = .62, \eta^2 = .005)\). There was no significant relationship between the baseline craving scores and the number of cigarettes smoked within an hour after the movie, but there was a positive relation between craving after smoking movie exposure and smoking behaviour \((r(58) = .41, p < .001)\).

In contrast to Hines et al. (2000), no significant differences between conditions were found between men and women. Additional analyses also showed no differences between conditions between participants who were heavy or light smokers, or between those who were low or high on baseline craving.

Discussion

The present study was designed to examine the effect of the portrayal of smoking in movies on craving among smokers and to compare whether dynamic cues have the same effects on smokers as pictorial cues. Using a cue-reactivity paradigm with pictorial smoking cues derived from the same film used in the main study, the results of the pilot study clearly revealed that smokers had higher subjective smoking urges after being exposed to smoking cues than after being exposed to neutral cues. These results corroborate previous studies (e.g. Baumann & Sayette, 2006; Bordnick, et al., 2004; Carter, et al., 2008; Drobes & Tiffany, 1997; Erblich & Bovbjerg, 2004; Sayette & Hufford, 1994; Shadel, et al., 2001; Tong, et al., 2007) and suggest that pictorial smoking cues, when isolated from the movie, evoke craving. In the main study, in which we exposed smokers to a movie segment either with or without smoking scenes, no evidence for the influence of smoking cues in movies on craving was found.
There are several possible explanations for the lack of findings in the present study. Studies using Stroop, visual probe and eye-tracking paradigms have shown that smokers have an attentional bias for pictorial smoking-related cues (Bradley, Field, Mogg, & De Houwer, 2004; Bradley, Garner, Hudson, & Mogg, 2007; Bradley, Mogg, Wright, & Field, 2003; Ehrman et al., 2002; Field, Mogg, & Bradley, 2004a; Field, Mogg, Zetteler, & Bradley, 2004b; Kwak, Na, Kim, Kim, & Lee, 2007; Mogg, Bradley, Field, & De Houwer, 2003); up to this point, however, no research has been conducted on whether or not smokers consciously detect smoking cues in movies and if so how they interpret those cues. It may be that participants simply do not see the cues, for example because of their involvement in the narrative.

Even if participants do see the smoking cues in the movie, the strength of the cue, in terms of number and duration, may be insufficient to affect craving in daily smokers. In our study, participants were exposed to nine smoking scenes with a total length of 203 seconds. Moreover, as opposed to research supporting the cue-craving link, which is often characterized by an explicit and strong focus on smoking cues, in our main study participants were exposed to more realistic, subtle cues and were unaware of the aim of the study. It might be the case that more frequent, longer or more explicit cues in movies still lead to an increase in craving.

The results may also be explained by the dynamics of craving. Shiffman (2000) distinguishes between background and episodic craving. Background craving appears steadily throughout the day and is not evoked by environmental cues, unlike episodic craving. We found an effect on background craving, as smokers in both conditions reported higher craving levels after watching the movie compared to their levels at baseline measurement. No effects were found on episodic craving. However, this may be deceptive because, unlike other cue-reactivity studies, in the main study it was not possible to obtain self-report measures immediately after cue-exposure and therefore to detect direct effects of smoking cues in movies on craving. Craving levels could increase at the moment of cue exposure and decrease immediately after cue appearance. The decrease in craving-level could be explained by the unavailability of cigarettes. Cue availability studies, in which smokers are exposed to smoking-related and neutral cues and in which the participants are informed about the availability of the drug, showed that craving increased with cigarette availability (Carter & Tiffany, 2001). The participants’ involvement in the storyline of the film could also strengthen this effect.

Besides having no opportunity to smoke during the experiment, the smoker might be distracted from further thoughts about smoking by the continuation of the movie.

Also, we did not find any effect of smoking cues in movies on smoking behaviour within one hour after the experiment. This could be explained simply by the lack of difference in craving between conditions, as craving is one of the strongest predictors of smoking behaviour (Shiffman, et al., 2004). However, smoking cues in movies could affect other constructs, such as smoking behaviour itself on an implicit, more unconscious level (Dal Cin, et al., 2007). In the same vein, cues might affect smoking behaviour directly through automatic processes such as mimicry (Chartrand & Bargh, 1999; Van Baaren, Horgan, Chartrand, & Dijkmans, 2004; Van Baaren, Maddux, Chartrand, De Bouter, & Van Knippenberg, 2003). As we did not allow people to smoke while watching, we could not test this assumption.

A number of limitations to this study should be acknowledged. First, in the main study, participants were not asked to be abstinent prior to the study (as we did not want to bring attention to the aim of the study). Nevertheless, we did not find different effects for participants who had not smoked a couple of hours before the experiment compared to those who had. Secondly, more than 60% of the participants indicated that they smoke one to 10 cigarettes per day. Different effects may be found if we were to focus only on heavy smokers. Thirdly, we did not measure craving at the moment of cue exposure or shortly after cue exposure. Further studies including more measurements during the movie are therefore suggested. In future investigations it might also be interesting to examine smokers’ attention to and perception of smoking cues in movies to investigate whether smokers also have an attentional bias for smoking-related cues in movies. Future studies are also needed to reveal whether people do indeed light a cigarette directly after being exposed to smoking cues in movies. This is relevant in occasions where people are permitted to smoke while watching a movie (e.g. at home). In circumstances where people are not permitted to smoke while watching (e.g. in the cinema) and cannot immediately fulfil their needs, we do not expect smoking portrayals in movies to have a strong effect on smoking behaviour after watching a movie.

In contrast to pictorial smoking cues, we did not find any direct effects of the portrayal of smoking in movies on craving and smoking behaviour among
smokers. Thus, if replicated, this might indicate that smoking cues in such contexts do not affect smokers as expected and the cue-craving literature may need to account for the effects of smoking cues in movies. However, as this is one of the first experimental studies testing the effects of smoking cues in movies on craving in smokers, further research needs to be undertaken.
Chapter 5

Lack of association of *DRD4* exon 3 VNTR genotype with reactivity to dynamic smoking cues in movies

*Published as:*
Introduction

Research has emphasized the role of environmental smoking cues in maintaining smoking and hindering quitting. Environmental smoking cues are considered important triggers for nicotine craving. One form of environmental smoking cues, dynamic smoking cues in movies, and their possible effects on smokers, have rarely been investigated in previous research. This seems surprising considering the prevalence of smoking cues in movies (Heatherton & Sargent, 2009; Titus, et al., 2009), and the frequency with which people are exposed to those cues. Moreover, the variability in the susceptibility to smoking cues might be related to a genetic predisposition. Smokers with certain genetic markers might be more likely to be susceptible to environmental smoking cues and therefore particularly at risk. The 7-repeat allele of the DRD4 VNTR polymorphism influences dopamine response and has been reported to be associated with cue-induced craving (Hutchison, et al., 2002). Therefore, the aim of the present study was to examine whether smokers experience higher levels of craving when they are exposed to smoking cues in movies, and to explore whether this effect is stronger in carriers of the 7-repeat allele of the DRD4 VNTR polymorphism.

Abstract

Introduction: The objective of the present study was first to examine whether dynamic smoking cues in movies trigger craving, and second to explore whether the DRD4 48bp variable number of tandem repeat (VNTR) in exon 3 genotype modifies this relationship. Using an experimental design, daily adult smokers were exposed to a movie segment in which either several characters smoked, or the smoking was completely edited out.

Methods: In a human laboratory, that reflected a naturalistic setting, 112 daily smokers (mean age = 22.45; SD = 4.15) watched an edited version of the movie Alfie (2007). Saliva samples were collected for DNA isolation. Craving was assessed at 4 times: before and after the movie, and in two advertisement breaks during the movie.

Results: The results did not indicate any evidence of a three-way interaction between condition, the DRD4 VNTR polymorphism and time and no evidence of a main effect of condition on craving. The results found evidence of a main effect of the DRD4 VNTR polymorphism on craving ($p = .03$), indicating that smokers carrying the DRD4 7-repeat allele showed higher levels of craving compared with smokers without the DRD4 7-repeat allele.

Discussion: Dynamic smoking cues in movies do not affect smokers’ craving and this is not modified by DRD4 genotype. Smokers carrying the DRD4 7-repeat allele develop higher levels of craving in the context of watching a movie than non-carriers. Due to the small sample size, these results need to be treated with caution.

Discussion

Dynamic smoking cues in movies do not affect smokers’ craving and this is not modified by DRD4 genotype. Smokers carrying the DRD4 7-repeat allele develop higher levels of craving in the context of watching a movie than non-carriers. Due to the small sample size, these results need to be treated with caution.

Many studies have shown that the exposure to smoking cues increases smokers’ level of craving (Carter & Tiffany, 1999). These effects have been shown using different forms of exposure, including in-vivo, imaginary, pictorial, video and virtual reality. So far, two experimental studies have examined the effect of dynamic smoking cues in movies on craving for cigarettes. In the first study, smokers showed higher levels of craving after exposure to short video clips containing smoking compared to smokers who were exposed to non-smoking clips (Hines, et al., 2000). In a previous study, we exposed smokers either to a movie with smoking scenes or to the same movie with the smoking scenes edited out. No difference in craving after the movie was found between conditions (Lochbuehler, et al., 2009). However, as craving was assessed after the movie and not directly after cue exposure, craving could have peaked at the moment of cue exposure and decreased in the course of the movie. In the current study, craving was therefore assessed at four points: before, after, and twice during advertisement breaks during the movie. This enabled the assessment of craving more directly after cue exposure and allowed us to examine the time course of craving while watching a movie.
Cigarette smoking is attended by a pleasant, rewarding feeling due to the activation of the mesolimbic dopamine system and the release of dopamine in the brain (Berridge & Robinson, 1998). Repeated cigarette smoking causes a neural sensitization in the reward systems of the brain, leading to a stronger dopamine release each time one smokes. Further, through classical conditioning, cues that are often paired with smoking become associated with its pleasurable outcome. This leads to an attribution of incentive salience to the perception of those cues. As a result, cues become attractive, desired and can induce incentive salience (i.e., wanting), by activating the mesolimbic dopamine system and an urge to smoke (e.g. Franken, 2003; Robinson & Berridge, 1993). One of the genes, which may contribute to individual differences in sensitivity to the rewarding properties of smoking is the DRD4 gene. The DRD4 gene encodes the D4 dopamine receptors in several brain areas, including those associated with positive reward from smoking (the incentive salience-related brain areas). The DRD4 gene is associated with differences in dopamine binding potential and may therefore influence variation in the experience of reward after smoking (Brody, et al., 2006). Activity at D4 dopamine receptors can be seen as relevant for the attribution of incentive salience and therefore for the initiation of craving (Berridge & Robinson, 1998; Hutchison, et al., 2002; Larsen, et al., 2010; Robinson & Berridge, 2001).

Support for variability in the susceptibility to environmental smoking cues among DRD4 genotypes was revealed in an in-vivo cue reactivity study. Smokers carrying the DRD4 7-repeat allele reported an increase in craving after exposure to smoking cues compared to non-carriers (Hutchison, et al., 2002). However, as this is the only experimental cue-reactivity study examining whether the DRD4 genotype affects cue-reactivity to environmental smoking cues, the aim of the current study was to further test this mechanism using dynamic smoking cues.

Using an innovative observational-experimental design, the aim of this study was to test whether daily smokers who are exposed to dynamic smoking cues in movies experience higher levels of nicotine craving than smokers who are exposed to a non-smoking movie. Moreover, we examined whether this association is moderated by the DRD4 genotype. We expected that smokers in the experimental condition report higher levels of craving than in the control condition. Also, we expected this association to be moderated by DRD4 genotype, with smokers carrying the DRD4 7-repeat allele developing higher levels of craving than non-carriers when exposed to smoking cues.

Methods

Sample

A total of 112 European ancestry university students from the Radboud University Nijmegen participated in the study and gave their written informed consent before participation. The sample consisted of 77 female and 35 male daily smokers with a mean age of 22.45 years (SD = 4.15). The participants had, on average, initiated smoking at the age of 14.00 (SD = 2.12) and reported smoking on average 61.85 cigarettes per week (SD = 36.51, range 10 - 160). Of the participants, 34.8% smoked 1-5 cigarettes per day, 33.0% smoked 6-10 cigarettes per day, 29.5% smoked 11-20 cigarettes/day, and 2.7% smoked 21-30 cigarettes/day. The average CO-reading at baseline was 4.38 (SD = 3.15).

Procedure

The protocols for the study were approved by the Ethical Committee of the Faculty of Social Sciences, Radboud University Nijmegen. The participants were recruited via an online-registration system in which the experiment was described as contributing to research on life-style and celebrities. This description functioned as cover for the real aim of the experiment. A pre-screening questionnaire assessing, for example, smoking status at the start of the participants’ degree allowed the selection of daily smokers only. The participants had to meet the screening criteria of being age 18 or older and being a daily smoker. To control for baseline craving-levels, the participants were instructed to refrain from smoking six hours prior to the experiment (Lochbuehler, et al., 2010; Sayette, et al., 2008). Additionally, to conceal the real aim of the study, they were also asked to refrain from any drugs or alcohol (Lochbuehler, et al., 2010). The participants were assigned randomly to one of two movie conditions. In the experimental condition, 56 smokers were exposed to the edited version of the movie in which several characters smoked. In the control condition, 56 smokers were exposed to the edited version of the same movie in which the smoking was completely edited out (Lochbuehler, et al., 2010; Lochbuehler, et al., 2009).

After signing up, the participants were invited to a laboratory at the university that was furnished with a comfortable chair and a big-screen television. After entering the lab, the experimenter explained the procedure.
In order to check whether the participants had fulfilled the requirement of six hours abstinence from smoking, they were given a carbon monoxide (CO) breath test using a Smokerlyzer (Bedfont Scientific Ltd, Bedford, UK). Participants showed CO-levels ranging between 0 and 13 parts per million (ppm; \( M = 5.42; SD = 3.22 \)). If participants did not meet the \(<13 \) ppm cutoff, they were excluded from the study (e.g. Conklin, et al., 2008). Then, saliva samples were collected for DNA isolation using Oragene kits (Genotek, Ottawa, Ontario, Canada). Craving-levels were assessed four times: before and after the movie and in two advertisement breaks during the movie. At all times, craving was assessed in combination with distracter items. The questionnaire before the movie assessed socio-demographic information and the current craving level. After the movie, transportation, identification with the characters, film appreciation and participants’ smoking habits were assessed. After filling in the questionnaire after watching the movie, the participants were asked about the real aim of the study (none of whom guessed correctly). They were debriefed, thanked and given €20 for their participation.

**Stimulus materials**

The contemporary movie Alfie (2007) was edited to obtain two similar versions of the movie, one with smoking scenes and one without any portrayal of smoking. First, for the version used in the control condition, all smoking cues were removed from the movie. In addition, other scenes were removed where necessary, in order to retain an intact, interesting and fluent storyline. Next, for the version used in the experimental condition, material from those scenes that were also edited in the control condition was removed. Thus, the possibility that any observed effect (or lack thereof) could be explained by differences in the story, affective responses caused by the movie, and/or the enjoyment of the movie is minimal, as movie segments did not differ with regard to scenes and storyline. The version shown in the experimental condition depicted smoking images over a length of 5.40 minutes spread over 20 scenes. The main male character smoked for 1.48 minutes and the main female character smoked for 1.26 minutes. In each time interval the last scene with smoking images was presented immediately before the advertisement break. Both edited versions lasted approximately 57 minutes. The first advertisement break was shown after 15 minutes and lasted 3.11 minutes. The second advertisement break took place after 33 minutes and lasted 3.26 minutes. All portrayed advertisements were neutral and did not contain any images of cigarettes, alcohol or food.

**Measures**

**Craving.** At the four measurement points, we used the widely used four-item Questionnaire of Smoking Urges (QSU-4) (Carter & Tiffany, 2001) to measure craving. The following four items were each rated on a scale from 0 - 100: (i) nothing would be better than smoking a cigarette right now; (ii) I have an urge for a cigarette; (iii) all I want right now is a cigarette; and (iv) I crave a cigarette. Cronbach’s alphas were excellent: .93 (before the movie), .95 (first break), .93 (second break), and .95 (after the movie).

**Smoking habits.** Participants completed a questionnaire assessing their smoking history and current smoking patterns (e.g., age of initiation, number of cigarettes smoked per week) (Lochbuehler, et al., 2010; Lochbuehler, et al., 2009).

**Transportation.** To measure transportation, participants had to complete an adapted version of the Transportability Scale (Dal Cin, et al., 2004). They were asked to indicate their level of agreement with regard to the movie they had been exposed to. Answers were measured on a 9-point scale ranging from “totally not agree” to “totally agree” for items such as: “I got mentally involved in the story” and “I could easily lose myself in the story”. Cronbach’s alpha was .88.

**Identification with movie characters.** Identification was measured with 8 items proposed by Cohen (2001). Participants were asked to consider their level of identification with the (male and female) main character by indicating their level of agreement with statements such as “I understand the reasons why he/she does what he/she does” and “I can feel the emotions that he/she portrayed”. They gave their response by choosing options ranging from 1 (“completely disagree”) to 7 (“completely agree”). Cronbach’s alphas were .84 (male main character) and .87 (female main character).

**Film appreciation.** Film appreciation was measured with 8 items (e.g. , “I thought the film was interesting”) on a 4-point scale ranging from “definitely yes” to “definitely not” (\( \alpha = .75 \)) (Engels, et al., 2009).

**DRD4 genotyping.** Genotyping of the DRD4 48bp variable number of tandem repeat (VNTR) in exon 3 was performed by simple sequence length analysis. PCR was on 10 ng genomic DNA using 0.5 \( \mu \)M fluorescently labeled forward primer (VIC-5’-GCGACTACGTGCTACTCG-3’) and reverse primer.
Table 2. Independent samples t-test on all study variables across conditions.

Note. ** p < .01

Table 3. Correlations between DRD4 genotype, weekly smoking, daily smoking, and craving.

Randomization and manipulation checks

To examine whether randomization over the two conditions was successful, we conducted an independent samples t-test and found no clear differences between conditions concerning gender, age, baseline craving level (p = .78), the CO-level, the average number of cigarettes smoked per day and per week. These findings indicated that the randomisation was successful. Further, in the experimental condition, 106% (96.6%) of the participants accurately recalled having seen the two main characters smoking. In the control condition, six (10.3%) of the participants mistakenly recalled having seen one of the two characters smoking.

(5’-AGGACCTCATGGCCTTG-3’), 1x GC buffer I TaKaRa (Westburg, Leusden, The Netherlands), 0.4 mM dNTPs TaKaRa (Westburg, Leusden, The Netherlands), 1M Betaine and 0.05 U TaKaRa LA Taq (Westburg, Leusden, The Netherlands). The cycling conditions for the polymerase chain reaction started with 1 min at 94°C, followed by 35 cycles of 30 sec at 94°C, 30 sec at the optimized annealing temperature (58°C), and 1 min at 72°C, then followed by an extra 5 min at 72°C. The product of the amplification was diluted 1:1 in H2O. Subsequent determination of the length of the alleles was performed by direct analysis on an automated capillary sequencer (ABI3730, Applied Biosystems, Nieuwerkerk a/d Ijssel, The Netherlands) using standard conditions. Results were analyzed with genemapper version 4.0 (Applied Biosystems, Nieuwerkerk a/d Ijssel, The Netherlands). Hardy-Weinberg equilibrium proportions were estimated, and no deviations from these proportions were found (p = .98). The DRD4 genotype was dummy-coded into two categories: 7-repeat allele carriers, carrying at least one long (7-repeat or 8-repeat) allele, and non-carriers, who were homozygous for the short (no 7-repeat or 8-repeat) allele (Larsen, et al., 2010; Lichter et al., 1993).

Results

Descriptive statistics

Smokers carrying the short (67.9%; 36 in the smoking, 40 in the non-smoking condition) and long (32.1%; 20 in the smoking, 16 in the non-smoking condition) allele were equally distributed over conditions, X² = .66, p = .42. Data of 4 participants could not be considered in the analyses due to the missing genotype data. The means for craving across DRD4 genotype groups are presented in Table 1 and the means for all study variables across conditions are presented in Table 2. DRD4 genotype did not correlate with any smoking-related variables (Table 3).
**Effects of exposure to movie smoking on craving**

A repeated measures ANOVA was performed to investigate the effect of smoking portrayal in movies and the DRD4 genotype on craving. The independent variables were the experimental condition (movie with smoking scenes vs. movie without any smoking scenes) and DRD4 genotype (carriers vs. non-carriers of the DRD4 7-repeat allele). The dependent variable was the level of craving (assessed at four points: before, after and twice during the movie). Due to a variety of different types of smokers in this sample, we controlled for weekly smoking in the analysis. The results did not indicate any evidence for the critical three-way interaction between condition, the DRD4 VNTR polymorphism and time (Wilks’ Lambda = .96, F (3,104) = 1.56, p = .20, η² = .04). There was also no evidence of a main effect for time (Wilks’ Lambda = .93, F (3,104) = 2.62, p = .06, η² = .07) or of a main effect comparing the two movie conditions (Wilks’ Lambda = .98, F (3,104) = .88, p = .45, η² = .03). The results indicated evidence of a main effect of the DRD4 VNTR polymorphism (Wilks’ Lambda = .92, F (3,104) = 3.16, p = .03, η² = .08), with smokers carrying the long (7-repeat) allele showing higher levels of craving compared with smokers carrying the short allele. Including gender as covariate did not affect the findings. Post-hoc, we conducted several ANCOVAs to explore possible interaction effects with smoking-related (i.e. weekly and daily smoking) and movie-related variables (i.e. transportation, identification with the characters, and film appreciation). These analyses did not indicate any evidence of interaction effects.

**Discussion**

The aim of the current study was to examine whether smoking cues in movies evoke craving and whether smokers carrying the DRD4 7-repeat allele have a higher risk for experiencing craving when exposed to smoking cues in movies. In an experimental design, smokers were either exposed to a movie with or without smoking characters, and craving was assessed at four time points.

The current study presents an extension of a previous study with a similar design (Lochbuehler, et al., 2009). In the previous study, smokers were also exposed to a movie with or without smoking content, but craving was assessed only once, after the movie. This design did not exclude the possibility that craving could have appeared at the moment of cue exposure and decreased after cue exposure. As craving is assessed immediately after cue exposure in traditional cue-reactivity studies, we assessed craving four times to enable a measure of craving more directly after cue exposure and to gain insight in the time course of craving while watching a movie. However, the results showed no effects of smoking cues in movies on craving. It should be emphasized that the current study replicates the previous findings; both studies found no evidence of a main effect of smoking cues in movies on craving.

A secondary aim of the present study was to investigate the role of the DRD4 genotype on the relationship between movie smoking exposure and craving. Based on a previous cue-reactivity study, which revealed that smokers carrying the DRD4 7-repeat allele reported an increase in craving after exposure to smoking cues compared to non-carriers (Hutchison, et al., 2002), we expected carriers of the DRD4 7-repeat allele to develop higher levels of craving than non-carriers when exposed to a movie with smoking cues. However, our results did not indicate any evidence of a condition by genotype interaction. There are several possible explanations for this.

First, dynamic smoking cues embedded in movies differ substantially in nature from cues used in other cue-reactivity paradigms (e.g. pictorial or in-vivo cues). As a detail embedded in a narrative, smoking cues in movies are less explicit, more subtle and inserted into a larger context. An on-going story in a movie adds another dimension to the pure smoking cues. Possibly, smokers’ response is influenced by contextual factors, which could overrule the effect of the smoking cues. Support for the assumption that context might play a role can be found in research on the effects of anti-tobacco PSA’s. Cue-reactivity studies using anti-tobacco PSAs showed that smokers’ craving was affected by the presence of smoking cues and the strength of arguments in anti-smoking PSAs (Kang, Cappella, Strasser, & Lerman, 2009; Lee, Cappella, Lerman, & Strasser, 2011). However, it is important to note that smokers do, in fact, focus their attention on smoking cues in movies so it cannot be claimed that the context overtly distracts the viewer from smoking cues (Lochbuehler, Voogd, Scholte, & Engels, 2011). Also, demand characteristics might play a more profound role in other cue-reactivity studies, as smokers are generally aware of the aim of the study, which was not the case in the current study.

Second, the unavailability of cigarettes and the lack of opportunity to smoke could play an important role in these specific experimental paradigms.
However, to test whether the activity of watching a movie or the unavailability of cigarettes causes this effect requires further research.

The strength of the current study includes the replication and extension of two previous studies (Hutchison et al., 2002; Lochbuehler et al., 2009). Given that our findings do not support our a priori hypotheses and are based on a small sample size, they have to be treated with caution. With regard to the lack of main effect of condition and the lack of genotype by condition interaction, our study exceeded the number of participants of the study by Hutchison (2002) and should therefore have been appropriately powered to detect a similar effect. However, besides the discussed theoretical explanations, the lack of findings in the current study might be due to insufficient power. Not too much weight should be put on the effect of the DRD4 genotype, as the statistical evidence was weak by the standards of genetic association studies (Munafò, 2009). Moreover, it is not clear how clinically significant this effect is, considering the short-term differences in craving by genotype. Inconsistencies in effects between the current study and the study by Hutchison (2002) support the view that genetic studies with small sample sizes tend to give unreliable results (Munafò, 2009). This is not too surprising, knowing of plausible genetic effect sizes for single variants (Ware & Munafò, 2012).

In conclusion, the current study did not find an effect for smoking cues in movies on craving among smokers. It was found that smokers carrying the DRD4 7-repeat allele showed higher levels of craving than non-carriers, independent of smoking cues in movies and have the option to smoke, it is possible that carriers of the risk allele are particularly at risk and give in more to their needs than non-carriers.

A third explanation for the lack of findings might be found in heaviness of smoking. Compared to the sample in the study by Hutchison et al. (2002), which consisted of smokers smoking more than 10 cigarettes per day, our sample varied strongly with regard to smoking level. In the current sample, weekly smoking ranged from 10 - 160 cigarettes and only 36 of our participants smoked more than 10 cigarettes per day. Possibly, the expected effect can only be found in heavy smokers. However, our results showed no evidence of interaction effects with smoking level, although this analysis was limited by low statistical power.

Our results showed a main effect for DRD4 genotype on craving, indicating that smokers carrying the DRD4 7-repeat allele reported higher levels of craving than non-carriers. As this effect was independent of smoking cue exposure, this finding indicates that not the smoking cues in the movie, but the context of watching a movie itself might cause this effect. Smokers might be used to smoking during the activity of watching movies, causing this association with smoking. It could be the case that the activity of watching a movie instigates contextual memory associations with smoking among DRD4 7-repeat allele carriers. With repeated smoking, not only cues that accompany smoking behaviour, but also environments in which smoking occurs become associated with smoking. Therefore, these environments can gain associative properties and evoke craving (Conklin, 2006; Conklin, Perkins, Robin, McClellan, & Salkeld, 2010; Conklin et al., 2008). However, it remains unanswered why this effect only appears among carriers with the DRD4 risk allele. Second, again the lack of opportunity to smoke needs to be taken into account. In the context of unavailability of a cigarette, smokers carrying the DRD4 7-repeat allele develop higher levels of craving than non-carriers.
Chapter 6
Attentional bias in smokers: Exposure to dynamic smoking cues in contemporary movies

Published as:
Abstract

Introduction: Research has shown that smokers have an attentional bias for pictorial smoking cues. The objective of the present study was to examine whether smokers also have an attentional bias for dynamic smoking cues in contemporary movies and therefore fixate more quickly, more often and for longer periods of time on dynamic smoking cues than non-smokers. By drawing upon established methods for assessing attentional biases for pictorial cues, we aimed to develop a new method for assessing attentional biases for dynamic smoking cues.

Method: We examined smokers’ and non-smokers’ eye movements while watching a movie clip by using eye-tracking technology. The sample consisted of 16 smoking and 17 non-smoking university students.

Results: Our results confirm the results of traditional pictorial attentional bias research. Smokers initially directed their gaze more quickly towards smoking-related cues ($p = .01$), focusing on them more often ($p = .05$) and for a longer duration ($p = .01$) compared with non-smokers.

Discussion: Thus, smoking cues in movies directly affect the attention of smokers. These findings indicate that the effects of dynamic smoking cues, in addition to other environmental smoking cues, need to be taken into account in smoking cessation therapies in order to increase successful smoking cessation and to prevent relapses.

Introduction

Tobacco use is still prevalent in movies (Sargent & Heatherton, 2009; Titus, et al., 2009) and given that young adults spend much of their spare time watching television and videos/DVDs (Roberts, 2000; Roberts, et al., 2005; Sargent, et al., 2001), young adults are frequently exposed to dynamic smoking cues. The prevalence of these cues made us question whether smokers are more likely to notice smoking cues in movies than non-smokers. Possibly, attentional biases for dynamic smoking cues could either directly (Shmueli, et al., 2010), or indirectly, through mediating factors such as craving (Lochbuehler, et al., 2009; Sargent, et al., 2009), affect smokers to light a cigarette during or immediately after watching a movie.

Biases in selective attention play an important role in the development and maintenance of drug-taking behaviour as well as in the resistance to abstinence and/or occurrence of relapse. The role of attentional biases in drug-taking behaviour has been theorized by Robinson and Berridge (1993; Robinson & Berridge, 2001, 2008). According to their incentive sensitization theory, through classical conditioning, the drug-related cue itself is able to produce a conditioned dopamine response. As a result, the drug-related cue acquires an ‘incentive salience’, which means that it “grabs attention, becomes attractive and ‘wanted’ and thus guides behaviour to the incentive” (Robinson & Berridge, 1993, p. 261).

Regarding attention to smoking cues, research has indicated that smokers have an attentional bias for smoking-related pictorial cues (Field & Cox, 2008). Both indirect (Stroop tasks and visual probe tasks) and direct measures, such as eye movement paradigms, have been used to assess attentional biases using these cues. In smoking Stroop tasks, smoking-related and neutral words are presented in different colours and participants are asked to name the colour of the word while ignoring its meaning. Smokers were slower to name the colours of smoking-related words than those of neutral words (Field, Rush, Cole, & Goudie, 2007; Munafò, Mogg, Roberts, Bradley, & Murphy, 2003).

Likewise, in visual probe tasks a pair of images is presented simultaneously, one image being smoking-related and the other unrelated to smoking. After a certain exposure time, the images disappear and a probe appears in the location of one of them. Participants are requested to indicate the location of the probe as quickly as possible by pressing one of two possible buttons.
Smokers, but not non-smokers, were faster in responding to a probe that appeared in the spot of smoking-related cues compared with neutral cues (Bradley, et al., 2004; Ehrman, et al., 2002; Mogg, et al., 2003). In visual probe tasks, the exposure duration has been manipulated in order to investigate different aspects of attention (initial orienting vs. maintenance of attention) (Field & Cox, 2008). The direction of the initial shift of the gaze (when two or more pictures are presented simultaneously) can be examined by presenting pictures briefly. A longer stimulus exposure provides the possibility to make multiple shifts in attention between the two stimuli which allows investigating the maintenance of attention (for a more detailed overview see Field & Cox, 2008). Several studies have revealed that smokers have a bias in the maintenance of attention to smoking-related cues (Bradley, et al., 2004; Bradley, et al., 2003; Field, et al., 2004b; Mogg, et al., 2003) and in initial orienting to smoking-related cues (Bradley, et al., 2004; Bradley, et al., 2003; Field, Mogg, & Bradley, 2006b).

In direct measures, the duration of eye movement fixations was monitored while participants viewed the pictures presented in a visual probe task. Smokers, but not non-smokers, maintained their gaze longer on smoking-related cues than on neutral cues (Field, et al., 2004a; Mogg, et al., 2003). Moreover, smokers were faster to detect probes that replaced smoking-related pictures than control pictures (Field, et al., 2004a; Mogg, et al., 2003).

While the existence of an attentional bias for pictorial smoking cues has been established, no study has assessed whether smokers also show an attentional bias for dynamic smoking cues. The lack of research in assessing dynamic cues provides an opening for the development of new methods capable of assessing attentional biases for dynamic smoking cues. Research on the effect of dynamic smoking cues is needed, not only because of the prevalence of dynamic smoking cues, but also because they are inherently different from pictorial cues. Moreover, it is still unclear whether the theory of attentional bias can be effectively transferred to dynamic cues.

The aim of the present study, therefore, is to investigate smokers’ and non-smokers’ attention while watching a movie with smoking cues through measuring their eye movements. To examine different aspects of attention we assessed the number of fixations on smoking cues, the duration of fixations and the latency of fixations using eye movement technology. With this new approach, eye-tracking combined with dynamic smoking cues, we measured the overall amount of time that the gaze was directed to the smoking-related cues over the course of the movie clip, which should indicate the maintenance of attention (Field & Cox, 2008). The latency of fixation was assessed by measuring the time interval between cue appearance and cue fixation, which reflects the initial orienting of attention (Field & Cox, 2008). We predicted that, compared with non-smokers, smokers would be more likely to direct their gaze more often, more quickly and for longer periods towards smoking-related cues when they appear on screen.

Method

Participants

A total of 33 students (16 smokers and 17 non-smokers) from the Radboud University Nijmegen, The Netherlands participated in the study. The group of 16 smokers consisted of nine men and seven women, ranging in age from 16 to 49 (M = 23.81, SD = 10.14). On average, they had started smoking at the age of 12.9 years (SD = 3.28) and smoked 89.50 cigarettes per week (SD = 61.9, range 7-250). On average, they had smoked 74.0 min (SD = 33.73, range 5-120) prior to the experiment. The non-smoking group (three men and 14 women) had a mean age of 22.24 years (SD = 8.87, range 18-55). They reported never having smoked. All participants had visual acuity within normal limits. They participated for course credits or received €20 for their participation.

The protocols for the study were approved by the Ethical Committee of the Faculty of Social Sciences, Radboud University Nijmegen, The Netherlands.

Material

The stimulus material consisted of the first 43 minutes of the movie Bridget Jones Diary (2003). This segment of the movie contained 14 smoking scenes (lasting in total 4 minutes and 19 seconds). The main female character used tobacco in 10 smoking scenes (3 minutes and 7 seconds) and one of the main male characters smoked in two scenes (36 seconds). In addition, other characters smoked in five scenes (1 minute and 16 seconds). One smoking scene consisted of several smoking incidents which are defined by the amount of time a smoking-related cue was portrayed in the movie. Smoking-related
they would watch a segment of a movie. Before watching the movie segment, the participants were requested to complete a questionnaire assessing several distracter items, such as questions concerning the actors, the lifestyle of the actors and their own lifestyle (including the last time they had smoked). Then, the participants were seated in a comfortable chair, 60cm from the eye-tracker. They were instructed to find a comfortable position in which they could watch the movie in a relaxed way without moving. Following calibration, the lights were dimmed and the experimenter left the room. In the questionnaire given after the movie, the participants were asked about their smoking habits. None of the participants guessed the actual aim of the study.

Afterwards, the experimenter gave a debriefing before paying the participant.

Coding procedures and statistical analysis

Gaze data was measured at 60Hz and the movie was portrayed with 25 fps (frames per second). For the analyses and coding procedure two programs that were developed in-house were used. The first program presents the movie in such a manner that each frame lasts exactly 40 ms so that the frequency of each frame remains constant over time. Moreover, the program links each frame separately marked to Clearview, which contains the frame number and the description of the scene. The second program uses the frames in such a manner that the samples of the gaze data are projected on the movie. Fifty-eight smoking incidents (lasting a total of 4 minutes and 19 seconds - 5432 frames) were coded for each participant. Figure 1 shows a still used for coding. For this illustration, the fixation of a smoker and a non-smoker are superimposed onto a single frame.

Figure 1. A smokers’ and non-smokers’ fixation on a random still frame. The fixation of a smoker is marked in red and that of a non-smoker is in green.
Two raters independently coded participants’ data. The intra-class correlation coefficient was .98 for the number of fixations measures, .93 for the duration measures and .96 for the measures of the initial fixations. One of the two coders was blind to the smoking status of the participant, whereas the second coder was blind for half of the data. As the intra-class correlations were high, we abstained from coding the data by a third coder. For each smoking incident, we defined the time of cue appearance, the length of cue appearance and the area of interest. The area of interest was restricted to the display of a smoking-related cue, which means that a fixation only took place if at least one of the participants’ eyes overlapped with the display of a smoking-related cue or if the eyes enclosed the smoking-related cue. Each frame was coded as fixation of the cue, non-fixation of the cue or missing data. Missing data included frames of either participants’ blink or saccadic shift. If a cue appeared in the same spot a participant focused on after a scene change, this was scored only if the participant focused on this spot longer than 150 ms (Field & Cox, 2008; Theeuwes, 2005).

The design had three dependent variables: the number of fixations on the smoking cues, the latency of initial fixations on the smoking cues and the duration of initial fixation (maintenance of gaze/gaze duration) (Field, Eastwood, Bradley, & Mogg, 2006a; Mogg, et al., 2003). The number of fixations on the smoking cue was determined by counting the times the participant fixated on a smoking cue. To examine the initial fixations on the cue, the interval between cue appearance and the participants’ first time to fixate on the cue within a smoking incident was measured. Maintenance of gaze was defined as the overall amount of time that the gaze was directed to the smoking cues. t-tests were used to test group differences in the number of fixations on the smoking cues, the total fixation time on the smoking cues and the latency of initial fixations.

Results

Number of fixations

The total number of fixations for each participant was expressed by the sum of the number of fixations on each smoking incident. An independent samples t-test was conducted to evaluate whether smokers directed their gaze more often to smoking-related cues than non-smokers. Overall, the results showed a significant difference in the number of fixations between smokers and non-smokers, $t(31) = 2.00, p = .05, \eta^2 = 0.11$, such that smokers ($M = 36.34, SD = 10.42$) focused more often on smoking-related cues than non-smokers ($M = 28.00, SD = 13.26$). The average number of fixations on smoking-related cues of smokers and non-smokers are shown in Figure 2.

![Figure 2: Average number of fixations (error bars depict 95% confidence intervals of the mean) of smoking-related cues in smokers (n = 16) and non-smokers (n = 17) (means are significantly different).](image-url)

Duration of fixation

A relative duration score was calculated for each smoking incident by expressing the time of cue fixation (in ms) as a proportion of the total eye data in this incident (in ms). The total eye data were calculated by means of deducting the missing eye data from the length of the cue exposure. On average, smokers ($M = 3.13, SD = .45$) directed their gaze longer to smoking-related cues than non-smokers ($M = 1.96, SD = .96$). This difference was significant $t(31) = 2.8, p < .05, \eta^2 = .20$. 
Latency of initial fixations

To test our hypothesis that smokers direct their gaze more quickly towards smoking-related cues than non-smokers, the time interval (in ms) between cue appearance and cue fixation for each smoking incident was measured. An independent samples t-test conducted on the latency of cue fixation revealed that smokers ($M = 3350.65, SD = 604.49$) directed their gaze more quickly towards smoking-related cues than non-smokers ($M = 4194.44, SD = 1127.35$), $t(31) = -2.66, p < .05, \eta^2 = .19$. Smokers directed their gaze to the cue on average 3351ms after the cue appeared, non-smokers after 4194ms. The average latency of initial fixations (in ms) towards smoking-related cues of smokers and non-smokers are shown in Figure 3.

As the two groups differed with regard to sex ($p = .02$), an analysis of covariance (ANCOVA) on the three dependent variables (number of fixations, gaze duration and latency of initial fixations) with the smoking status of the participant as independent variable (factor) and sex as covariate was conducted to control for these differences. No differences in the results were found for the number of fixations [condition: $F(1, 33) = 4.77, p = .04$; sex: $F(1, 33) = 48, p = .50$; condition x sex: $F(1, 33) = .75, p = .39$], the gaze duration [condition: $F(1, 33) = 5.03, p = .03$; sex: $F(1, 33) = .02, p = .87$; condition x sex: $F(1, 33) = .003, p = .96$] and the latency of initial fixations [condition: $F(1, 33) = 5.63, p = .03$; sex: $F(1, 33) = .26, p = .62$; condition x sex: $F(1, 33) = .40, p = .53$]. Linear regressions with time as predictor and the number, duration and latency of fixation as dependent variables did not show a significant decrease or increase over time for smokers and non-smokers. Each of the three correlations between the three dependent variables and the number of cigarettes smoked per day and week were not significant.

Discussion

The present study was designed to examine whether smokers have an attentional bias for smoking cues in contemporary movies and to test whether the theory of attentional bias can be applied to dynamic cues. Using eye-tracking technology to assess smokers’ and non-smokers’ attention while watching a movie, the results revealed significant effects for all of the three tested aspects of attention. Smokers not only initially directed their gaze more quickly towards smoking-related cues, but also focused more often and maintained their gaze longer on smoking-related cues when compared with non-smokers. These results indicate the complexity of the construct of the attentional bias and the need to assess its different aspects. The tendency of smokers to direct their initial gaze more quickly to the cue when it appears indicates that smoking cues in movies are capable of capturing smokers’ attention. The difference in gaze duration between smokers and non-smokers reflects the difficulties smokers have in removing their attention from the smoking cue and the ability of the cues to hold smokers’ attention (Field & Cox, 2008).

Research using both indirect measures like the smoking Stroop task or the visual probe task, and direct measures, such as eye movement paradigms, have identified an attentional bias for pictorial smoking cues among smokers (Bradley, et al., 2004; Bradley, et al., 2003; Field, et al., 2004b; Field, et al., 2007; Mogg, et al., 2003). Our results extend the studies using pictures to investigate the attentional bias in dynamic cues and confirm the results of traditional attentional bias research. In our paradigm, dynamic cues are embedded in context, which could result in distraction from the smoking cues. However, even if cues are presented in a less explicit way, with variations in length and context of cue exposure, dynamic smoking cues have the ability to capture...
and hold smokers’ attention. The fact that we found evidence for all measures underscores the theory on attentional biases.

The additional value of attentional bias research on dynamic cues presented in contemporary movies is twofold. First, as smoking cues in movies and in other types of media like soaps and TV series are omnipresent, smokers are often automatically exposed to smoking cues in movies. Smoking cues in movies, like other environmental smoking cues, capture and hold smokers’ attention and might therefore also increase their craving or affect their smoking behaviour directly (Shmueli, et al., 2010). Results on the association between attentional bias and craving have been mixed (Attwood, O’Sullivan, Leonardis, Mackintosh, & Munafò, 2008; Field, Duka, Tyler, & Schoenmakers, 2009a; Field, et al., 2009b). A recent meta-analysis of over 60 studies on the relationship between attentional bias and craving revealed a significant but weak association between attentional bias and craving (Field, et al., 2009b). Other studies reported no significant associations between attentional bias and craving (Field, et al., 2009a), or suggested that the effects found were moderated by gender (Attwood, et al., 2008). However, these cross-sectional findings do not imply a causal relationship between attentional bias and craving and can therefore not be interpreted as such. Craving could for instance also lead to increased attention to substance cues (Franken, 2003), providing evidence for the reversed pathway. In future studies it might be interesting to scrutinize the relationship between attentional bias and smoking behaviour in more detail, and to test whether this relationship is mediated by craving. Other possible processes such as priming effects should also be considered.

Second, in addition to indirect assessments such as Stroop tasks and visual probe tasks, previous studies have used eye movement measures during pictorial visual probe tasks to assess the attentional bias (Bradley, et al., 2004; Bradley, et al., 2003; Field, et al., 2004b; Field, et al., 2007; Mogg, et al., 2003). Direct measures, that are eye-tracking paradigms, are considered a preferred method to investigate attentional biases because they provide a direct measure of attention and do not infer attentional processes on the basis of reaction times in comparison to indirect measures (Field, et al., 2009b). Our study is the first study to combine direct measures (eye-tracking technology) with dynamic cues in extended and long three-dimensional stimuli. In comparison to pictorial cues, direct measurements of the attentional bias of dynamic cues through eye-tracking technology increases their ecological validity, because the cues which are used are not created but already exist and participants might be confronted with those cues in everyday life. Also, research on dynamic cues carries with it fewer demand characteristics, because participants do not know the aim of the study and the cues presented are more subtle; research with pictorial cues is often characterized by an explicit and strong focus on the presented cues. A considerable advantage in using dynamic cues can be seen in the opportunity to expose participants to a variety of smoking cues in different contexts as well as to cues that vary in length of cue presentation. As mentioned before, the attentional bias is composed of different aspects, all of which need to be assessed to achieve a complete overview of the construct. The investigation of different aspects of the attentional bias enables us to accumulate more valid information about it, which in turn helps us to better understand the theory of cue reactivity and the role of the attentional bias in the process of addiction.

The use of eye-tracking technology to measure dynamic cues in other disciplines is rare. This conceptualization has been used in a study (Klin, Jones, Schultz, Volkmar, & Cohen, 2002) to investigate gaze patterns of individuals with autism, but, to our knowledge, not in other psychopathologies. Our study shows the possibly great value of this conceptualization by which to examine eye movements of dynamic cues for other research areas as well. Taking into account the important role of attention in both internalizing (e.g. anxiety disorders) and externalizing (e.g. addiction to alcohol or drugs) psychopathologies, this method can be applied and used to answer unresolved questions about underlying mechanisms involving attention.

Several limitations of this study need to be acknowledged. First, we did not include any control cues (e.g. food cues) with which the attention to smoking-related cues can be compared. Compared with pictorial attentional bias studies, the inclusion of appropriate matching control cues seems practically impossible to realize in a design using a long segment of dynamic cues. Still, the possibility that smokers are generally susceptible to appetitive cues exists and needs to be mentioned. Second, smokers and non-smokers differed according to their sex. Due to this difference a potential bias could be present; however, after controlling for sex in the analyses, the results remained significant. Another limitation of our study is that we did not examine the link between attentional bias and craving. Our results do not provide a conclusion on the value of the attentional bias on smoking-related emotions and behaviour. As mentioned before, Field et al. (2009b) found in a meta-analysis an association between attentional bias and craving. Most of those studies
used indirect measures to investigate the attentional bias. To better understand the role of attentional bias in addiction, it is necessary to investigate whether this association also exists by exposure to dynamic cues. As this is the first study investigating attentional biases of dynamic cues, the main aim of the study was to examine the existence of attentional biases among smokers. Further research is needed to test whether certain smoking scenes are responsible for the differences found. Future studies should acknowledge this issue and include certain factors such as the type of smoking-related cue, the length of display or the nature of the scene. For this purpose, future studies could include several shorter scenes of different movies as well.

In conclusion, smokers fixated more often, more quickly and for a longer duration on smoking-related cues in a contemporary 43-minute movie clip compared with non-smokers. Potentially, these findings are of value for the conceptualization of interventions to reduce or to quit smoking. They suggest that in order to increase the likelihood of successful smoking cessation, therapies need to take the effects of dynamic smoking cues into account, in addition to other environmental smoking cues. Because of an attentional bias, former smokers who are attempting to quit might be at high risk of relapse when exposed to smoking cues in movies.
Chapter 7
Discussion
Chapter 5: Effects of smoking cues in movies on smokers’ craving during smoking movie exposure and the role of DRD4 VNTR polymorphism

Dynamic smoking cues in movies do not affect smokers’ craving while watching a movie and this is not modified by DRD4 genotype. However, smokers carrying the DRD4 7-repeat allele develop higher levels of craving in the context of watching a movie than non-carriers (independent of smoking cue exposure).

Chapter 6: Smokers attention to dynamic smoking cues in movies

Dynamic smoking cues in movies directly affect smokers’ attention. By using an eye-tracking paradigm, we discovered that when exposed to a movie with smoking cues, smokers initially directed their gaze more quickly towards smoking-related cues, focusing on them more often and for a longer duration compared with non-smokers.

Reflections on the main findings

In the following sections, we first discuss our results separately for each investigated construct in the light of previous findings. We will then draw a general conclusion on the findings of all conducted studies. The discussion of the findings on the role of the DRD4 polymorphism is not repeated here and can be found in the discussion section of Chapter 5.

Summary of the main findings

Chapter 2: Effects of smoking cues in movies on smokers’ immediate smoking behaviour

Dynamic smoking cues in movies have an effect on the number of cigarettes smoked while watching a movie, but only when smokers show lower levels of transportation. The results showed a significant interaction effect between movie condition and transportation on immediate smoking behaviour, indicating that smokers who were less transported smoked significantly more cigarettes when they were exposed to smoking characters compared with non-smoking characters.

Chapter 3: Effects of smoking cues in movies on adolescent smokers’ immediate smoking behaviour

No evidence was found for the effects of smoking cues in movies on immediate smoking behaviour in adolescent smokers. This association was not affected by several smoking- and movie-related variables.

Chapter 4: Effects of smoking cues in movies on smokers’ craving after smoking movie exposure

Dynamic smoking cues in movies do not evoke urges to smoke among smokers after watching a movie. No differences in craving were found between smokers who were exposed to smoking characters and smokers who were exposed to non-smoking characters.

Chapter 5: Effects of smoking cues in movies on smokers’ craving during smoking movie exposure and the role of DRD4 VNTR polymorphism

Dynamic smoking cues in movies do not affect smokers’ craving while watching a movie and this is not modified by DRD4 genotype. However, smokers carrying the DRD4 7-repeat allele develop higher levels of craving in the context of watching a movie than non-carriers (independent of smoking cue exposure).

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As mentioned before, studies on the effects of smoking cues in movies on smoking behaviour in adult smokers revealed mixed results, dependent on the design of the study (including the length of movie exposure and the assessment of smoking behaviour during or after exposure to smoking characters). One study found that smokers who were exposed to an 8-minute movie clip with smoking cues were more likely to smoke in a 10-minute recess after watching the clip than those exposed to the clip without smoking cues (Shmueli, et al., 2010). A second study found no effect of movie condition on the frequency and quantity of cigarettes smoked during a movie (Harakeh, et al., 2010). When interpreting these findings, it might be appropriate to compare the findings of studies that assessed smoking behaviour while watching a movie and studies that assessed smoking behaviour after exposure. The study by Shmueli et al. (2010) using a set-up similar to traditional cue-reactivity studies, assessed the effects of the exposure to smoking cues after exposure.

Cue-reactivity research investigating the effects on actual smoking behaviour (including the number of cigarettes smoked, the latency to smoke, puff duration and frequency) has been rare. One in-vivo cue-reactivity study has shown that nicotine-dependent individuals demonstrated increased use and quicker latency to smoking in a 20-minute recess after exposure to smoking-related cues (Payne, et al., 1991). When smokers get the opportunity to smoke during the exposure to movie smoking (Harakeh, et al., 2010; study presented in Chapter 3), no main effect on immediate smoking behaviour was found. We found an effect of smoking cues in movies on smokers who show lower levels of transportation. Thus, it is possible that certain types of smokers or situational movie-related variables put smokers at risk when being exposed to smoking cues in movies. However, as the interaction effect with transportation has not yet been replicated, it should be treated with caution. Although a recent theoretical review on transportation and smoking portrayal in movies suggests that individuals who are more transported in a narrative show greater attitude, belief and behaviour change, this review unfortunately mentions no empirical evidence for the role of transportation on the effects of smoking portrayal in movies (Green & Clark, in press). Also, in our studies presented in Chapters 3 and 5, no evidence for the influence of transportation was found.

Although the results of movie smoking in a lab-based setting are mixed, one could argue that such cues might have an impact on real world smoking behaviour. The study by Shmueli et al. (2010) also revealed that smokers in the experimental condition were more likely to have smoked within 30 minutes after leaving the laboratory. However, in our cue-reactivity study assessing the impact of smoking cues in movies on craving (Chapter 4), we also assessed smokers’ smoking behaviour one hour after the experiment. No differences in smoking behaviour were found between smokers who were exposed to smoking characters compared to smokers who were exposed to non-smoking characters. The lack of difference in smoking behaviour between conditions could be explained simply by the lack of difference in craving between conditions. However, there was a positive relation between craving after movie smoking exposure and smoking behaviour within the hour after leaving the laboratory.

In an adolescent sample, ages 16-18, no effects of smoking cues in movies on actual smoking behaviour was found (Chapter 3). As far as we know, our study has been the first to investigate the influence of smoking cues in movies on adolescents’ smoking behaviour. Moreover, no cue-reactivity study among adolescent smokers has examined the effect of environmental smoking cues - using cue presentation modes other than movie smoking - on smoking behaviour. Cue-reactivity studies among adolescent smokers are rare and have focussed on craving and physiological responses as outcome measures (Upadhyaya, Drobes, & Thomas, 2004; Upadhyaya, Drobes, & Wang, 2006). Therefore, without replication, it remains difficult to generalize our findings and to compare them with other empirical work. More cue-reactivity research in this age group is unquestionably needed.

Explanations for the variant results between adolescent and adult smokers can, perhaps, be found within the assumptions of the Dual process model (Wiers, et al., 2007a). The Dual process model (Wiers, et al., 2007a), which is used to explain the development of addiction, is divided into an appetitive, approach-oriented system and a regulatory executive system. Repeated cigarette smoking causes a neural sensitization in the reward systems of the brain, leading to a stronger dopamine release every time one smokes. Further,
through classical conditioning, cues that are often paired with smoking become associated with its pleasurable outcome. This leads to an attribution of incentive salience to the perception and mental representation of those cues. As a result, cues become attractive, desired and capable of capturing attention automatically, which may foster automatic approach tendencies (e.g., Franken, 2003; Robinson & Berridge, 1993). The model proposes that the automatic link between cues and behaviour is influenced by the ability and motivation to control (Wiers, et al., 2007a). With regard to the appetitive, approach-oriented system, not enough is known about the timeline of the development of incentive salience. It is still unclear how many pairings are needed to evoke sensitization and cue-induced appetitive response tendencies. It is possible that smokers with a short smoking history, such as the adolescent smokers in our sample, have formed first associations, but are not yet completely susceptible to environmental smoking cues. This assumption is supported by the low levels of nicotine dependence measures, which indicate that the adolescents in our sample might still be in the earlier stages of the development of nicotine dependence. Therefore, it is possible that the reactivity to environmental smoking cues is not yet fully developed. Or in other words, adolescent smokers may not yet be sufficiently sensitized to be influenced by visual smoking cues.

With regard to the regulatory executive system, Dual process models emphasize the role of ability and motivation to control in regulating appetitive response tendencies (Wiers, et al., 2007a). There are indications that adolescents might have more difficulties regulating appetitive response tendencies, as their regulatory executive system has not yet been fully developed (Steinberg, 2007; Wiers, et al., 2007a). The opportunity to smoke might play an important role, especially among adolescent smokers, who might not be permitted to smoke in all contexts, such as at home and on school grounds. Despite low craving levels due to smoking a cigarette before watching the movie as a first part of the experiment, it seems that if adolescent smokers get the opportunity to smoke, they do. In the previous study with a similar set-up among adults, participants smoked on average the same number of cigarettes during the movie as the adolescents (Lochbuehler, et al., 2010), but adult smokers’ baseline craving levels were higher due to deprivation from smoking. Adolescents smoked the same amount as adults did, even though they were not deprived. And contrary to adults, adolescents’ smoking behaviour in the experimental condition did not seem to be influenced by movie smoking exposure in any way.

The two studies also differ with regard to the way we controlled for baseline craving levels. In the study among adolescent smokers, participants were not asked to stay abstinent, but in fact were asked to smoke a cigarette just prior to testing. It should be noted that although this method has previously been used in other cue-reactivity studies (e.g., Carpenter, et al., 2009; Drobes & Tiffany, 1997) due to the benefits of equalizing all participants as to the time the last cigarette had been smoked (Carpenter, et al., 2009), this might have influenced participants’ background craving and diminished their cue-reactivity. Cue-reactivity research is usually conducted among temporarily deprived smokers (Ferguson & Shiffman, 2009) and deprivation prior to cue exposure has been shown to result in larger craving effects (Carter, et al., 2006). It may be difficult to assess cue-induced craving in satiated adolescent smokers who might not have the same smoking history and developed the same smoking habits as adult smokers. Also, it is unclear whether the effects of background craving and cue-induced craving are additive in adolescent smokers and if so, whether the design we used would allow for finding such an effect (see also section on study limitations). Thus, it cannot be ruled out that a different experimental set-up in terms of satiation/deprivation would have influenced the response to cues and the between-cue variability of smoking behaviour and therefore led to the expected differences between the two experimental groups in smoking behaviour.

In conclusion, like past studies, our studies show mixed results of the effects of smoking cues in movies on smokers’ immediate smoking behaviour. The results seem to constitute a pattern that is related to the time of assessment of smoking behaviour. Effects of smoking cues in movies on smoking behaviour have been found among studies that assessed smoking behaviour after cue exposure (Payne, et al., 1991; Shmueli, et al., 2010). However, the time of exposure in these studies was considerably shorter than in the studies that assessed smoking behaviour during exposure. No main effect of smoking cues in movies on immediate smoking behaviour has been found in studies that assessed smoking behaviour during exposure (Harakeh, et al., 2010; studies presented in Chapters 2 and 3).

Effects of smoking cues in movies on smokers’ craving

Research among smokers has shown that environmental smoking cues are important triggers for craving. It has been documented in several cue-reactivity
studies that smokers who are exposed to smoking cues experience increased craving compared with exposure to neutral cues (Carter & Tiffany, 1999). In the study presented in Chapter 4, we tested whether smoking cues in movies also function as triggers to evoke craving. First, in a pilot study, we examined smokers’ reactivity to smoking cues from a particular movie in a common cue-reactivity paradigm using pictures (stills from movie fragments). In line with previous cue-reactivity research on craving, the pilot study revealed that pictures of smoking characters had strong effects on craving. In the main study, we tested whether smokers who are confronted with smoking characters in a movie segment have a greater desire to smoke than smokers confronted with non-smoking characters. However, no differences in craving were found after the movie between those who watched smoking characters and those who watched non-smoking characters.

One explanation for the difference in findings between our main study and our pilot study - and more traditional cue-reactivity studies generally - can be found in the experimental design. Possibly, craving actually occurred upon cue exposure but our design was not suitable for assessing this effect. In our design craving was not immediately assessed after cue exposure. It has been shown that cue-induced craving rises within seconds after the exposure to smoking cues and declines to pre-cue levels within a few minutes after the removal of the cue (Conklin, 2006; Niaura, Abrams, Demuth, Pinto, & Monti, 1989). To replicate our findings, to decrease the chance of a false negative effect and to gain more insight into the development of craving while watching a movie with smoking scenes, we extended the design of the study and assessed craving at four points of time: both before and after the movie, and twice in advertisement breaks during the movie (Chapter 5). However, even when measuring craving sooner after cue exposure, no effect of smoking cues in movies on craving was found.

Both traditional cue-reactivity studies and our pilot study using pictorial cues derived from the movie (Chapter 4) differ from our main studies on the effects of smoking cues in movies on craving in at least three ways: in the nature of the cues, in the timing of the assessment of craving and in the opportunity to control the cue exposure. The results of the study presented in Chapter 5 indicate that the time-point of the measurement of craving does not explain the lack of effect in our first movie study. Measuring craving twice during the movie and sooner after cue exposure instead of after the movie does not affect the results.

First, a possible explanation for the lack of findings in both movie smoking studies could be that dynamic smoking cues embedded in movies differ inherently from cues used in other cue-reactivity paradigms (which used in-vivo, imaginary, pictorial, short video, and virtual reality exposure). When smokers are exposed to more realistic, subtle cues embedded in a context, compared to a design which is often characterized by an explicit and strong focus on smoking cues, no effects on craving are found. Thus, it cannot be ruled out that the context of the cues causes a difference in findings. As the movie continues past the point of exposure, one could argue that the context leads to smokers being distracted from further thoughts about smoking. One factor that describes the movie context might be the involvement in the movie narrative. However, we did not find differences in craving levels among smokers who were more involved in the movie narrative compared with smokers who were less involved.

Second, traditional cue-reactivity studies are characterized by a controlled and standardized cue exposure (i.e. standardized number of cues and length of cue exposure, standardized colour, size and explicitness of cues prior to each assessment of craving). Using existing contemporary movies, the ability to control the portrayal of the cues is limited. In our design, we neither controlled for the length of cue exposure, nor for the time periods between cue exposure and the time periods prior to the assessments of craving. It was also not controlled for the explicitness of the cue (whether it was zoomed in on the cigarette or whether it was portrayed in the background). Thus, it cannot be ruled out that frequent, longer, or more explicit cues in movies lead to an increase in craving.

Third, the unavailability of cigarettes and the lack of opportunity to smoke are also possible explanations for the lack of findings. Cue availability studies in which smokers are exposed to smoking-related and neutral cues and in which the participants are informed about the availability of the drug, showed that craving increased when cigarettes were immediately available (e.g. Carter & Tiffany, 2001; Juliano & Brandon, 1998; Sayette, et al., 2003). Due to the unavailability of cigarettes and the inability to smoke during the experiment, craving at the moment of cue exposure might drop quickly after disappearance of the cue. It is conceivable that the effect disappears if smokers are not able to fulfil their needs. However, in our studies presented in Chapters 2 and 3, when smokers were given the opportunity to smoke during cue exposure, no differences were found between smokers who were exposed to smoking characters and smokers who were exposed to non-smoking characters.
In conclusion, the results of our studies show that the same cues - once presented in the form of stills and once presented in the form of dynamic cues in a movie - can lead to different results in craving. So far, it is unclear why different presentation modalities of the same cues evoke different responses in craving. Given that traditional cue-reactivity studies are characterized by an explicit focus on smoking cues, the results of our studies also raise the question whether individuals consciously detect smoking cues embedded in the context of a narrative and if, how those cues are interpreted. It may be that individuals simply do not see the cues, or do not focus on the cues because of, for example, their involvement in the narrative.

Effects of smoking cues in movies on smokers’ attention

Another goal of this section of the dissertation was to examine smokers’ attention to and perception of smoking cues in movies. We were interested in whether smokers would be too distracted by the movie narrative to see these cues. Furthermore, we aimed to investigate whether smokers focus on such cues more often, more quickly, and for a longer period of time than non-smokers, which might indicate that a bias in attentional processing could function as possible underlying mechanism in explaining continued smoking behaviour. Biases in selective attention play an important role in the development and maintenance of drug-taking behaviour as well as in the resistance to abstinence and/or the occurrence of relapse. While the existence of an attentional bias for pictorial smoking cues has been established, no study has assessed whether smokers also show an attentional bias for dynamic smoking cues and whether the theory of attentional bias can be effectively transferred to dynamic cues. Using eye-tracking technology to assess smokers’ and non-smokers’ attention while watching a movie, our results revealed that smokers initially directed their gaze more quickly towards smoking-related cues and focused more often and maintained their gaze longer on smoking-related cues when compared with non-smokers. Our results extend the studies using stills to investigate the attentional bias to dynamic cues and confirm the results of traditional attentional bias research. Although the narrative could distract viewers from the smoking cues, smoking cues in movies have the ability to capture and hold smokers’ attention. However, as no control cues were included against which to compare the attention to smoking-related cues, the possibility that smokers are generally susceptible to appetitive cues exists and should be mentioned. Compared with pictorial attentional bias studies, the inclusion of appropriate matching control cues is in practical terms more difficult to realize in a design using a long segment of dynamic cues.

Overall...

Based on addiction theories (e.g. Franken, 2003; Robinson & Berridge, 1993), we expected smoking cues in movies to influence smokers’ attentional processing, their craving and their smoking behaviour. Our findings suggest little impact of smoking cues in movies on smokers’ reactivity. The studies showed no significant or mixed effects of smoking cues in movies on smokers’ craving and smoking behaviour. Explanations for the lack of findings on craving and smoking behaviour have been provided in the previous sections. A robust effect was only found for smokers’ attention to smoking cues in movies. Our study confirmed the results of previous attentional bias research and indicates that smokers do, in fact, focus their attention on smoking cues. Therefore, it cannot be claimed that the narrative overtly distracts the viewer from smoking cues. This finding suggests that the lack of effects of smoking cues in movies on craving and smoking behaviour is unlikely due to a lack of attentional focus. It seems to be the case that smoking cues in movies attract and hold smokers’ attention. However, whether the attentional focus underlies craving and/or smoking behaviour when exposed to smoking cues in movies remains unclear. To draw any conclusions on whether individual differences in attentional processing of smoking cues in movies predict craving-levels and the subsequent lighting of cigarettes, would require studies that assess the interrelation of these constructs. Therefore our studies can only offer speculation as to why an effect of smoking cues in movies was only found on smokers’ attention, but not on smokers’ craving and smoking behaviour. Several methodological and theoretical points can be mentioned which might explain a difference in findings among the three constructs. Methodological explanations for the inconsistent findings among the three constructs can be found in different study types, different designs and in the assessment of the constructs. The study on smokers’ attentional focus to smoking cues in movies is not based on an experimental design like the other studies, as we tested differences in the attentional focus of smokers and non-smokers. To be able to compare the results of this study with the results of the studies on craving and smoking behaviour, the design would require
testing individual differences in smokers’ attention by comparing smokers’ attention to smoking versus matching control cues. Such a design would also provide clarity on whether smokers’ attentional bias is limited to smoking cues or whether they have an attentional bias for appetitive cues in general. Another methodological explanation for why significant results were only found with regard to smokers’ attention, is the possibility that the design of this study has fewer limitations than the studies on craving and smoking behaviour. The aim of the studies in this part of this dissertation were to assess smokers’ reactivity to smoking cues in movies using a naturalistic approach. Compared to the study on smokers’ attention, it is possible that the design of the studies on craving and smoking behaviour provided fewer possibilities to control for variables that could have influenced or overruled the effects of the cues. These are, in particular, variables that are related to the difficulty of assessing craving and smoking behaviour in a naturalistic setting (see also the section on study limitations). Moreover, the assessment of craving has been recognized as problematic (e.g. Munafò & Hitsman, 2010; Perkins, 2009b). Variant results between our study on attention and our studies on craving could be due to a limited reliability of the self-report craving measures compared to non-self report measures of attentional processing (i.e. eye-tracking measures) (Franken, 2003).

A possible theoretical explanation for the found effects on smokers’ attention might originate in the assumption that attentional bias and craving reflect the same underlying process. Some addiction theories (e.g. Franken, 2003; Robinson & Berridge, 1993) propose that a bias in attentional processing mediates the relationship between smoking cues and craving/smoking behaviour. Franken (2003) suggests that attentional bias and craving affect each other, however attentional bias first activates craving; craving is not able to develop without attention. The IST (Robinson & Berridge, 1993) proposes that the attentional bias and craving are positively correlated. Both processes are seen as emotional and cognitive outputs of the dopaminergic system (Field & Cox, 2008). However, other models (e.g. Tiffany, 1990) suggest that substance-related cues are automatically detected and divisible from aspects of consciously reportable cognitive processes (e.g. craving). Also, the IST (Robinson & Berridge, 1993) acknowledges that in some cases, the incentive-motivational properties of cues can drive substance-seeking behaviour unconsciously, suggesting that attentional bias and craving can be decoupled (Field, et al., 2009b). Although a recent meta-analysis showed a modest but significant correlation between attentional bias and craving (Field, et al., 2009b), indicating that craving and attentional bias reflect the same underlying process, the circumstances under which attentional bias and craving are correlated strongly remains unclear (Field & Cox, 2008).

Another theoretical explanation lies in the possibility that the relationship between attentional biases and craving or substance-seeking behaviour is moderated by other factors. One theory, which contributes to, but does not solely explain the continuation and escalation of substance use by incentive sensitization/motivational salience, is the Dual process model of addiction (Wiers, et al., 2007a). According to Dual process models, engagement in substance use is not only affected by relatively automatic, appetitive or impulsive processes but also by relatively controlled or reflective processes. The controlled, reflective processes are characterized by explicit decision making processes and involve deliberate and conscious appraisals of available information. Thus, the automatic link between cues and behaviour is supposed to be affected by the capacity to inhibit an approach tendency and to change the attentional focus and the motivation to control impulses. It has been proposed that substance use will occur when the controlled, executive system does not overrule the automatic, appetitive system. Furthermore, a model by Field and Cox (2008) also states that the relationship between attentional bias and craving/smoking behaviour is affected by impulsive decision-making and poor inhibitory control. Highly impulsive substance users and those with poor inhibitory control are particularly sensitive to attentional-grabbing properties of substance-related stimuli and report greater subjective cravings. Further, intact inhibitory control processes might have the ability to prevent attentional biases from influencing craving or actual substance-seeking behaviour. The relationships between attentional biases and craving or substance-seeking behaviour might be most pronounced in individuals who are highly impulsive or who have compromised inhibitory control. Thus, it might be the case that other factors (factors we have not assessed in our studies) moderate the relationship between the attentional bias to smoking cues in movies and craving/smoking behaviour and prevent the development of craving and the lighting of cigarettes.

Moreover, other moderating factors could play a role. It is possible that the effects of smoking cues in movies on craving and behaviour are moderated by smoking-related or movie-related aspects and are therefore limited to certain sub-groups or certain situational circumstances. Our finding that smoking cues in movies had an effect only on the smoking behaviour of participants...
who were less transported in the movie supports this assumption. It is possible that while smoking cues in movies generally have the ability to affect the attention of smokers, with regard to craving and smoking behaviour certain groups might particularly be at risk to smoking cues in movies. But as mentioned before, the issues discussed above can only be seen as speculations since we have not investigated the interrelation between the attentional focus, craving and smoking behaviour.

Implications for theory and research

The next sections provide conclusions and examine some of the implications for theory and research based on the findings of our studies. In the introduction, we discussed several motivational salience addiction theories. When referring to cue-reactivity theories in the next sections, we are referring to the motivational salience addiction theories that are based on classical conditioning and focus on automatic processes as an explanation for continued substance use (e.g. Franken, 2003; Robinson & Berridge, 1993).

Overall, using various designs and testing the effects on different outcome measures (attentional processing, craving, smoking behaviour during and after cue exposure), we found little impact for the influence of smoking cues in movies on smokers’ reactivity. These findings suggest that cue-reactivity theories cannot be extended fully to smoking cues in movies. Our results show that assessing proximal smoking cues in a naturalistic setting (i.e. using smoking cues in movies) leads to different results than under controlled experimental conditions (i.e. using pictorial smoking cues). This difference can be seen when comparing the presented studies on craving and smoking behaviour with traditional cue-reactivity studies, but also in the studies presented in Chapter 4. The same cues, once presented in the form of stills in a common cue-reactivity paradigm and once presented in the form of dynamic cues in a movie, led to strong craving effects and no difference in craving between experimental conditions (Chapter 4). That the degree of the response can vary across different presentation modalities has been shown in previous studies (e.g. Erblich & Bovbjerg, 2004; Niaura et al., 1998).

There might be two explanations for the difference in responses when using the two different presentation modalities. First, traditional cue-reactivity studies have been used to investigate the genesis of cue-induced cravings and smoking behaviour and to establish a causal relation between cues and craving/smoking behaviour (Ferguson & Shiffman, 2009). Cue-reactivity paradigms have also been useful when assessing the efficacy of novel treatments/medication in advance of costly clinical trials (e.g. Carpenter, et al., 2009; Carter & Tiffany, 1999; Ferguson & Shiffman, 2009; Niaura et al., 2005; Shiffman et al., 2003; Tiffany, Cox, & Elash, 2000b), and in studying the neuro-biology of nicotine addiction using brain imaging models (Brody et al., 2004; McClernon, Hiott, Huettel, & Rose, 2005; Wilson, Sayette, Delgado, & Fiez, 2005). In order to test these research questions, cue-reactivity paradigms typically require the induction of strong smoking-related responses (craving/smoking behaviour) and therefore the exposure to explicit proximal cues. Because explicit proximal cues have presumably been paired with nicotine administration multiple times over the course of every smoker’s history, they are expected to elicit smoking-related responses across smokers (Conklin, et al., 2008; Drummond, 2000; Wray, Godleski, & Tiffany, 2011). The advantage of using proximal cues is that smokers’ reliable reactivity to such cues reduces within-group variability, making the effects of within- and between-group manipulations more readily observable (Conklin, et al., 2008). When compared to smoking cues in movies, explicit proximal pictorial cues might have a higher likelihood of producing strong cue-reactivity effects because they are highly salient. In addition, they might completely represent/match the encoded stimulus configurations responsible for the production of a cue-specific response, a representation smoking cues in movies might do less explicitly (e.g. Tiffany, 1990; Wray, et al., 2011).

Second, although smoking cues in movies are proximal cues in the sense that they consist of an image of a cigarette or a character smoking a cigarette and therefore represent cues that are reliably associated with nicotine administration, they differ from proximal cues used in traditional cue-reactivity studies. As a detail embedded in a narrative, smoking cues in movies are less explicit and more subtle. Also, an on-going story in a movie adds another dimension to the pure smoking cues. It may be that smokers’ response is influenced by contextual factors, which could overrule the effect of the smoking cues. Whereas the results in traditional cue-reactivity studies can be attributed to the presented cues, smoking cues in movies, which are inserted into a larger context, suggest the possibility that certain aspects of the context trigger past memories of smoking, which, in turn, activate smoking-related responses. So, the effect or lack hereof cannot be completely attributed to the presented smoking cues (see also the section on study limitations).
smokers were exposed to smoking cues, were emotionally upset, or had been drinking (Shiffman et al., 1997; Shiffman, Paty, Gnyys, Kassel, & Hickcox, 1996). Moreover, the inter-relationships between cues can influence the salience of the cues and their capacity to elicit cue-induced responses (Drummond, 2000). Certain cues might be salient only in a particular context. In such a ‘cue cluster’ (the interaction between co-occurring cues), each cue is necessary but not independently able to evoke a response (Drummond, 2000). It is certainly possible that smoking cues in movies are part of a ‘cue cluster’ and affect smokers only in combination with other specific cues. Future research should address whether cue relationships have a greater predictive validity concerning craving and smoking behaviour than individual cues (Drummond, 2000).

Limitations

Despite the strength of the naturalistic approach used in the reported studies, several limitations need to be acknowledged; our findings need to be considered in the context of these study limitations. The primary limitations across the studies include the diversity of the type of smokers in our samples and different aspects of the research design.

Sample diversity with regard to smoking level

Although the participants in our samples reported being daily smokers, their daily smoking habits, and therefore their nicotine dependence levels, varied strongly. The samples in all of the reported studies included smokers who ranged in their daily smoking levels between 1-5 cigarettes and more than 31 cigarettes per day. As a result, the samples in our studies might have been too heterogeneous with regard to smoking history and habits. Conducting analyses separately for smokers with different smoking levels or controlling for smoking level in the analysis did not change our results. However, it should be noted that the lack of findings among certain groups of smokers in our studies might be due to insufficient power when testing interaction effects. Also, traditional cue-reactivity studies usually focus on nicotine-dependent, heavy smokers (smoking at least more than 10 cigarettes per day). Therefore, different effects could emerge if we were to focus only on heavy smokers.
Controlling the experimental manipulation

Cue-reactivity research in a laboratory setting typically uses explicit proximal cues and offers the great potential of controlling the experimental manipulation (Carpenter, et al., 2009; Sayette & Tiffany, 2012), confirming that the found effects can be attributed to the presented cues. The exposure to smoking cues in movies differs from a conventional cue-reactivity design in the sense that the exposure is not limited to the pure cue but that cue exposure is related to a context; the activity of watching a movie. Therefore, it might be difficult to disentangle the effects elicited by smoking cues and the effects elicited by the activity of watching the movie itself. As environments and contexts associated with smoking have been shown to function as conditioned stimuli capable of evoking strong subjective responses (Conklin, 2006), it could be the case that the very activity of watching movies functions as a cue to provoke reactivity in smokers. Based on learning experiences, some smokers might have associated watching a movie with their own smoking behaviour. Therefore, the activity of watching a movie might have acquired the properties of a conditioned stimulus which has the ability to elicit a conditioned response. One could argue that the randomization of participants over conditions should control for such an effect, suggesting that this effect might appear across conditions. However, if it is the case that the activity of watching a movie acquired the properties of a conditioned stimulus and elicits smoking-related responses in smokers, this forces the question of how the responses elicited by the activity and the responses elicited by cues interrelate. First, it is unclear whether these effects are additive and elicit stronger responses and second, whether the experimental design we used would allow to find group-differences of such an additive effect. Therefore, our experimental design is limited with regard to parsing the effect of smoking cues in movies from other contextual stimuli present during the cue-reactivity session.

Moreover, individuals who learned an association between watching movies and their own smoking behaviour might not have been equally distributed over the two groups. Conceivably, in the control condition compared with the experimental condition, more smokers have learnt an association between the activity of watching a movie and their own smoking behaviour. The exposure to a movie clip would therefore elicit craving in smokers in both conditions – craving would be elicited in the experimental condition by the smoking cues in the movie and in the control condition by the activity of watching a movie. Consequently, it cannot be ruled out that the lack of differences in smoking-

Controlling for baseline craving

The discussion among cue-reactivity researchers about how to control for baseline craving, and whether that is indeed necessary, is on-going (Sayette & Tiffany, 2012). The challenge in cue-reactivity research lies in the difficulty of disentangling the effects caused by cue-induced and background craving. Common approaches have been to either ask smokers to smoke a cigarette just before cue exposure or to ask participants to stay abstinent for a certain period of time and to adjust for baseline levels by calculating a change score, calculating a residual score, or by using baseline scores as covariates in analyses (Sayette et al., 2000). In our study on the effects of smoking cues in movies on immediate smoking behaviour in adult smokers, participants were requested to stay abstinent from smoking six hours prior to the experiment. Also, before cue-exposure participants were asked to answer questions on their current craving levels (baseline assessments). It is questionable whether this study design was suitable to find group-differences in smoking behaviour. Due to participants’ deprivation, one would expect all participants to smoke a cigarette at the beginning of the movie, regardless of condition.

Additionally, this effect might have been consolidated by the baseline craving assessment, which could have primed participants in both conditions. Thus, the lighting of the first cigarette is probably not induced by smoking cues in movies. Any group-differences with regard to the first cigarette might be attributed to individual differences in smoking habits and background craving and/or to the priming effects of the baseline craving assessment. The diversity in smoking level of smokers in our sample supports this possibility. A smoker who smokes 1-5 cigarettes per day might respond differently to a period of deprivation than a smoker who smokes more than 31 cigarettes per day. Moreover, having smoked the first cigarette, the length of the movie might have been too short to assess effects in smoking behaviour induced by smoking cues in movies. This design might make it difficult to separate the effects of background and craving evoked by smoking cues in movies. It could be the case that the effect of smoking cues in movies on smoking behaviour was undermined by effects caused by deprivation and/or baseline craving assessments.
related responses between conditions are due to individual differences in associations between watching a movie and smoking behaviour. In conclusion, there is a possibility that other distal cues (e.g. the activity of watching a movie, negative affect) can serve as potent factors to elicit smoking-related responses. There is a lack of knowledge about how these cues would interrelate with smoking cues in movies and whether the responses caused by other distal cues are equalized over conditions.

**Between- versus within-subject design**

Traditional cue-reactivity studies follow the relatively standard procedure of a within-subject design with pre- and post-measurement. Participants are requested to complete baseline reports (e.g. subjective reports and physiological measurements) followed by the exposure to smoking-related stimuli. After the exposure, measurements are repeated. In many studies, smokers are also exposed to control stimuli, which have no association with smoking (Ferguson & Shiffman, 2009). Within-subject designs have the advantage that variables that could influence participants’ responses can be controlled for (for example the wording of items) (Sayette, et al., 2000) and the disadvantage of possible carry-over effects (for example the possibility that an earlier assessment evokes craving that is reported in a later assessment) (Sayette, Griffin, & Sayers, 2010; Sayette, et al., 2000). Some cue-reactivity studies have used between-subject designs and exposed participants either to smoking or control cues which prevented possible carry-over effects (e.g. Juliano & Brandon, 1998; Litvin & Brandon, 2010; Warthen & Tiffany, 2009). The within-subject design needs fewer participants because each subject can serve as his/her own control. However, it can only be considered the more effective design if participants can process the smoking and the control cue with minimal carry-over effects (Sayette, et al., 2010). In our studies, between-subject comparisons were used because we were primarily interested in between-person differences and not in within-person changes in smoking-related responses (Sayette, et al., 2000). Also, because we were using representative movie clips with and without smoking cues, the design did not allow us to expose participants to the same clip with and without smoking cues. The alternative would be a within-subject design using different movie clips. However, the matching of the smoking and control stimuli would be limited and the effect or lack thereof could not be attributed to smoking cues.

**Directions for future research**

Our studies show that the effects of smoking cues in movies on smokers’ reactivity is difficult to assess and as a result raises important questions regarding which design would offer the best method to test this construct. We have argued that a naturalistic approach, the exposure of smokers to actual smoking cues in movies, would be a better method than generalizing the results of cue-reactivity research using pictures. The fact that our studies have shown variation in results when using different approaches of cue exposure supports the naturalistic approach. However, because the naturalistic approach has several limitations, we propose that while future research should maintain a naturalistic approach, that it should also consider and try to reduce these limitations. In the following section, we make recommendations for how the disadvantages of the naturalistic setting can be overcome and which additional aspects should be considered in future research.

As discussed previously, the samples in our studies might have been too heterogeneous with regard to smoking habits and nicotine dependence levels. We suggest future research examine the effect of smoking cues in movies on smokers’ craving and smoking behaviour in more homogenous samples (with regard to smoking level). Moreover, it would be interesting to investigate differences in smoking-related responses between different types of smokers (e.g. heavy smokers, light smokers, quitters, treatment-seeking smokers, etc.), as they might be affected differently.

It remains an important challenge for future research to control for baseline craving levels and to unravel the effects of background and cue-induced craving. The two approaches of either asking participants to refrain from smoking or to smoke a cigarette before movie exposure have advantages and disadvantages. Both deprivation and satiation might influence smokers’ background craving and diminish their cue-reactivity. Testing the effects in a more homogeneous sample with regard to smoking level and adjusting the length of deprivation might be a possibility to partially solve this issue.

Another challenge for future work on the effects of smoking cues in movies on smokers is to handle the difficulty of controlling influential factors. As discussed previously, the activity of watching a movie might function as a cue to elicit smoking-related responses in some smokers, making it difficult to assess solely the effect of smoking cues in movies. Increasing the sample
size limits the possibility that individual differences are not distributed equally among conditions. Also, assessing participants’ usual viewing behaviour (whether they usually watch movies at home, with someone else, or whether they usually smoke when watching a movie, etc.) might help to gain a more complete understanding of whether smokers have associated watching a movie with their own smoking behaviour and could give an insight into whether watching a movie might function as a distal cue to evoke smoking-related responses. EMA (Ecological momentary assessment) (Shiffman, et al., 1997; Shiffman, et al., 1996) might be a possible method to assess participants’ usual viewing behaviour.

Given that the study presented in Chapter 3 is one of the few cue-reactivity studies among adolescent smokers, we recommend that future research focus on this particular target group. It has been argued earlier that adolescent smokers differ from adult smokers in smoking habits, history and developmental stage of addiction. Therefore, results found among adult smokers might not be transferred to adolescent smokers. However, it is important to combat the progression of smoking and to implement interventions successfully among this particular target group. As it is relatively unknown whether and how adolescent smokers respond to environmental smoking cues, traditional cue-reactivity studies on adolescents’ craving and smoking behaviour might be a good beginning in this rather young research field. Research on the influence of variant environmental smoking cues on adolescent smokers can provide additional insights into how smoking patterns become entrenched in adolescents, and may subsequently help to understand the development of habits and dependence as well as the difficulties of smoking cessation in this specific age group.

Moreover, most cue-reactivity research focuses on craving and physiological measures; outcome variables less often include behavioural assessments (Drummond, 2000; Sayette, et al., 2000; Tiffany, Carter, & Singleton, 2000a). Like other researchers, we therefore recommend that future work focus on actual smoking behaviour in cue-reactivity studies (Drummond, 2000; Perkins, 2009a; Sayette, et al., 2000; Tiffany, et al., 2000a) and on linking the findings of cue-reactivity research to smoking behaviour in the real-world.

Our results do not permit firm conclusions about the interrelation of smokers’ attentional focus, their craving and their smoking behaviour when exposed to smoking cues in movies. Therefore, it remains unclear whether the attentional processing provides an underlying mechanism in the relation between smoking cues in movies and craving/smoking behaviour. Further research is required in order to clarify whether individual differences in the attentional processing of smoking cues in movies predict smokers’ craving and their smoking behaviour. One option would be to assess smokers’ attentional bias to smoking cues in movies (similar to a paradigm used in the study presented in Chapter 5) and to assess their craving afterwards. Another possibility might be to investigate the correlation between the attentional focus and participants’ latency to smoke after exposure (for example in a recess after the eye-tracking task).

Conclusion

The aim of the studies in this part of this dissertation was to assess smokers’ reactivity to smoking cues in movies using a naturalistic approach. Overall, smoking cues in movies had little impact on smokers’ reactivity. The studies showed no significant or mixed effects of smoking cues in movies on smokers’ craving and smokers’ smoking behaviour. A strong effect was only found for smokers’ attention to smoking cues in movies (as compared to non-smokers). Although the reported studies have the strength of a naturalistic approach, this approach has several limitations and false negative effects cannot be ruled out. Therefore, future research, which attempts to overcome the limitations of the naturalistic approach, is needed. The reported studies show little impact of smoking cues in movies on smokers, and therefore we cannot make strong suggestions for the adaptation of policy regulations controlling tobacco portrayals in movies. Yet, as smoking cues in movies have been shown to have a tremendous impact on the instigation of smoking in adolescents, our studies do not suggest or justify the broad inclusion of smoking in movies.
Part II

Exposure to parental and movie smoking: Effects on non-smokers
Chapter 1

Introduction
The onset of tobacco use takes place primarily during adolescence. In the Netherlands, experimentation with smoking reaches a peak at the age of 12. In 2011, 12% of 12-year-old children reported having already tried smoking. Moreover, smoking prevalence rates increase most steeply between the ages of 13 and 16; it is in this particular age range that a shift from experimenting with cigarettes to more regular smoking is most likely to be observed (Stivoro, 2012b). Given the high smoking initiation rates among adolescents and the negative health consequences, it is essential to prevent the initiation of smoking. Therefore, it is necessary to focus on the time period preceding the uptake of smoking and to understand processes that underlie the initiation of smoking.

Many theories on the experimentation and initiation of tobacco use emphasize the role of cognitive processes in the development of smoking initiation (Petratis, Flay, & Miller, 1995). Smoking initiation contains different developmental stages of progression, starting with a stage of forming and modifying beliefs and attitudes regarding smoking (Mayhew, Flay, & Mott, 2000). In this contemplation or preparatory stage, which precedes actual experimentation with cigarettes, children already form ideas and attitudes about smoking (Flay, McFall, Burton, Cook, & Warnecke, 1993; Leventhal & Cleary, 1980; Stern, Prochaska, & Velicer, 1987). Proximal factors, such as cognitive-affective influences, are considered to be the most immediate precursors to initiation and therefore highly predictive. It is suggested that proximal, cognitive-affective factors are, in turn, influenced by distal, environmental factors (Petratis, et al., 1995). Distal, environmental influences that have been shown to contribute to the initiation of smoking in adolescents are friends and parents smoking (Leonardi-Bee, Jere, & Britton, 2011) and smoking portrayed in the media (National Cancer Institute, 2008).

Research aiming to understand and tap into the processes underlying smoking initiation profits from studies on children and teens who have not tried smoking yet. Given that smoking prevalence rates increase most steeply from early to middle adolescence (Stivoro, 2012c), it can be assumed that the formation of smoking-related cognitions starts prior to this age, indicating that these studies should be conducted among children and early adolescents. Compared with the smoking by friends, parental smoking seems to be the main source of influence for smoking initiation in pre-adolescents, whereas among adolescents, friends’ smoking is more influential in the process of smoking initiation (Vitaro, Wanner, Brendgen, Gosselin, & Gendreau, 2004).

As even young children watch television and movies (Rideout, Vandewater, & Wartella, 2003) and since G-rated movies contain smoking scenes (Goldstein, Sobel, & Newman, 1999; Thompson & Yokota, 2001), it can be assumed that movie smoking is another important and prominent source that influences smoking-related cognitive processes. Therefore, with regard to environmental smoking, this dissertation focuses on the effects of parental smoking and entertainment media, and specifically on the influence of smoking portrayal in movies. As cognitive processes can be seen as a proxy and are considered to play an important role in the uptake of smoking, cognitive processes will be central outcome variables in the studies in this part of the dissertation.

For prevention purposes and policy regulations (tobacco control initiatives regulating the exposure to smoking in movies and to second-hand smoke), it is important to understand whether and how non-smoking children develop cognitive responses as a result of exposure to different environmental factors. In order to implement successful prevention programs, research needs to identify possible environmental sources of risk (e.g. movie smoking) and different risk groups (e.g. children with smoking parents). Therefore, the goal of the second part of this dissertation is to investigate the association between the exposure to parental and movie smoking and children’s and adolescents’ smoking-related cognitive processes.

Theoretical perspectives

Two somewhat overlapping theories have described the possible meditational role of cognitive processes on the relationship between environmental smoking and adolescent smoking initiation. One line of research is built upon the premise that substance use is based on introspection and explicit decision-making processes. The more recent literature describes a pathway that considers, next to explicit, implicit cognitive processes. Both lines of research have in common that cognitive processes, both explicit and implicit, are partly a result of the social environment.

Smoking-related explicit cognitive processes

These theories presume that the decision to engage in substance use is based
on the rational evaluation of possible positive and negative consequences of substance use. Theories of health behavior, like the Theory of planned Behavior (TPB) (Ajzen, 1991) and models based on Social Cognitive Learning Theory (Bandura, 1977) suggest that explicit expectancies, being the perceptions of positive and negative consequences of substance use, are important proximal predictors for engagement in that behavior. Cognitive affective theories state that cognitive-affective processes mediate the influences of others on behavior. The perception of the consequences (costs and benefits) of substance use is considered to play an important role in adolescents’ decisions to engage in substance use. One example of a cognitive-affective theory is the Theory of planned Behavior (Ajzen, 1991). The TPB posits that a person's behavior is determined by their behavioral intention and that this, in turn, depends on the person’s attitude towards the behavior, their subjective norm and their perceived behavioral control (self-efficacy). Bandura’s (1969) classic modelling theory postulates that the observation of a certain behavior by significant others/role models is essential for acquiring this behavior. The observation of a certain behavior by role models leads to the adoption and imitation of this behavior. The Social Cognitive Learning Theory (Bandura, 1982, 1986) is a modification of the classic direct modeling theory (Bandura, 1969) and extends this view by cognitive mediating factors. Through observation of the behavior in a social context, role models and their behavior also shape an adolescent’s positive and negative expectancies of substance use (their beliefs about the consequences of substance use) and their self-efficacy.

**Smoking-related implicit cognitive processes**

Dual process models state that both controlled and automatic cognitive processes influence substance use (e.g. Wiers, et al., 2007a). Dual process models extend the assumption that substance use is a solely rational process by the view that the decision to engage in substance use is also affected by memory associations that can spontaneously be activated. According to dual process models substance use is affected by both relatively automatic, appetitive or impulsive processes and relatively controlled or reflective processes. The controlled, reflective processes are characterized by explicit decision-making processes and involve deliberate and conscious appraisals of available information. The automatic, appetitive processes refer to unconscious, automatic associations towards the substance and do not depend on deliberate or conscious recollection. These memory associations have been learned through experiences with the substance (either by encounters with the substance or information about the substance) and are able to influence behavior automatically through non-reflective processes (Rudman, 2011). Implicit processes can be subdivided into the following three categories: attentional biases (i.e. that certain cues have the ability to capture and hold someone’s attention), memory associations (i.e. the development of automatic affective associations with a substance), and automatic approach tendencies (i.e. the tendency to automatically approach the administration of the substance). It is assumed that these three features of automatic processes reciprocally relate to each other. For instance, substance-related stimuli capture and hold users’ attention, which in turn automatically evoke affective associations and lead to an automatic approach tendency toward the substance (Wiers, 2009).

Until now, the role of automatic cognitive processes has mainly been tested in the escalation and continuation of substance use, which is based on the repeated administration of a substance (Robinson & Berridge, 1993; Wiers, et al., 2007a). Although the literature states that implicit cognitions stem from and are already formed by early experiences in childhood (Rudman, 2004; Rudman, Phelan, & Heppen, 2007), the investigation of the development of automatic cognitive responses in children and adolescents who have not experienced the administration of a substance, is a relatively new research area. It has been proposed that repeated exposure to environmental substance-related cues can lead to automatic cognitive responses, even without personal experiences (administration) with the substance (Pieters, van der Vorst, Engels, & Wiers, 2010; Van Der Vorst et al., 2012). Possibly, repeated exposure to environmental smoking cues forms and strengthens memory associations about smoking (Stacy, 1995). The likelihood of the activation of an association depends not only on the mere presence of pathways in memory between cues and the valenced information, but also on the strength of these associations (O’Connor, Fite, Nowlin, & Colder, 2007). A repetitive association between environmental smoking cues and a positive affect or outcome might attribute to a high salience to these cues, allowing them to be captured more easily. The exposure to such cues could activate implicit positive associations towards smoking, prompting approach behavior (Stacy & Newcomb, 1998; Van Der Vorst, et al., 2012). Therefore, the individual may be automatically guided towards social situations in which cigarettes are available (Rooke, Hine, & Thorsteinsson, 2008) and if individuals are found in a
spontaneous situation where they could smoke, cognitions might be activated in memory and individuals might be more inclined to act upon it (O'Connor et al., 2007; Stacy & Newcomb, 1998). In contrast, a negative evaluation of smoking might increase the probability of avoidance behaviour (Rooke et al., 2008).

Environmental smoke exposure and smoking-related cognitions

Both lines of research explain that cognitive processes, both explicit and implicit, are partly a result of the social environment. The Social Cognitive Learning Theory (Bandura, 1977) postulates that the exposure to smoking behaviour and smoking-related cognitions of significant others is essential for the onset of smoking and the formation of smoking-related cognitions (positive and negative expectancies of smoking and self-efficacy) (Bandura, 1969, 1982, 1986). According to Dual process models (Wiers et al., 2007a), the exposure to environmental smoking plays a role in the formation and maintenance of smoking-related memory associations.

From an early age and throughout their lives, children and adolescents are exposed to smoking and its consequences in their social environment. They perceive, for example, their parents, relatives, or peers smoking in different places (e.g. at home, sport clubs, etc.) and on different occasions (e.g. parties). In addition to the people in their immediate social environment, media and society as a whole also communicate attitudes about smoking. The repeated exposure to environmental smoking and attitudes about smoking might lead to the formation of explicit and implicit smoking cognitions (O'Connor et al., 2007). The formation of explicit and implicit smoking-related cognitions might depend on the frequency, duration and intensity of exposure to significant others (Bandura, 1977; Van Der Vorst et al., 2012). Different sources of exposure (e.g. parents, peer, media, society) can communicate different affective values of smoking, assuming that children develop and store positive and negative smoking-related cognitions simultaneously. For example, whereas children observe parental smoking in a positively valued context, leading to the storage of positive smoking cognitions, a general anti-smoking attitude in society may develop and form negative cognitions towards smoking. Moreover, one sole source can convey contradictive cognitions. For example, a mother who smokes but forbids her child to smoke because smoking is bad and unhealthy might communicate positive as well as negative smoking-related cognitions. Smoking in movies is often positively portrayed (Tanski et al., 2009), but smoking by ‘good characters’ or ‘bad characters’ may also lead to the formation of positive and negative smoking-related cognitions. Moreover, smoking is a complex behaviour and children and adolescents could endorse different cognitions towards different aspects of smoking (Huijding & de Jong, 2006). Empirical research testing the described dual processes regarding smoking has been rare. There is some empirical evidence on the influence of the exposure to environmental smoking on children’s and adolescents’ explicit and implicit smoking cognitions. In the next section, we summarise and discuss the empirical results for the effects of movie smoking and parental smoking on smoking-related cognitions.

Empirical findings

Effects of smoking portrayal in movies on smoking-related cognitions

Based on the total weight of evidence from cross-sectional, longitudinal, and experimental studies, the US National Cancer Institute has stated in its 19th Tobacco Control Monograph a causal relationship between exposure to movie smoking depictions and youth smoking initiation (National Cancer Institute, 2008). Research has demonstrated an association between the exposure to smoking cues in movies and smoking initiation (Dalton et al., 2003; Jackson et al., 2007; Sargent et al., 2005; Sargent et al., 2001; Titus-Ernstoff et al., 2008; Wills et al., 2007) and established smoking (Dal Cin et al., 2012; Dalton et al., 2009; Sargent et al., 2007) in adolescents. Adolescents with a greater exposure to smoking cues in movies were more likely to initiate smoking and to progress to later stages of smoking. This has not only been found in US studies, but received support from research in European countries (Hanewinkel & Sargent, 2007, 2008; Hunt, Henderson, Wight, & Sargent, 2011; Morgenstern et al., 2011), Mexico (Thrasher et al., 2008; Thrasher et al., 2009; Wilkinson et al., 2009), and India (Arora et al., 2012).

However, few studies have investigated how movie smoking exposure affects smoking behaviour. As mentioned, cognitive processes might provide a mechanism to explain the association between cumulative exposure to smoking cues in movies and smoking initiation. Studies investigating mediating factors showed that the association between exposure to smoking
in movies and intentions to smoke is mediated by positive expectancies (Tickle, et al., 2006; Wills, et al., 2008) and one’s identification as a smoker (Tickle, et al., 2006). These concepts are in turn related to smoking. Pechmann and Shih (1999) conducted an experimental study revealing that exposure to two 8-minute movie previews in which the characters smoke, compared with the exposure to two comparable 8-minute movie previews with the smoking edited out, affected adolescents’ beliefs about how smokers perceived themselves. Adolescents who were exposed to movie smoking attributed a higher social status to smokers (Pechmann & Shih, 1999).

To our knowledge, the study by Pechmann & Shih (1999) has been the only experimental study testing the effects of the exposure to movie smoking on cognitive processes in non-smokers. As this study has been conducted among adolescents aged 14 and 15, it is still unclear and therefore important to clarify whether and how depictions of smoking in movies affect children and early adolescents who have not yet experimented with smoking and are in the process of developing more favourable beliefs about smoking. Moreover, up to now, no study has investigated whether the short-term exposure to movie smoking prompts affects implicit smoking-related cognitions. Therefore, one study in this dissertation examined the short-term effect of movie smoking prompts on children’s explicit and implicit smoking cognitions (Chapter 2). Another question, which is still unanswered, is whether lifetime exposure to movie smoking is associated with implicit smoking-related cognitions. Therefore, in this dissertation we investigated the association between lifetime exposure to movie smoking and early adolescents’ explicit and implicit smoking-related cognitions (Chapter 4). Our studies contribute to previous research by assessing the short-term effects of movie smoking prompts as well as the association between lifetime exposure to movie smoking and explicit and implicit smoking-related cognitions. This could reveal more insights into how the exposure to movie smoking affects smoking-related cognitive processes in children and early adolescents.

**Effects of parental smoking on smoking-related cognitions**

Research has identified parental smoking as a strong predictor of the risk of the uptake of smoking among adolescents. A recent meta-analysis revealed that having parents who smoke significantly increases the risk of smoking in adolescence (Leonardi-Bee, et al., 2011). Adolescents with smoking parents are more likely to instigate smoking themselves than those with non-smoking parents. Next to genetic transmission (Munafò & Johnstone, 2008), the literature describes a direct and an indirect influence in explaining the effect of parental smoking on the uptake of smoking in adolescents. The direct pathway states that parents function as role models and adolescents take over parents’ smoking behaviour (Avenevoli & Merikangas, 2003; Bandura, 1977).

In addition to this view of a direct effect, the effect might operate indirectly via cognitive processes. Children’s ideas regarding smoking are partly formed through exposure to parents’ smoking behaviour and their beliefs about smoking. Previous research supports this theory, as parental smoking has been linked to more favourable smoking-related cognitions in children. When asked explicitly, children with smoking parents reported more favourable attitudes towards smoking (Brook, Mendelberg, Galili, Priel, & Bujanover, 1999) and were more likely to report a desire to smoke in the future than children with non-smoking parents (Shute, St Pierre, & Lubell, 1981). Moreover, even young children with smoking parents view smoking as normative in social situations, as they show a tendency to model their parents’ smoking behaviour in role-playing tasks (Dalton et al., 2005; De Leeuw, Engels, & Scholte, 2010c). Regarding the development of implicit smoking cognitions, one study among 5th graders (12-year olds) revealed that children with family members who smoked had more favourable implicit attitudes towards smoking than children with non-smoking family members (Andrews, Hampson, Greenwald, Gordon, & Widdop, 2010). Another study found an association between mothers’ implicit attitudes towards smoking and adolescents’ implicit attitudes towards smoking. Mothers with more positive implicit smoking attitudes had children with more positive implicit smoking attitudes (Sherman, Chassin, Presson, Seo, & Macy, 2009).

These findings provide preliminary evidence that exposure to parental smoking already affects children’s explicit and implicit smoking cognitions at a young age. However, as research in this area is scarce, these effects should first be replicated and it should be investigated further how parental smoking affects smoking-related explicit and implicit cognitive processes in children and early adolescents. Therefore, two studies presented in this dissertation investigate the association between parental smoking and children’s and early adolescents’ explicit and implicit smoking cognitions (Chapters 3 and 4).
Objectives of part II

The aim of the second part of this dissertation is to yield insight into the influence of environmental smoke exposure on mechanisms that likely underpin smoking initiation. Research has shown that environmental factors such as parental smoking as well as smoking in the media contribute to the initiation of smoking. However, little is known about how the exposure to environmental smoking contributes to the initiation of smoking among adolescents. The studies described in the second part of this dissertation aim to contribute to the understanding of the association between different factors of environmental smoke exposure and cognitive processes in children and early adolescents. The assessment of explicit smoking cognitions, as well as different facets of implicit cognitive processes, can provide new insights into the empirical and theoretical understanding of the effects of environmental smoke exposure.

The second part of this dissertation addresses the following research questions (in order of appearance):

- Does short-term exposure to movie smoking affect explicit and implicit smoking cognitions in children?
- Is parental smoking associated with the attention to environmental smoking cues in children?
- Is parental and movie smoking associated with explicit and implicit smoking cognitions in early adolescents?

Overview of part II

With regard to environmental smoking, the first study (Chapter 2) focuses on movie smoking, the second (Chapter 3) on parental smoking and the last study (Chapter 4) on both parental and movie smoking. In Chapter 2, we aimed to investigate whether short-term exposure to movie smoking affects explicit and implicit smoking cognitions in children. In an experimental design, children were exposed to a movie clip with or without smoking scenes and their smoking-related cognitive responses were assessed after exposure. In Chapter 3, selective attention to smoking cues (one of the facets of implicit processing) was assessed. The study addresses the question of whether parental smoking is associated with attention to environmental smoking.
cues in children. Using an eye-tracking paradigm, it was investigated whether children with smoking parents, compared to children with non-smoking parents, differ in their selective attention to environmental smoking cues. All investigated concepts of the studies described in Chapters 2 and 3, including parental and movie smoking, explicit smoking cognitions and the three facets of implicit smoking cognitions, were integrated into the study in Chapter 4. The aim of this study was to investigate the association between environmental smoking (parental and movie smoking) and explicit and different facets of implicit smoking cognitions in early adolescents.
Chapter 2

Influence of smoking cues in movies on children’s beliefs about smoking

Published as:
Abstract

Introduction: Experimental research has revealed that short exposure to movie smoking affects beliefs about smoking in adolescents. In this study, we tested that association in children.

Method: In two experiments, participants were exposed to either a cartoon or family-oriented movie and randomly assigned to 20-minute segments with or without smoking characters. Data collection took place at elementary schools. A total of 101 children (8-10 years; 47.5% boys) were exposed to a cartoon, and in a second experiment, 105 children (8-11 years; 56.2% boys) were exposed to a family-oriented movie. Beliefs about smoking (assessed by questionnaire) and implicit associations toward smoking (single target implicit association task) were assessed after watching the movie.

Results: The majority of both samples of children viewed smoking unfavourably. Exposure to movie smoking had no effect on implicit associations toward smoking when experiments were analysed separately or if the results were combined. For smoking beliefs, effects were again small and only statistically significant for social norms regarding smoking.

Discussion: Short-term exposure to smoking in cartoon and family-oriented movies had little immediate impact on beliefs about smoking in preadolescent children, but a significant cumulative impact on norms cannot be ruled out.

Introduction

The US National Cancer Institute has stated in its 19th Tobacco Control Monograph that the total weight of evidence from cross-sectional, longitudinal, and experimental studies indicates a causal relationship between exposure to movie smoking depictions and youth smoking initiation (National Cancer Institute, 2008). However, few authors have investigated how movie smoking exposure affects smoking behaviour. Many theories on the experimentation and initiation of tobacco use emphasize the role of beliefs about smoking. Effects on beliefs about smoking might provide a mechanism to explain the association between cumulative exposure to smoking cues in movies and smoking initiation. Smoking initiation contains different developmental stages of progression, starting with a stage of forming and modifying beliefs and attitudes regarding smoking (Mayhew, et al., 2000). Research has revealed that young children have strong anti-smoking attitudes (Porcellato, Dugdill, & Springett, 2005); however, in early adolescence, these attitudes soften as preadolescents develop more favourable beliefs and some become willing to try tobacco (Dinh, Sarason, Peterson, & Onstad, 1995; Mayhew, et al., 2000). Because movie smoking exposure begins well before adolescents start to smoke, it is important to clarify whether and how depictions of smoking in movies affect children who have not yet experimented with smoking and are in the process of developing more favourable beliefs about smoking (Glynn, 1993).

Could brief exposures to movie smoking affect beliefs about smoking in randomized experiments? Pechmann and Shih (1999) conducted the one experimental study revealing that exposure to two 8-minute movie previews in which the characters smoke, compared with the exposure to 2 comparable 8-minute movie previews with the smoking edited out, affected adolescents’ beliefs about how smokers perceived themselves. Adolescents who were exposed to movie smoking attributed a higher social status to smokers (Pechmann & Shih, 1999). This study applied to adolescents (Glynn, 1993), who presumably are well along the way toward developing more favourable smoking beliefs (De Leeuw, et al., 2008a), because this is the age associated with smoking experimentation. Moreover, the movies used in this study were adult-oriented; reaction to smoking in films rated for general audiences has experimentally not been examined. Yet, many critiques of movie smoking focus on the frequent depiction of smoking in family-oriented films and cartoons (Goldstein, et al., 1999; Thompson & Yokota, 2001). Given that children spend lots of time watching such films (Rideout, Foehr, & Roberts, 2010; Roberts,
In this current study, we aim to extend previous experimental work by investigating how short-term exposure to general audiences movie smoking affects beliefs about smoking among preadolescents. We expanded the scope of the beliefs assessed in previous research by including explicit and implicit measures. In an experimental design, participants were exposed to a movie clip with or without smoking scenes. In one experiment, the clips were derived from a popular cartoon, in another they were from a family-oriented movie. We expected that children who were exposed to smoking characters in movies would have more favourable beliefs about smoking than children exposed to the same characters in non-smoking situations.

Method

Sample

A total of 206 8- to 11-year-old children participated in two separate studies. Study 1 comprised 101 children aged 8 to 10 years ($M = 8.41; SD = .57$) who were exposed to the movie Lucky Luke - De Daltons op pad (2005). This sample consisted of 48 boys (47.5%) and 53 girls (52.5%), 96% of whom had never tried smoking. Study 2 included 105 children (8-11 years, $M = 9.31, SD = .56$) and had a similar experimental design but with the movie Alles is Liefde (Love Is All) (2007). In the second sample, 56.2% were boys and 43.8% were girls, and 90.5% of the children had never tried smoking.

Stimulus Material

In each study, the participants were assigned randomly to one of two different movie conditions. In the experimental condition, children were requested to watch a segment of one of the two movies with smoking scenes, and in the control condition they were exposed to a similar segment of the same movie without any portrayal of smoking. The movies were chosen because they are suitable for all ages and displayed smoking behaviour by lead characters. Both movies were edited to obtain two similar versions of the movie, one with smoking scenes and one without any portrayal of smoking. For the movie displayed in the experimental condition, several smoking scenes were selected from each original movie and integrated into an edited version that lasted ~20 minutes. A comparable version was edited for the control condition without smoking scenes. The movie was shortened so that the storyline was preserved. The storyline and the length of the edited movies were similar in the experimental and control conditions. Lucky Luke is based on a Belgian comic book; the story is set in the Old West and portrays an American cowboy who is known to “shoot faster than his shadow.” Lucky Luke smoked in 17 scenes (4.36 minutes) in the experimental condition. The other movie, Love Is All, is a popular Dutch romantic comedy that portrays a number of characters coming together in events around the Dutch Christmas holiday Sinterklaas (Appendix). Smoking was portrayed by several lead characters in 10 scenes (1.31 minutes).

Procedure

The studies were conducted in 5 elementary schools in different regions of the Netherlands. Before the study, the parents provided active written consent for the participation of their children. The studies took place in a separate classroom at each school between November 2009 and February 2010. The children were equally allocated by random assignment to each condition. They were taken out of their classroom for ~45 minutes in groups of 5 to 15. First, the researcher explained to the children that they were participating in a study in which they would watch a 20-minute movie and then complete a short questionnaire. They were not informed about the aim of the study. Before the start of the movie, the children were told not to talk to each other, and the researcher remained in the room to maintain order. After watching the movie, the children were asked to complete a questionnaire. The researcher read the questions and response options to the group and explained them if necessary. Each participant then filled in his/her answer individually on a separate sheet. After that, several children performed a single target implicit association task (stIAT). Resources were not available to run stIAT on all children, so lots were drawn to randomly select participants to complete the stIAT. Thirty-seven children in study 1 and 57 children in study 2 performed the stIAT. After the study, all children were debriefed and received a small token for their participation. The study protocols were approved by the Ethical Committee of the Faculty of Social Sciences, Radboud University Nijmegen.
Measures

Child Smoking. Children were asked whether they had tried smoking before. Response category was on a 4-point scale: “never,” “yes, I have taken one puff once,” “yes, I have taken a puff a couple of times,” and “yes, I try smoking once in a while.”

Parental Smoking. Parental smoking was assessed with the 2 questions, “Does your mother smoke?” and “Does your father smoke?”, post-coded to “both parents do not smoke” (0) or “at least one parent smokes” (1).

Film Appreciation. Film appreciation was measured with 8 items (e.g. “I thought the film was interesting”) on a 4-point scale ranging from “definitely yes” to “definitely not” (α = .69 in study 1 and .80 in study 2) (Engels, et al., 2009).

Beliefs About Smoking. The questionnaire assessed the general attitude toward smoking, personal smoking-related expectancies, the perceived social norm regarding smoking, the prototypes of daily smoking, and non-smoking peers and children’s susceptibility to smoke; all measures have been shown to predict smoking onset in previous work (Harakeh, Scholte, Vermulst, De Vries, & Engels, 2004; Otten, Harakeh, Vermulst, Van den Eijnden, & Engels, 2007b; Pierce, Choi, Gilpin, Farkas, & Merritt, 1996; Spijkerman, van den Eijnden, & Engels, 2005).

Attitude Toward Smoking. The general attitude toward smoking reflects the extent to which the participant approves or has a positive regard for smoking (Dijkstra, Sweeney, & Gebhardt, 2001). Attitudes were assessed with 7 items (e.g. “I think smoking is unhealthy”) measured on a 7-point-scale (unhealthy (1) to healthy (7) or unpleasant (1) to pleasant (7)). The α was .78 in study 1 and .77 in study 2.

Smoking-Related Expectancies. Personal smoking-related expectancies were measured with 10 items on a 7-point scale ranging from “definitely yes” to “definitely no” (Kremers, Mudde, & de Vries, 2002). Pros of smoking refer to items assessing positive personal outcomes of smoking (5 items; e.g. “If I were to smoke, it would make me feel very relaxed”), whereas cons of smoking refer to items assessing negative personal outcomes (5 items; “If I were to smoke, it would be bad for my health”). The α was .64 and .78 (study 1) and .73 and .86 (study 2) for pros and cons of smoking, respectively.

Perceived Social Norm Regarding Smoking. We assessed the perceived social norm regarding smoking by asking the participants’ perception of the approval of friends and parents to smoke (4 items: “Do you think your best friend would approve when you smoke,” “Do you think your friends would approve when you smoke,” “Do you think your father would approve when you smoke,” and “Do you think your mother would approve when you smoke,” “Do you think your father would approve when you smoke,” and “Do you think your mother would approve when you smoke” on a 5-point scale, “definitely not” to “definitely yes”) (De Vries, Backbier, Kok, & Dijkstra, 1995). The α was .66 (study 1) and .67 (study 2).

Prototypes. The scale for measuring prototypes of daily smoking peers contained 22 items (Spijkerman, Van den Eijnden, Vitale, & Engels, 2004). The participants were asked to indicate to what extent the presented characteristics would describe/reflect the typical peer who smokes on a daily basis. Items were answered on a 5-point scale ranging from 1 “not at all” to 5 “very much.” The same items were used to measure participant’s prototypes of non-smoking peers by assessing to what extent the characteristics would fit the typical non-smoking peer. Example characteristics for the scales are as follows: “being cool, looking tough, and enjoying life.” The α was .79 and .83 for the smoker prototype scale and .90 and .88 for the non-smoker prototype scale in studies 1 and 2, respectively.

Susceptibility to Smoke. Susceptibility to smoke assesses intentions to smoke and resistance to peer offers by using 5 items (Pierce, et al., 1996) that were answered on a 4-point scale (definitely not, probably not, probably yes, and definitely yes): “If one of your friends offered you a cigarette, would you try it?”; “Do you think you will smoke a cigarette some time in the next year?”; “Would you smoke a cigarette if someone gave you one?”; “Do you think you will smoke cigarettes when you are in high school?”; and “Do you think you will ever smoke cigarettes?” The α was .70 (study 1) and .75 (study 2).

Implicit Associations Toward Smoking. In both studies, we used a child-friendly version of the stIAT to assess children’s implicit associations toward smoking (Huijding & de Jong, 2006). Participants sorted target pictures of smoking-related scenes (Huijding & de Jong, 2006) and stimulus words (Pieters, et al., 2010) as fast as possible into 2 attribute categories, “good” and “bad,” and one target-related category, “smoking.”
The D2SD and D600 penalty measures were used as stiAT scores (Greenwald, Nosek, & Banaji, 2003; Thush et al., 2007).

**Statistical Analysis**

First, the results were analysed for the 2 studies separately, and null results were found for both experiments and for all outcomes. To enhance statistical power, the data for both studies were then combined, and these results are presented below. A multivariate analyses of variance (MANOVA) was used to examine whether children who were exposed to a movie with smoking scenes and children who were exposed to a movie without any portrayal of smoking differ in their beliefs about smoking. A MANOVA was also conducted to examine the influence of smoking cues in movies on implicit associations toward smoking.

**Results**

**Randomization and Manipulation Checks**

Randomization over the 2 conditions was successful. The participants in the 2 conditions did not differ with regard to gender (study 1: \( p = .63 \); study 2: \( p = .28 \)), parental smoking (study 1: \( p = .87 \); study 2: \( p = .62 \)), whether participants had tried smoking before (study 1: \( p = .16 \); study 2: \( p = .87 \)), and whether they had already seen the movie (study 1: \( p = .56 \); study 2: \( p = .43 \)). The data indicated that the experimental manipulations were successful. In the experimental condition, 91.7% (study 1) and 80% (study 2) of the participants accurately recalled having seen the character(s) smoking. In the control condition, 24% (study 1) and 18% (study 2) of the participants mistakenly recalled having seen a character smoking.

**Descriptives**

With regard to the appreciation of the movie, children who were exposed to the smoking movie had higher scores (\( M = 3.12; SD = .50 \)) than children who were exposed to the non-smoking version (\( M = 2.84; SD = .67 \)) of the movie. Love is All, \( t = 22.42, p = .02 \). There were no differences in film appreciation between conditions for the movie Lucky Luke, \( t = 23.23, p = .75 \). Average scores with SDs for all outcome measures are shown in Table 1. The distributions of all explicit outcome measures revealed that the children had on average unfavourable beliefs about smoking, with distributions skewed toward an anti-smoking stance.

**Table 1: Multivariate analysis of variance of the influence of movie smoking on explicit smoking cognitions**

<table>
<thead>
<tr>
<th>Smoking movie</th>
<th>Non-smoking movie</th>
<th>Mean</th>
<th>SD</th>
<th>Mean</th>
<th>SD</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pros of smoking</td>
<td></td>
<td>1.56</td>
<td>.80</td>
<td>1.49</td>
<td>.75</td>
<td>.33</td>
<td>.57</td>
</tr>
<tr>
<td>Cons of smoking</td>
<td></td>
<td>1.66</td>
<td>.90</td>
<td>1.78</td>
<td>.99</td>
<td>.75</td>
<td>.39</td>
</tr>
<tr>
<td>Anti-smoking Norms</td>
<td></td>
<td>2.69</td>
<td>1.84</td>
<td>2.72</td>
<td>1.71</td>
<td>.007</td>
<td>.94</td>
</tr>
<tr>
<td>Smoker prototypes</td>
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<td>.46</td>
<td>1.39</td>
<td>.44</td>
<td>4.25</td>
<td>.04</td>
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<tr>
<td>Non-smoker prototypes</td>
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<td>.48</td>
<td>1.94</td>
<td>.52</td>
<td>.05</td>
<td>.83</td>
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<tr>
<td>Susceptibility to smoke</td>
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<td>.62</td>
<td>3.41</td>
<td>.60</td>
<td>.29</td>
<td>.59</td>
</tr>
</tbody>
</table>

Note: A higher score indicates more favourable smoking cognitions

Table 1. Multivariate analysis of variance of the influence of movie smoking on explicit smoking cognitions

**The Influence of Exposure to Smoking in Movies on Beliefs About Smoking and Implicit Associations**

The differences in groups for each of the measures are also shown in Table 1. The results revealed no differences between groups for the general attitude toward smoking, personal smoking-related expectancies, smoker and non-smoker prototypes, or susceptibility to smoke (Wilks’ Lambda = .96, F(7, 192) = 1.18, \( p = .32 \)). A significant difference between groups was found only for the perceived social norm regarding smoking. Figure 1 shows the distributions for response to the norm questions by group. A score of 1.0 would represent the most anti-smoking norms stance. Figure 1 illustrates that exposure to movie smoking was associated with a shift away from the most anti-smoking stance. Although 42% of the control group was in the most anti-smoking category, only 27% were in that category for the group exposed to movie smoking. A MANOVA was conducted to examine the influence of smoking cues in movies on implicit associations toward smoking. No significant results were found (D600 penalty: \( F(1, 92) = 0.00, p = .996 \); D2SD penalty: \( F(1, 92) = .05, p = .82 \).
The results on beliefs about smoking and implicit associations toward smoking were not affected when including film appreciation as a covariate.

Figure 1. Side-by-side display of the distribution for anti-smoking norms across groups.

Discussion

This study revealed that a 20-minute segment of smoking from family-rated entertainment had no effect on implicit associations toward smoking and only a small effect on one smoking-related cognition, antismoking norms, that became apparent only when the results from two studies were combined. Notably, this is one statistically significant test out of 21 attempted (7 for each of 2 studies and another 7 for the studies combined), so the finding could have occurred by chance. There are several plausible explanations for the weak impact of movie smoking on smoking beliefs and attitudes in the present studies.

First, epidemiologic studies, which reveal an effect of smoking portrayal in movies on smoking initiation, assess cumulative doses of exposure that measure in the thousands. In the present two studies, children's smoking beliefs were measured after exposure to a single 20-minute movie segment with smoking scenes. It is possible that it takes more than a 20-minute exposure to affect beliefs about smoking, such that an experiment in children would have to employ a design that delivered repeated exposures over time to reveal a result. These results on short-term effects would seem reassuring for parents who wish to restrict exposure but worry about the fact that their children also watch movies with friends outside the home environment. However, as it has been shown that cumulative smoking movie exposure affects smoking initiation, the question arises as to where the threshold lies. A single movie may not affect beliefs about smoking, but this study begs the question of just how many depictions of smoking in movies constitute the turning point.

Second, it might be the case that the influence of smoking cues in movies increases with age as children enter adolescence. Longitudinal research on smoking beliefs has revealed that favourable beliefs about smoking increase with age (Dinh, et al., 1995; Freeman, Brucks, & Wallendorf, 2005). Thus, children between the ages of 8 and 10 years are more cognitively resistant to social influence prompts from movies than adolescents, as evidenced by beliefs about smoking of children in this study, which were substantially skewed toward an anti-smoking stance. A media influence prompt was unable to change strongly held negative beliefs about smoking, in contrast to adolescents, who are cognitively more susceptible to a variety of social influence prompts. One problem with this explanation is that longitudinal survey research indicates an influence of smoking in movies that starts before experimentation of smoking during the preadolescent period (Titus-Ernstoff, et al., 2008).

Another possibility is that, although smoking portrayal is present in all movies, smoking movie prompts from cartoons and family-oriented movies might be less salient than smoking depictions in movies rated for older adolescents and adults, because characters who smoke in family-rated movies deliver a different message than smoking characters in movies rated for older audiences. For example, a smoking Lucky Luke might not represent the prototype of a cool, sexy, glamorous smoker (the prototype adolescents tend to emulate) and might therefore not have a large impact on children's beliefs about smoking. Also, in the movies used in this study, smoking was portrayed by "good guys," which has been found to be less influential than exposure to "bad guy" smoking (Tanski, et al., 2009). Instead, smoking presented in the context of other adult situations, as portrayed in PG-13- and R-rated movies, would have more impact. This hypothesis is supported by another study revealing that exposure to smoking in G- and PG-rated movies has little prospective association with smoking behaviour in adolescents (Sargent, Tanski, & Stoolmiller, 2012).
The study strengths include the unique paradigm, being the first experimental study on the influence of movie smoking exposure in such a young age group. Although the current study extends previous research by assessing several explicit and implicit measures, some limitations should be acknowledged. Because previous research suggests that eliminating the portrayal of smoking in movies would reduce smoking onset by one-third to one-half (Dalton, et al., 2003; Sargent, et al., 2005; Titus-Ernstoff, et al., 2008) we expected to find medium to large effects in the current study. Based on these expectations, power calculations (based on power = .80 and \( p = .05 \)) indicated that a sample of 98 was necessary for detecting large effects (\( f^2 = .16 \)), and a sample of 248 was needed to detect medium effects (\( f^2 = .06 \)). However, effects of this size were not found in this study. As a result, the observed power of the current study was .50. Thus, our sample size was not powered to detect a small population effect, which can therefore not be ruled out. Another limitation is the order of the assessment of the cognitive tasks. In the current study, explicit cognitions were examined before implicit cognitions. Some scholars argue for carry-over effects when implicit cognitions are assessed after explicit measures (Bosson, Swann, & Pennebaker, 2000). However, research has also indicated that assessing explicit cognitions (i.e. questions about alcohol and drug use) before implicit memory associations not only increased the amount of alcohol associations produced but also concurrently and prospectively predicted alcohol use (Krank, Wall, Stewart, Wiers, & Goldman, 2005).

**Conclusions**

These studies examined the impact of family-oriented movie smoking on children’s beliefs about smoking and implicit associations toward smoking. A significant effect was only found for anti-smoking norms. However, as previous studies have revealed that cumulative exposure to movies with smoking cues influences smoking experimentation among adolescents, future research needs to examine whether and how these portrayals affect adolescents’ beliefs about smoking. Understanding the underlying mechanism of this association is not only necessary to tailor prevention programs but is also significant in respect of policy implications for the movie rating system. The current study suggests that prevention and policy initiatives should rather focus on the effect of smoking in family-oriented movies. Thus, tobacco control initiatives in the United States should pay attention to adjusting the rating system to address smoking in PG-13 movies. However, this should not be taken to mean that enriching G- and PG-rated movies with smoking is justified or desirable.
Appendix

Description of the Movie Lucky Luke

Based on a Belgian comic, this story is set in the Old West and portrays an American cowboy who is known to “shoot faster than his shadow” and who helps the sheriffs and cavalry in catching villains. Both the comic and the movie are suitable for and popular amongst children in the Netherlands, Belgium, and France. In the present clip, Lucky Luke fights crime and injustice against the Dalton brothers. Lucky Luke smokes cigarettes in earlier film versions, but the cigarette was replaced with a blade of straw in later versions due to public pressure.

Description of the Movie Love Is All

This popular Dutch romantic comedy, featuring many known Dutch actors, contains different storylines that come together during the movie. The movie portrays events around the Dutch holiday Sinterklaas (Santa Claus - December 5th). Several of the main characters smoke cigarettes. All characters who smoked in this movie were good (positively valenced) characters.
Chapter 3
Parental smoking and children’s attention to smoking cues

Published as:
Abstract

Introduction: Research has shown that children with smoking parents are more likely to initiate smoking than children with non-smoking parents. So far, these effects have been explained through genetic factors, modelling and norm-setting processes. However, it is also possible that parental smoking affects smoking initiation through automatic cognitive processes. Therefore, we examined whether children with a smoking parent focus longer, faster and more often on smoking cues.

Method: The children were given two movie clips to watch, during which their attention to smoking cues was assessed with eye-tracking technology.

Results: Results showed that children with a smoking parent focused more often and longer on smoking cues compared with children with non-smoking parents. No correlations between attentional bias and explicit smoking cognitions were found.

Discussion: In conclusion, results suggest that parental smoking affects children’s attention to smoking cues. These findings may indicate that parental smoking instigates automatic cognitive processes in children who have not experimented with smoking, and possibly even before explicit smoking cognitions become more favourable.

Introduction

A number of studies have shown that parental smoking is one of the strongest predictors of adolescents’ smoking behaviour (Avenevoli & Merikangas, 2003; Mayhew, et al., 2000). Adolescents with smoking parents are more likely to instigate smoking themselves than those with non-smoking parents. The effect of parental smoking on the first stages of smoking onset has been explained through genetic transmission (Munafò & Johnstone, 2008), modelling and norm-setting processes (Avenevoli & Merikangas, 2003; Bandura, 1977). Children’s ideas regarding smoking are partly formed through exposure to parents’ smoking behaviour and their beliefs about smoking. Children observe their parents’ behaviour and copy it when they are in the same situation (De Leeuw, et al., 2010c). Also, parents express their pro-smoking attitudes and norms through their own smoking behaviour and consequently influence the attitude development of their children. Previous research supports this theory, as parental smoking has been linked to more favourable smoking-related cognitions in children. When asked explicitly, children with smoking parents reported more favourable attitudes towards smoking (Brook, et al., 1999) and were more likely to report a desire to smoke in the future than children with non-smoking parents (Shute, et al., 1981). Moreover, even young children with smoking parents view smoking as normative in social situations, as they show a tendency to model their parents’ smoking behaviour in role-playing tasks (Dalton, et al., 2005; De Leeuw, et al., 2010c). These findings indicate that exposure to parental smoking affects children’s smoking cognitions even at a young age.

However, young children are generally negative about smoking (Brook, et al., 1999; Porcellato, et al., 2005) and little is known about the initial stage of preparation, when children’s attitudes, beliefs and intentions to smoke are formed by exposure to opinions and smoking behaviour of significant others. It is possible that in the initial stage, before children develop pro-smoking attitudes and beliefs, exposure to parental smoking influences children implicitly and predisposes them to initiate smoking. Thus, the exposure to parental smoking may not only be explained by the explicit pathway through social learning, but also through an implicit pathway in the form of automatic cognitive processes.

According to dual process models of addiction, development of smoking in adolescents can be explained as a result of an imbalance between a regulatory
executive system and an impulsive approach-oriented system (Wiers, et al., 2007a). The regulatory executive system is characterized by deliberate, explicit evaluations about smoking, such as attitudes and beliefs, and is available to conscious introspection. The impulsive approach-oriented system is characterized by associations that affect cognitive and affective processes and behaviour automatically. Repeated cigarette smoking causes a neural sensitization in the reward systems of the brain, leading to a stronger dopamine release every time one smokes. Further, through classical conditioning, cues that are often paired with smoking - with the stimulation of the reward systems - become associated with its pleasurable outcome. This leads to an attribution of incentive salience to the perception and mental representation of those cues. As a result, cues become attractive, desired and capable of capturing attention automatically, which may foster automatic approach action tendencies (e.g. Franken, 2003; Robinson & Berridge, 1993). According to dual process models, the presence of sufficient capacity and motivation can still inhibit this action tendency (Wiers, et al., 2007a).

Dual process models may also explain the initiation of smoking, as environmental cue exposure may influence both systems by shaping explicit evaluations and implicit associations. Thus, exposure to parental smoking may affect children’s explicit evaluations through social learning processes. There is one mechanism that could explain how environmental smoking exposure may also influence implicit associations, predisposing children to smoke and putting them at risk of initiation before experimenting with cigarettes. Although certain scholars argue that the development of automatic cognitive responses requires repeated experiences with a drug (Robinson & Berridge, 1993; Wiers, et al., 2007a), others claim that repeated exposure to environmental drug-related cues can lead to automatic cognitive responses, even without personal experiences with the drug (Pieters, et al., 2010; Van Der Vorst, et al., 2012). With regard to cigarette smoking, repeated exposure to environmental smoking cues (e.g. parental smoking) might spontaneously lead to mental representations about smoking. When smoking occurs in a positively valued context, for example when children perceive that smoking relaxes their parents, a positive association of smoking will be stored in the memory. Repetitive exposure to smoking might form and strengthen these memory associations (Stacy, 1995). A repetitive association between environmental smoking cues and a positive affect or outcome might attribute a high salience to those cues, allowing them to be captured more easily. Those cues might trigger implicit associations towards smoking, and therefore if adolescents are found in a spontaneous situation where they could smoke, they might be more inclined to act upon it.

One study provided preliminary evidence that exposure to parental substance use affects automatic cognitive responses in adolescent non-users. Zetteler et al. (2006) found an attentional bias for alcohol-related information in adolescents with alcohol-dependent parents.

Examining the impact of parental smoking on children’s automatic cognitive responses is important, as it may explain the increased risk of smoking initiation later in life. Automatic cognitive responses in non-smoking children after exposure to parental smoking would be a cause for concern, as this might indicate that the incentive motivational system is sensitized without the children using tobacco themselves. If non-smoking children develop automatic cognitive responses as a result of exposure to parental smoking, prevention programmes will need to be amended so that they target automatic cognitive responses instead of focusing solely on explicit attitudes, beliefs and expectancies. Therefore, the objective of the present study was to examine whether parental smoking is associated with automatic cognitive responses in non-smoking children. As selective attention plays an important role in the maintenance of smoking behaviour and the attentional bias is a common and reliable measure in addiction research (Field & Cox, 2008; Field, et al., 2009b), we assessed selective attention as an indicator of automatic responses. We exposed children with non-smoking parents and children with a smoking parent to two movie clips with smoking cues. Their attention while watching the movie clips was examined with eye-tracking technology. It was hypothesized that children with a smoking parent, compared with children with non-smoking parents, would be more likely to have their attentional focus automatically captured and held by smoking cues when they appear on screen. Based on the mentioned literature, we expected children with a smoking parent to have more favourable explicit smoking cognitions compared with children with non-smoking parents. Moreover, we expected selective attention to be positively correlated with explicit smoking cognitions.

**Method**

**Participants**

A total of 71 family units were invited to participate in the study. Of the 71, 64
parents gave active consent for the participation of their children. Due to former and current smoking behaviour, 30 family units were excluded from the study. The data of four children could not be used due to insufficient calibration. A total of 30 children (17 boys and 13 girls) between the ages of 10 and 13 years ($M = 11.47; \text{SD} = .86$) participated in the study. The group of 19 children with non-smoking parents consisted of 12 boys and seven girls, ranging in age from 10 to 13 ($M = 11.37; \text{SD} = .83$). All parents reported being non-smokers. One of the children reported having taken a puff once. The group of 11 children with one smoking parent (five boys and six girls) had a mean age of 11.64 years ($\text{SD} = .92$). Of each child, one parent reported being a daily smoker. One of the children reported having taken a puff a couple of times. All children reported living with the smoking parent. All children had visual acuity within normal limits.

**Material**

The stimulus material consisted of two movie clips, one from the Dutch version of the movie *101 Dalmatians* (1996) and the other from the Dutch movie *De Schippers van de Kameleon* (2003). The segment of the movie *101 Dalmatians* (1996) contained 58 smoking scenes (= 2.55 minutes, range 560-7160 ms), in which one of the female main characters smoked. The segment of the movie *De Schippers van de Kameleon* (2003) contained 19 smoking scenes (= 1.30 minutes, range 760-11320 ms). In this clip, two adolescent boys smoked. A smoking scene was defined by the amount of time a smoking-related cue was portrayed in the movie. Smoking-related cues were mainly portrayed in the form of cigarettes; only one incident in the clip of *De Schippers van de Kameleon* (2003) included a lighter. To control for order effects, the presentation of the two clips was counterbalanced. The fixation of a child with a smoking parent and a child with non-smoking parents are superimposed onto a single frame.

**Procedure**

The study protocols were approved by the Ethical Committee of the Faculty of Social Sciences, Radboud University Nijmegen. In order to recruit children with a smoking parent and due to small sizes of the school classes, the studies were conducted in three elementary schools in different regions of the Netherlands. Prior to the study, the parents completed a questionnaire on their own smoking habits and provided active written consent for the participation of their children. The studies took place in a separate classroom at each school between November 2009 and May 2010. The children were individually taken out of their classroom for approximately 50 min. First, the researcher explained to the children that they were participating in a study in which they would watch two 15-minute movie clips. They were not informed about the aim of the study in advance. Then, the participants were seated in a comfortable chair, 60 cm from the eye tracker. They were instructed to find a comfortable position in which they could watch the movie clips in a relaxed way without moving. After watching the movie clips, the participants were requested to complete a written questionnaire (see **Measures**). All children were debriefed and received a small token (a pen) for their participation.

**Measures**

**Parental smoking.** Children were asked whether their parents smoked, separately for their fathers and mothers with two questions: ‘Does your mother smoke?’ and ‘Does your father smoke?’. Response categories were ‘no’ and ‘yes’ which were recoded to ‘both parents do not smoke’ (0) and ‘one parent smokes’ (1) (De Leeuw, et al., 2010c). Parents were asked to report on an 8-point scale (1: ‘I have never smoked, not even one puff’, 2: ‘I tried smoking, I don’t smoke anymore’, 3: ‘I stopped smoking, after smoking less than once a week’, 4: ‘I stopped smoking, after smoking at least once a week’, 5: ‘I smoke less than once a month’, 6: ‘I smoke not weekly, but at least once a month’, 7: ‘I smoke not daily, but at least once a week’, and 8: ‘I smoke at least once a day’) which stage of smoking applied to them and the other parent (De Leeuw, et al., 2010c). Based on these responses, parents were classified into two categories (0) both parents did not smoke currently (both responses were 1), and (1) one parent smokes currently (the response of one parent was 8). Children whose parents answered between 2 and 7 were not selected for the study. The selection was based on the parents’ report. However, correspondence between child and parent report was high; all children identified their parents correctly as smokers or non-smokers. Parents were also asked about their smoking history (age of initiation) and current smoking patterns (number of cigarettes smoked per day and week, whether they smoke at home, whether they have a designated room where
**Apparatus and coding procedures**

Eye movements were recorded with a corneal reflection eye tracker (Tobii T120 Eye Tracker, Tobii Technology, Danderyd, Sweden). Two raters independently coded participants’ data and were blind to parents’ smoking status (the first rated 100%, and the second 50% of the data). The intra-class correlation coefficient was assessed for all dependent variables per film and ranged from .86 - .97 (Lochbuehler, et al., 2011).

**Statistical analysis**

The design had three dependent variables: the number of fixations on the smoking cues, the latency of initial fixations on the smoking cues and the duration of initial fixation (maintenance of gaze/gaze duration) (Field, et al., 2006b; Mogg, et al., 2003). The number of fixations was determined by counting the times the participant fixated on a smoking cue. To examine the initial fixations, the interval between cue appearance and the participants’ first time to fixate on the cue within a smoking incident was measured. Maintenance of gaze was defined as the overall amount of time that the gaze was directed to the smoking cues. A relative duration score was calculated for each smoking scene by expressing the time of cue fixation as a proportion of the total eye data in this incident. The total eye data were calculated by means of deducting the missing eye data from the length of the cue exposure (Lochbuehler, et al., 2011). For the statistical analyses, the scores of both films were combined. A multivariate analysis of covariance (MANCOVA) was conducted to test group differences in the number of fixations on the smoking cues, the total fixation time on the smoking cues and the latency of initial fixations. We controlled for age.

**Results**

**Descriptive statistics**

The participants in the two conditions did not differ with regard to sex ($p = .36$), age ($p = .42$), whether participants had tried smoking before ($p = .41$) and whether they had already seen the movie ($p = .71$ and $p = .19$).
Influence of parental smoking on attentional bias

A MANCOVA was performed to examine whether children with a smoking parent and children with non-smoking parents differ in their attention to smoking cues. The independent variable was the condition (children with non-smoking parents vs. children with one smoking parent), and the dependent variables were the number of fixations, the relative duration of fixations and the latency of fixations. Age was used as covariate. The results are presented in Table 2. The results showed a significant difference between conditions on the dependent variables, \( F(3, 25) = 3.05, p = .047; \) Wilks’ Lambda = .732; partial eta squared = .27. When the results for the dependent variables were considered separately, the difference in the number of fixations and the relative duration of fixations between children with a smoking parent and children with non-smoking parents reached statistical significance. Children with a smoking parent (\( M = 45.55, SD = 18.18 \)) focused more often on smoking cues than children with non-smoking parents (\( M = 35.26, SD = 10.38 \)). On average, children with a smoking parent (\( M = .11, SD = .07 \)) directed their gaze significantly longer on smoking cues than children with non-smoking parents (\( M = .08, SD = .03 \)). No significant difference between groups was found with regard to the latency of cue fixation; however, the results constituted a trend. Children with a smoking parent directed their gaze towards the cue on average 1310.87 ms after the cue appeared, children with non-smoking parents after 1471.32 ms.

### Parental smoking habits and smoking exposure

In the group of children with one smoking parent, of each child, one parent reported being a daily smoker (seven fathers and three mothers). On average, they smoked 11.44 cigarettes per day (\( SD = 5.92, range 5–20 \)) and 87.38 cigarettes per week (\( SD = 42.10, range 35–150 \)). Three of the smoking parents reported not smoking at home, five reported to have a designated room where they smoke, and four reported not smoking in the presence of their child. In four of the 11 families, other people are allowed to smoke at their house. On average, parents reported that their child knows 2.07 (\( SD = 1.57 \)), and children reported that they know 2.83 (\( SD = 2.55 \)), people who smoke (other than their parents).

### Movie-related variables

A total of 56.7% of the children reported having seen the movie De Schippers van de Kameleon before and 76.7% reported having seen the movie 101 Dalmatians before. The children, on average, enjoyed watching the movies. They liked watching the movie De Schippers van de Kameleon more (\( M = 3.14; SD = .45 \)) than the movie 101 Dalmatians (\( M = 2.98; SD = .42 \)).

### Explicit smoking cognitions

Children had, on average, very unfavourable cognitions towards smoking. The results of a MANOVA showed no differences between groups (Wilks’ Lambda = .67, \( F(3, 26) = 4.37, p = .01 \)) for the general attitude towards smoking and cons of smoking, but for pros of smoking. The differences in groups for each of the cognitions are also shown in Table 1.

<table>
<thead>
<tr>
<th>Smoking parent</th>
<th>Non-smoking parent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pro-smoking Attitudes</td>
<td>1.69</td>
</tr>
<tr>
<td>Pros of smoking</td>
<td>1.31</td>
</tr>
<tr>
<td>Cons of smoking</td>
<td>6.47</td>
</tr>
</tbody>
</table>

### Table 1. Multivariate analysis of variance of the influence of parental smoking on explicit smoking cognitions.

### Influence of parental smoking on attentional bias

A MANCOVA was performed to examine whether children with a smoking parent and children with non-smoking parents differ in their attention to smoking cues. The independent variable was the condition (children with non-smoking parents vs. children with one smoking parent), and the dependent variables were the number of fixations, the relative duration of fixations and the latency of fixations. Age was used as covariate. The results are presented in Table 2. The results showed a significant difference between conditions on the dependent variables, \( F(3, 25) = 3.05, p = .047; \) Wilks’ Lambda = .732; partial eta squared = .27. When the results for the dependent variables were considered separately, the difference in the number of fixations and the relative duration of fixations between children with a smoking parent and children with non-smoking parents reached statistical significance. Children with a smoking parent (\( M = 45.55, SD = 18.18 \)) focused more often on smoking cues than children with non-smoking parents (\( M = 35.26, SD = 10.38 \)). On average, children with a smoking parent (\( M = .11, SD = .07 \)) directed their gaze significantly longer on smoking cues than children with non-smoking parents (\( M = .08, SD = .03 \)). No significant difference between groups was found with regard to the latency of cue fixation; however, the results constituted a trend. Children with a smoking parent directed their gaze towards the cue on average 1310.87 ms after the cue appeared, children with non-smoking parents after 1471.32 ms.

### Table 2. Multivariate analysis of variance of the influence of parental smoking on attention to smoking cues.
Smoking-related cues might receive a high salience through observational learning. The repeated pairing of parental smoking and its positive outcome leads to the storage of a positive mental representation of smoking in children's memories. It also needs to be mentioned that the existence of an attentional bias could potentially be explained by familiarity or expertise with smoking cues. Ryan (2002) argues that attentional processing is influenced by repetitive exposure to and the frequency of processing particular cues.

As previous research supports a potential role of familiarity or expertise on attentional biases (Chanon, Sours, & Boettiger, 2010; Dalgleish, 1995; Ryan, 2002), the question remains whether the occurrence of an addiction-related attentional bias is based on addictive processes or familiarity with the cue (Chanon, et al., 2010). Moreover, the possibility of a third co-related variable explaining the link between parental smoking and selective attention should be taken into account. As parental smoking behaviour in the presence and close proximity of the child varied in this study, a third co-related variable (e.g. sensation seeking) could underlie the effect. Future research should reveal which mechanism underlies the association between parental smoking and attention to smoking cues.

The lack of association between the measures of attention and explicit smoking cognitions raises two points of discussion. First, prior research has not only revealed that children are highly negative about smoking when asked explicitly (Brook, et al., 1999; Porcellato, et al., 2005), but has also shown that implicit attitudes prospectively predicted smoking onset among adolescents, above and beyond the effects of explicit attitudes (Sherman, et al., 2009). Also, during play, young children with smoking parents who pretended to smoke did this irrespective of their explicit smoking attitudes (De Leeuw, et al., 2010c). This emphasizes the relevance of measuring implicit as well as explicit smoking cognitions. Second, the lack of association between the measures of attention and explicit smoking cognitions may indicate an influence of parental smoking on attention before cognitions become more favourable. This could mean that children with smoking parents develop automatic cognitive responses in the form of an attentional bias and positive implicit associations towards smoking before they form favourable explicit cognitions. It can be assumed that the stronger the link between smoking exposure and automatic cognitive responses (mental representations), the more likely children initiate smoking.
This is the first study to investigate the influence of parental smoking on children’s attention to smoking cues. One of the study’s strengths is the usage of an eye-tracking paradigm to assess selective attention, which provides the advantage of measuring attention directly and not inferring attentional processes on the basis of reaction times in comparison with indirect measures (Field, et al., 2009b). In comparison with pictorial cues, eye-tracking technology, combined with dynamic cues, measures the attention to cues that are less explicit, therefore providing high ecological validity. Also, in the context of assessing the attention of children, this measure seems to be an appropriate alternative to assess attentional focus. Moreover, we used two different stimuli (two films) to assess children’s attention and the same effects were found in both of them.

However, some limitations should be acknowledged. First, it needs to be mentioned that the valence of the attentional focus is not clear. It is possible that the attentional focus reflects children’s concerns regarding smoking and does not represent positive associations with smoking. Future research should address this issue and investigate the valence of the attentional focus. Second, we did not include any control cues with which the attention to smoking-related cues can be compared. It is possible that children of smokers versus non-smokers differ in their attentional styles more generally and do not only focus on smoking cues, but on salient stimuli in general. Future research should test whether their attentional focus is limited to smoking cues. Third, not all measures of attention were significant. We did not find a significant effect for latency of fixation, but this outcome constituted a trend. This lack of significance could be due to statistical power. Fourth, our study compared children with non-smoking parents and children with one smoking parent. Future research should include children with two smoking parents and a more precise measure of environmental cue exposure in order to investigate whether a greater exposure to environmental smoking cues leads to a stronger effect on selective attention. Fifth, due to a relatively small size, our sample was not sufficiently powered to perform analyses on moderating factors. In future research, it would, for example, be interesting to test whether smoking mothers have stronger effects on selective attention than smoking fathers. Next to replication of our findings by other research labs, it is important to conduct a longitudinal study in which repeated measures of attention to smoking cues in samples of adolescents of smoking and non-smoking families are linked to smoking initiation. Moreover, neuropsychological studies could provide an indication on the question whether the attentional focus is driven by familiarity with the cue or by learning processes.

In conclusion, this study reveals an association between parental smoking and children’s attention to smoking cues in the way that children with smoking parents, as compared with children with non-smoking parents, focus more often and longer on dynamic smoking-related cues. These results may indicate that parental smoking instigates automatic cognitive processes in children who have not experimented with smoking, possibly even before explicit smoking cognitions become more favourable. If replicated, early prevention programmes may need to be adapted so as to target automatic cognitive responses. Our results are also relevant for the implications of the portrayal of smoking in movies. This is of great importance, as children are regularly exposed to smoking cues in movies (Roberts, 2000; Roberts, et al., 2005; Sargent, et al., 2001) and exposure to smoking portrayal in movies has been linked to smoking initiation (Dalton, et al., 2003; Hanewinkel & Sargent, 2008; Jackson, et al., 2007; Titus-Ernstoff, et al., 2008; Wills, et al., 2007). Selective attention might also explain the strong association between exposure to smoking in movies and smoking initiation. Repeated exposure to environmental smoking cues, such as smoking cues in movies, parental and peer smoking, might lead to the development of an attentional focus to smoking cues.
Chapter 4
Parental and movie smoking and early adolescents’ explicit and implicit smoking cognitions

Unpublished manuscript:
**Abstract**

*Introduction:* Dual process models propose that the formation and development of explicit and implicit smoking-related cognitions are partly a result of the social environment. The aim of the current study was to test the associations between the exposure to parental and movie smoking and early adolescents’ explicit and implicit smoking-related cognitions.

*Method:* Early adolescents’ explicit smoking-related cognitions were measured using questionnaires. We assessed three facets of implicit smoking-related cognitions: attention to smoking cues (assessed with an eye-tracking paradigm), smoking-related memory associations (measured with a single target implicit association task), and automatic approach tendencies toward smoking (assessed with a stimulus-response compatibility task).

*Results:* The exposure to movie smoking was not associated with any explicit or implicit smoking-related cognition in early adolescents. Also, a difference between adolescents with smoking parents and those with non-smoking parents was only found for the number of fixations to smoking cues and this was related to adolescents’ age. No difference between early adolescents with smoking parents and adolescents with non-smoking parents was found for the duration and the latency of fixations, smoking-related memory associations, and automatic approach tendencies toward smoking.

*Discussion:* Our study found little impact of the exposure to parental and movie smoking on explicit and implicit smoking-related cognitions. As our study was exploratory and previous research on the effects of environmental smoke exposure on the formation of explicit and implicit smoking-related cognitions is scarce, further research is needed.

**Introduction**

Research has shown that children with smoking parents have an increased risk to start smoking later in life (Leonardi-Bee, et al., 2011). Up to now, researchers named genetic transmission (Munafò & Johnstone, 2008) and modelling and norm-setting processes (Avenevoli & Merikangas, 2003; Bandura, 1977) as underlying mechanisms explaining the effect of parental smoking on smoking initiation (Leonardi-Bee, et al., 2011). It has been proposed that in addition to the explicit pathway through social learning, the exposure to parental smoking might also affect children implicitly in the form of automatic cognitive processes (O’Connor, et al., 2007; Rooke, et al., 2008; Chapter 3). Only recently, researchers started to investigate the development of automatic cognitive processes in children and adolescents and its role in the initiation of substance use. It has been proposed that repeated exposure to environmental substance-related cues can lead to automatic cognitive responses, even without personal experiences (i.e. administration) with the substance (Pieters, et al., 2010; Van Der Vorst, et al., 2012). With regard to cigarette smoking, if children and adolescents are repeatedly exposed to smoking in their social environment and they perceive smoking in a positive way, they might attribute a high salience to those cues and might form and strengthen positive associations with smoking (Stacy, 1995). Also, after repeated exposure, environmental smoking cues might receive the ability to activate implicit associations towards smoking. Later, when children and adolescents are in a situation in which they get the opportunity to experiment with smoking, they might be likely to do so (O’Connor, et al., 2007; Stacy & Newcomb, 1998; Van Der Vorst, et al., 2012). Thus, the exposure to smoking in the social environment might affect the development of explicit and implicit smoking cognitions, strengthening positive associations with smoking and putting children at risk for the initiation of smoking.

In a first exploratory study (Chapter 3), we examined whether parental smoking was associated with children’s selective attention to smoking cues. Children’s attention was assessed while watching two movie clips with smoking cues by using eye-tracking technology. Results showed that children with a smoking parent focused more often and longer on smoking cues as compared to children with non-smoking parents. No difference between children with a smoking parent and children with non-smoking parents was found for latency of fixation. These preliminary findings suggest that parental smoking affects children’s attention to smoking cues.
Yet, as our pilot study was the first study examining the relation between parental smoking and children’s attention to smoking cues, a conclusive interpretation can only be made after these results have been replicated. Also, the pilot study leaves several unanswered questions, which should also be addressed in future research. First, based on our pilot study, it remains unclear whether the attentional focus is positively or negatively valenced. The exposure to parental smoking might not necessarily lead to the formation of positive associations, but an attentional bias for smoking cues could also reflect children’s concerns regarding smoking.

Second, the assessment of explicit as well as different features of implicit smoking-related cognitions (selective attention to smoking cues, smoking-related memory associations, and automatic approach tendencies toward smoking) might provide a more complete picture of cognitive mechanisms underlying the onset of smoking (O’Connor, et al., 2007). With regard to implicit smoking-related associations, one study among 5th-graders revealed that children with smoking family members had more favourable implicit attitudes towards smoking (assessed with an implicit association task) than children with non-smoking family members (Andrews, et al., 2010). Recent research on alcohol-related memory associations showed that paternal alcohol use was related to implicit negative alcohol-related associations of young children (Pieters, et al., 2010) and that parental drinking was related positively to alcohol-related memory associations, which in turn predicted adolescents’ alcohol use a year later (Van Der Vorst, et al., 2012). Based on these studies, we expected parental smoking to be associated with early adolescents’ smoking-related memory associations.

Third, the pilot study assessed the relation between parental smoking and children’s attention to smoking cues, but did not consider the exposure to other sources of environmental smoke exposure (such as movie smoking). Selective attention might also explain the strong association between exposure to smoking in movies and smoking initiation (Dalton, et al., 2003; Hanewinkel & Sargent, 2007, 2008; Jackson, et al., 2007; Sargent, et al., 2005; Sargent, et al., 2001; Thrasher, et al., 2008; Titus-Ernstoff, et al., 2008; Wills, et al., 2007). It would be interesting to investigate whether early adolescents who are exposed to several environmental sources are particularly at risk for developing favourable smoking-related cognitions.

Therefore, the aim of the current study was to test the associations between parental and movie smoking and early adolescents’ explicit and implicit smoking-related cognitions. Early adolescents’ attention to smoking cues was assessed with an eye-tracking paradigm (Lochbuehler, Otten, Voogd, & Engels, 2012; Lochbuehler, et al., 2011), their smoking-related memory associations were measured with a single target implicit association task (stIAT) (Huijing & de Jong, 2006), and their automatic approach tendencies toward smoking were measured with a stimulus-response compatibility task (SRC) (De Houwer, 2003; Field, Caren, Fernie, & De Houwer, 2011). Based on our pilot study (Chapter 3), we expected parental smoking to be related with early adolescents’ attention to smoking cues. As previous research showed an association between family smoking and children’s favourable implicit attitudes towards smoking (Andrews, et al., 2010), we expected parental smoking to be associated with early adolescents’ smoking-related memory associations. To our knowledge, no study has assessed the association between parental smoking and early adolescents’ automatic approach tendencies toward smoking. Also, this is the first study assessing the relation between movie smoking exposure and early adolescents’ implicit smoking-related cognitions. Therefore, no hypotheses can be formulated regarding these relations. Our pilot study found mixed results on the association between parental smoking and several explicit smoking-related cognitions. Therefore, no clear hypotheses can be formulated either.

Method

Sample and procedure

In December 2011, a total of 649 families from three high schools in the Netherlands were contacted and invited to participate. Parents were requested to complete a questionnaire assessing their own smoking habits and to provide active written consent for the participation of their children. Of the 649 families, 113 early adolescents (17.4%) agreed to participate in the study and received their parents’ active consent. Several early adolescents had to be excluded from the study: 12 due to insufficient calibration regarding the eye-tracking task. Further, 34 were excluded due to their parents’ former or current smoking behaviour as we aimed to compare the results of the current study with the results of the pilot study (Chapter 3), early adolescents with parents who quit smoking or who were smoking, but not on a daily basis, were excluded from the analyses (see Measures).
Exposure to movie smoking. Exposure to smoking in movies was assessed with the Beach method (Sargent, Worth, Beach, Gerrard, & Heatherton, 2008), which is based on the recall of seeing movies presented to participants in the form of a list of movie titles. Each participant received a list with a random selection of 50 movie titles out of a pool of 250 movies. The pool of 250 box-office hits consisted of the 50 most successful movies from 2005 to 2008 and the 25 most successful movies from 2004 to 2009. All included movies were content coded with regard to tobacco occurrences, assessing the number of occurrences of on-screen tobacco in each of the movies. Exposure to movie smoking was calculated for each participant by summing the number of tobacco occurrences in each movie they had seen. The measure was adjusted for possible variation in the movie lists by expressing individual exposure to movie smoking as a proportion of the total number of possible tobacco occurrences each participant could have seen on the basis of the movies included in his/her questionnaire. The final exposure estimate was the proportion of seen tobacco occurrences multiplied by the total number of tobacco occurrences in the respective movie population (Morgenstern, et al., 2011). More detailed information on this measure can be found in Morgenstern et al. (2011). For the analyses, the exposure to tobacco occurrences was dichotomized into two categories using the median: (0) low level of exposure to movie smoking, and (1) high level of exposure to movie smoking.

Adolescent smoking. Adolescents were asked whether they had tried smoking before. Response category was on a 9-point scale: 1: ‘I have never smoked, not even one puff’, 2: ‘I tried smoking, I don’t smoke at the moment’, 3: ‘I stopped smoking, after smoking less than once a week’, 4: ‘I stopped smoking, after smoking at least once a week’, 5: ‘I smoke not daily, but at least once a week’, and 8: ‘I smoke at least once a day’ (De Vries, Engels, Kremers, Wetzels, & Mudde, 2003).

Measures

Parental smoking. Adolescents were asked whether their parents smoked, separately for their fathers and mothers with two questions: ‘Does your mother smoke?’ and ‘Does your father smoke?’. Response categories were 1: ‘(S) he has never smoked, not even one puff’, 2: ‘(S) he tried smoking, but doesn’t smoke anymore’, 3: ‘Yes, less than once a day’, 4: ‘Yes, between 1 - 5 cigarettes per day’, 5: ‘Yes, between 6 - 10 cigarettes per day’, 6: ‘Yes, between 11 - 20 cigarettes per day’, 7: ‘Yes, between 21 - 30 cigarettes per day’ (based on Fagerstrom, 1991).

Parents were asked to report on an 8-point scale (1: ‘I have never smoked, not even one puff’, 2: ‘I tried smoking, I don’t smoke anymore’, 3: ‘I stopped smoking, after smoking less than once a week’, 4: ‘I stopped smoking, after smoking at least once a week’, 5: ‘I smoke less than once a month’, 6: ‘I smoke not weekly, but at least once a week’, and 8: ‘I smoke at least once a day’) which stage of smoking applied to them and the other parent (De Leeuw, et al., 2010c). Based on these responses, parents were classified into two categories: (0) both parents have never smoked (both responses were 1), and (1) at least one parent smokes on a daily basis (the response of one parent was 8). Children whose parents answered between 2 and 7 were not selected for the study. The selection was based on the parents’ report. However, correspondence between adolescent and parent report was high; all adolescents identified their parents correctly as daily smokers or never-smokers.
Explicit smoking cognitions

**Attitude towards smoking.** The general attitude towards smoking reflects the extent to which the participants approve or have a positive regard for smoking (Dijkstra, et al., 2001). Attitudes were assessed with seven items measured on a 7-point scale. Example items are: ‘I think smoking is: unhealthy (1)/healthy (7) and unpleasant (1)/pleasant (7)’. Alpha was .93.

**Smoking-related expectancies.** Personal smoking-related expectancies were measured with 10 items on a 7-point scale ranging from ‘definitely yes’ to ‘definitely no’ (Kremers, et al., 2001). The items measuring the pros of smoking refer to expected positive personal outcomes of smoking, while cons of smoking refer to expected negative personal outcomes of smoking. Both subscales consisted of five items each. An example item for the pros of smoking is: ‘If I were to smoke, it would make me feel very relaxed’. Alpha was .84. An example item for the cons of smoking is: ‘If I were to smoke, it would be bad for my health’. Alpha was .89.

**Perceived social norm regarding smoking.** We assessed the perceived social norm regarding smoking by asking the participants’ perception of the approval of friends and parents to smoke. It was measured with four items: ‘Do you think your best friend would approve when you smoke’, ‘Do you think your friends would approve when you smoke’, ‘Do you think your father would approve when you smoke’ and ‘Do you think your mother would approve when you smoke’. Both these items were answered on a 5-point scale ranging from 1 (definitely not) to 4 (definitely yes). Alpha was .65 (De Vries, et al., 1995).

**Prototypes.** The scale for measuring prototypes of daily smoking peers contained 22 items (Spijkerman, et al., 2004). The participants were asked to indicate to what extent the presented characteristics would describe/reflect the typical peer who smokes on a daily basis. Items were answered on a 5-point scale ranging from 1 ‘not at all’ to 5 ‘very much’. Alpha was .84. The same items were used to measure participant’s prototypes of non-smoking peers by assessing to what extent the characteristics would fit the typical non-smoking peer. Example characteristics for the scales are: ‘being cool, looking tough, and enjoying life’. Alpha was .82.

**Susceptibility to smoke.** Susceptibility to smoke was assessed with the following 5 items (Pierce, et al., 1996) that were answered on a 4-point scale (definitely not, probably not, probably yes, definitely yes): ‘If one of your friends offered you a cigarette, would you try it?’, ‘Do you think you will smoke a cigarette some time in the next year?’, ‘Would you smoke a cigarette if someone gave you one?’, ‘Do you think you will smoke cigarettes when you are in high school?’, ‘Do you think you will ever smoke cigarettes?’. Alpha was .78.

Implicit smoking cognitions

**Attentional focus.** Eye movements were recorded with a corneal reflection eye tracker (Tobii T120 Eye Tracker, Tobii Technology, Danderyd, Sweden). The stimulus material consisted of two movie clips, one from the Dutch version of the movie 101 Dalmatians (1996) and the other from the Dutch movie De Schippers van de Kameleon (2003). The segment of the movie 101 Dalmatians (1996) contained 58 smoking scenes (= 2.55 minutes, range 560 - 7160 ms), in which one of the female main characters smoked. The segment of the movie De Schippers van de Kameleon (2003) contained 19 smoking scenes (= 1.30 minutes, range 760 - 11320 ms). In this clip, two adolescent boys smoked. A smoking scene was defined by the amount of time a smoking-related cue was portrayed in the movie. Smoking-related cues were mainly portrayed in the form of cigarettes; only one incident in the clip of De Schippers van de Kameleon (2003) included a lighter. To control for order effects, the presentation of the two clips was counterbalanced (Lochbuehler, et al., 2012; Lochbuehler, et al., 2011). Two raters independently coded participants’ data and were blind to parents’ smoking status (the first rated 100%, and the second 25% of the data). The intra-class correlation coefficient was assessed for all dependent variables per film and ranged from .71 - .97.

**Single target implicit association task.** We used a child-friendly version of the stIAT to assess children’s implicit associations towards smoking (Huijding & de Jong, 2006). Participants simultaneously sorted target pictures of smoking-related scenes (Huijding & de Jong, 2006) and stimulus words (Pieters, et al., 2010) as fast as possible into two attribute categories ‘good’ and ‘bad’ and one target-related category ‘smoking’. The task consisted of two test phases, which were each preceded by a practice trial. In one test phase ‘smoking’ and ‘good’ were mapped on a single key and ‘bad’ was mapped on the other. In the other test phase ‘smoking’ and ‘bad’ were mapped on a single key and ‘good’ on the other. The two test phases were counterbalanced. If a participant responded incorrectly, a large red X appeared in the middle of the
screen until the correct response was given. The D2SD and D600 penalty measures were used as sIAT scores (Greenwald, et al., 2003; Thush, et al., 2007). A difference score in reaction times between both test phases was calculated. This score reflects whether smoking is associated more strongly with either ‘good’ or ‘bad’, with relatively fast responses indicating relatively strong associations (Huijding & de Jong, 2006).

**Stimulus-response compatibility task.** In this reaction time task, which was designed to assess approach tendencies toward smoking cues, a set of 20 smoking-related pictures served as experimental stimuli and 20 matched non-smoking pictures were used as control stimuli. In each trial of the task, smoking-related and non-smoking pictures appeared in the centre of the screen. In addition, a manikin figure was displayed either below or above the picture. Participants were instructed to move the manikin figure either towards or away from the picture by making use of the keys ‘’ (manikin moved downwards) and ‘’ (manikin moved upwards). The SRC task consisted of two blocks with two different stimulus-response assignments: One block required participants to move the manikin towards smoking-related cues (positive approach movement) and to move the manikin away from non-smoking pictures (negative avoidance movement), whereas the other block required participants to move the manikin away from smoking-related pictures (negative avoidance movement) and towards the non-smoking pictures (positive approach movement). The latency between picture onset and the participant’s response served as the dependent variable. All participants completed both blocks, however, the order of blocks was counterbalanced across participants. Within each block, the manikin appeared below the picture on 50% of the trials, and above it on the other 50%. When the manikin appeared below the picture, 50% of the trials required a down response, whereas the other 50% required an up response, and the same was true when the manikin appeared above the picture. If the participant responded incorrectly, a large red X appeared in the middle of the screen. The manikin position and picture type varied randomly over trials. Each block was preceded by 8 practice trials. During the test trials, each experimental picture was presented twice, implying that each block contained 40 test trials. The whole task contained 96 trials. For each participant, the mean reaction time on ‘approach smoking trials’ was subtracted from the mean reaction time on ‘avoid smoking trials’. A higher score on this measure indicated a relative approach preference to smoking pictures. The criterion of being excluded from the analysis was if participants’ errors scores exceeded 25%. None of the participants had to be excluded from the analysis (Pieters, Burk, Van der Vorst, Wiers, & Engels, 2012; Woud, Anschutz, Van Strien, & Becker, 2011).

## Results

**Descriptives**

Data of 67 early adolescents (32 boys and 35 girls) between the ages of 12 and 14 years ($M = 12.89; SD = .66$) were analysed. Of them, 46 adolescents had non-smoking and 21 at least one smoking parent. In the group of adolescents with smoking parents, 11 mothers reported to smoke on average 96.70 cigarettes per week ($SD = 73.25$) and 12.55 cigarettes per day ($SD = 9.80$) and 13 fathers reported to smoke 54.18 cigarettes per week ($SD = 49.60$) and 8.33 cigarettes per day ($SD = 6.83$). Adolescents with non-smoking parents did not differ from adolescents with at least one smoking parent with regard to age ($p = .49$) and their smoking status ($p = .43$). They did differ with regard to gender ($p = .01$); the group of adolescents with non-smoking parents consisted of 27 boys and 19 girls, whereas the group of adolescents with at least one smoking parent consisted of 5 boys and 16 girls. In total, 62 of the adolescents reported never having taken a puff, 4 adolescents reported to have tried smoking before and one adolescent did not answer the question. The participants have on average been exposed to 752.45 tobacco occurrences in movies ($SD = 671.92$; range 0-2948.11). Overall, adolescents reported relatively unfavourable explicit smoking-related cognitions. The average scores (and SDs) for the explicit smoking-related cognitions can be found in Table 1.

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Table 1. Average scores and SDs for explicit smoking-related cognitions
Correlations

In order to examine associations between all study variables, Pearson’s correlation coefficients were calculated for each pair of variables. Correlations between all variables are shown in Table 2. Neither parental smoking nor movie smoking was related to any explicit or implicit smoking-related cognition. The three implicit smoking-related cognitions (selective attention to smoking cues, smoking-related memory associations, and automatic approach tendencies toward smoking) were not correlated. With regard to measures of the attentional focus (number of fixations, duration of fixations, and latency of fixations), the number of fixations correlated positively with the duration of fixations, whereas the duration of fixations was negatively correlated with the latency of fixations. Explicit and implicit smoking-related measures were hardly correlated. Latency of fixations was positively correlated with positive smoking-related expectancies.

Parental and movie smoking and smoking-related cognitions

A MANCOVA was performed to examine whether early adolescents with at least one smoking parent and early adolescents with non-smoking parents differed in their attention to smoking cues. Independent variables were the condition (adolescents with non-smoking parents vs. adolescents with at least one smoking parent) and age of the adolescents (which was categorized in the three groups of 12-, 13- and 14 year-olds). The dependent variables were the number of fixations, the relative duration of fixations and the latency of fixations. As the two groups with smoking vs. non-smoking parents differed with regard to adolescents’ gender, gender was used as covariate. The results showed a significant difference between conditions and age on the dependent variables, \(F(6, 112) = 2.53, p = .03\); Wilks’ Lambda = .78; partial eta squared = .12. When the results for the dependent variables were considered separately, the difference in the number of fixations between adolescents with a smoking parent and adolescents with non-smoking parents reached statistical significance. In the group of 12-year olds, adolescents with a smoking parent (\(M = 16.36, SD = 4.86\)) focused less on smoking cues than adolescents with non-smoking parents (\(M = 24.36, SD = 11.02\)). In the group of 13-year olds, adolescents with a smoking parent (\(M = 18.68, SD = 5.88\)) focused evenly on smoking cues than adolescents with non-smoking parents (\(M = 18.90, SD = 7.65\)). And with regard to the group of 14-year olds, adolescents with a smoking parent (\(M = 24.50, SD = 8.32\)) focused more often on smoking cues than adolescents with non-smoking parents (\(M = 14.88, SD = 5.64\)). No significant difference between groups (parental smoking and age) was found with regard to the duration of fixation and the latency of cue fixation.

Figure 1. Average number of fixations for adolescents with non-smoking and smoking parents and different age groups.
Several (M)ANCOVAs were performed to examine whether early adolescents with smoking parents and early adolescents with non-smoking parents differed in their automatic approach tendencies toward smoking, their smoking-related memory associations and their explicit smoking cognitions. No significant differences between groups (parental smoking and age) were found. Furthermore, we conducted several (M)ANCOVAs to investigate whether adolescents with a low level of smoking movie exposure and adolescents with a high level of smoking movie exposure differed in attention to smoking cues, their smoking-related memory associations, their automatic approach tendencies toward smoking and their explicit smoking-related cognitions. These tests did not show any significant differences between adolescents with a low and adolescents with a high level of smoking movie exposure. In a last set of (M)ANCOVAs, we tested the interaction between parental smoking and movie smoking on adolescents’ implicit and explicit smoking cognitions. However, no significant results were found.

Discussion

The aim of the current study was to test the associations between parental and movie smoking and early adolescents’ explicit and implicit smoking-related cognitions. First, we investigated whether parental smoking affects early adolescents’ attention to smoking cues, which has been shown in a previous study with a similar set-up among children (Chapter 3). The results of the pilot study could not be completely replicated. In the pilot study, the groups of children with smoking parents differed from children with non-smoking parents with regard to the number of fixations on smoking-related cues and the duration of fixations. In the current study, differences between adolescents with non-smoking and at least one smoking parent were only found for the number of fixations in specific age groups. As the correlations between selective attention and explicit and implicit smoking-related cognitions were mixed (no correlation was found between the attention measures and smoking-related memory associations; regarding explicit smoking-related cognitions, only the latency of fixations was positively related to positive personal expectancies), the valence of the attentional focus remains unclear.

With regard to the other measures of implicit cognitions (smoking-related memory associations and automatic approach tendencies toward smoking) and explicit smoking-related cognitions, no differences between adolescents with smoking parents and adolescents with non-smoking parents were found. The present study found also no evidence for the association between exposure to movie smoking and adolescents’ implicit and explicit smoking-related cognitions. No evidence for an association between the exposure to parental and movie smoking and adolescents’ smoking-related cognitions was found, indicating that early adolescents who are exposed to two environmental smoking sources are not particularly at risk for developing positive smoking-related cognitions. The results will be discussed in depth in the discussion section of this dissertation (Chapter 5).
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<td>14</td>
<td>11</td>
<td>06</td>
<td>-01</td>
<td>-05</td>
<td>07</td>
<td>10</td>
<td>-03</td>
<td>15</td>
<td>-15</td>
<td>31**</td>
<td>-15</td>
<td>-20</td>
<td>-36**</td>
</tr>
<tr>
<td>16</td>
<td>Susceptibility</td>
<td>-21</td>
<td>-05</td>
<td>03</td>
<td>05</td>
<td>19</td>
<td>14</td>
<td>-07</td>
<td>-05</td>
<td>02</td>
<td>34**</td>
<td>-25*</td>
<td>33**</td>
<td>44**</td>
<td>-27*</td>
</tr>
</tbody>
</table>

Table 2. Correlations of all study variables.
Chapter 4: Parental and movie smoking and early adolescents’ explicit and implicit smoking cognitions

This study found little impact for the exposure to parental and movie smoking on early adolescents’ explicit and implicit smoking-related cognitions. The exposure to movie smoking was not associated with any explicit or implicit smoking-related cognition in early adolescents. Also, a difference between adolescents with smoking parents and those with non-smoking parents was only found for the number of fixations to smoking cues and this was related to adolescents’ age. No difference between early adolescents with smoking parents and adolescents with non-smoking parents was found for the duration and the latency of fixations.

Summary of the main findings

Chapter 2: Influence of smoking portrayal in movies on smoking cognitions among children

Short-term exposure to smoking in cartoon and family-oriented movies had little immediate impact on explicit and implicit smoking cognitions in children. Exposure to movie smoking had no effect on implicit associations with smoking. For explicit smoking cognitions, effects were small and only statistically significant for social norms regarding smoking.

Chapter 3: Parental smoking and children’s attention to smoking cues

This study revealed an association between parental smoking and children’s attention to smoking cues. Children with smoking parents, as compared to children with non-smoking parents, focus more often and longer on dynamic smoking-related cues. No difference between children with a smoking parent and children with non-smoking parents was found for latency of fixations. Attentional focus was not related to explicit smoking cognitions.

Chapter 4: Parental and movie smoking and early adolescents’ explicit and implicit smoking cognitions

This study found little impact for the exposure to parental and movie smoking on early adolescents’ explicit and implicit smoking-related cognitions. The exposure to movie smoking was not associated with any explicit or implicit smoking-related cognition in early adolescents. Also, a difference between adolescents with smoking parents and those with non-smoking parents was only found for the number of fixations to smoking cues and this was related to adolescents’ age. No difference between early adolescents with smoking parents and adolescents with non-smoking parents was found for the duration and the latency of fixations.
short-term effect of smoking movie prompts on explicit smoking-related cognitions in children. Then, we will discuss the findings of our two studies, which investigated the association between lifetime exposure to movie and parental smoking and explicit smoking-related cognitions.

From an early age, children watch television/DVDs (Rideout, et al., 2003) and as many G-rated movies contain smoking scenes (Goldstein, et al., 1999; Thompson & Yokota, 2001), even young children are exposed to the portrayal of smoking in movies. We expected that regular exposure to smoking portrayal in movies over a longer period of time may affect the formation of smoking-related explicit cognitions; for example the formation of children's social norms regarding smoking, transmitting that smoking is a normative behaviour. Repetitive exposure to smoking portrayal in movies might emphasize that smoking is a commonly exhibited behaviour and might communicate that smoking may be approved by family and friends. However, short-term exposure to movie smoking had only a small effect on explicit smoking cognitions - only for smoking norms - in children (Chapter 2). There are several explanations for the weak impact of movie smoking prompts on smoking-related explicit cognitions.

First, one explanation for the weak effect is that explicit measures depend on self-assessment; in this instance, on children's ability to assess their own smoking-related cognitions. In addition to the possibility that children may be unaware of their true attitudes (Greenwald & Banaji, 1995), the assessment of explicit cognitions also relies on the willingness to report these. As smoking is a sensitive social topic carrying negative social norms, children might reflect this and give answers that are socially desirable. Moreover, although our explicit outcome measures showed good reliability and obtained inter-item reliabilities that are comparable to assessments in older adolescents and adults (e.g. Harakeh, et al., 2004; Otten, et al., 2007b; Pierce, et al., 1996; Spijkerman, et al., 2005), the explicit outcome measures might have been insufficiently precise and sensitive to detect small changes in cognitions. A problem with this explanation is that no effect of smoking movie prompts on smoking-related memory associations was found either (for more details, see next section on implicit cognitions).

Second, as mentioned before, the formation of smoking-related cognitions is based on the exposure to several sources in the social environment (e.g. parents, peers, media, society), which probably leads to the endorsement of positive and negative smoking-related cognitions. Previous research has shown that the majority of young children report unfavourable cognitions towards smoking when asked directly (Freeman, et al., 2005; Hahn, et al., 2000; Porcellato, et al., 2005). This indicates that children, like those in our sample, exhibit an imbalance between negative and positive smoking-related explicit cognitions, with negative ones being stronger than positive ones. Based on this discrepancy, strong and salient smoking prompts would be needed to trigger positive smoking-related associations, such as positive attitudes towards smoking. It might have been the case that the smoking cues in the movies we used were not strong or salient enough to trigger positive associations and/or to undermine the stronger negative ones, which children have learned and stored as well. In the experimental study, children's smoking cognitions were measured after exposure to a single 20-minute movie segment with smoking scenes. Epidemiologic studies, which reveal an effect of smoking portrayal in movies on smoking initiation, assess cumulative doses of exposure. It is possible that it takes more salient or a greater number of cues to activate positive associations towards smoking.

Third, in addition to the salience regarding number and strength of smoking movie prompts, the type of portrayal of smoking could also be an explanation for the lack of findings. Smoking movie prompts from cartoons and family-oriented movies might be less salient than smoking depictions in movies rated for older adolescents and adults, because characters who smoke in family-rated movies deliver a different message than smoking characters in movies rated for older audiences. For example, a smoking Lucky Luke might not represent the prototype of a cool, sexy, glamorous smoker (the prototype adolescents tend to emulate) and might therefore not have a large impact on children's smoking cognitions. Instead, smoking presented in the context of other adult situations, as portrayed in PG-13- and R-rated movies, would have had more impact. This hypothesis is supported by another study revealing that exposure to smoking in G- and PG-rated movies has little prospective association with smoking behaviour in adolescents (Sargent, et al., 2012).

Fourth, previous research indicates that the unfavourable explicit smoking-related cognitions in children undergo a developmental shift and soften when children and adolescents grow older (Chassin, Presson, Sherman, & McGrew, 1987; De Leeuw, et al., 2008a). Adolescents, compared with children, reported more favourable subjective norms (Andrews, Hampson, Barkley, Gerrard, & Gibbons, 2008), perceived the instrumental benefits of smoking, while...
retaining a general negative attitude toward smoking (Freeman, et al., 2005), and saw smokers in a more positive and non-smokers in a more negative light (Dinh, et al., 1995). Also, in the time from early to middle adolescence, negative consequences of smoking were perceived as more likely than potential benefits (Chassin, Presson, Rose, & Sherman, 2001; O'Connor, et al., 2007). However, older adolescents perceived the benefits of smoking as more likely and the costs as less likely than younger adolescents (Chassin, et al., 2001; O'Connor, et al., 2007), indicating that the discrepancy between cost and benefits of smoking narrows as children get closer to the risk-age of initiation (O'Connor, et al., 2007). Therefore, the influence of smoking prompts in movies might possibly increase with age. In our study, children's cognitions were substantially skewed toward an anti-smoking stance. Mid and late adolescents, compared with children, might be more susceptible to a variety of social influence prompts and therefore also more susceptible to movie smoking prompts. This assumption is supported by a previous study that showed that adolescents who were exposed to movie smoking, compared to adolescents who were exposed to a non-smoking clip, attributed a higher social status to smokers (Pechmann & Shih, 1999).

Fifth, another explanation for the little impact of short-term exposure to smoking prompts in movies lies in the possibility that children have not been exposed to the portrayal of smoking in movies on a regular basis and therefore have not developed and stored positive associations with movie smoking. Thus, to them, the portrayal of smoking in movies does not function as a cue and does not trigger stored associations with smoking. In our experimental study, we have not assessed children's lifetime exposure to movie smoking. Moreover, if children have acquired positive smoking-related cognitions based on their exposure to another source in the social environment than movie smoking (e.g. parental smoking), it remains unclear whether these cognitions could be activated by the exposure to movie smoking prompts.

In two studies, we investigated the associations between parental and movie smoking and explicit smoking-related cognitions. The exposure to movie smoking was not related to any of the explicit smoking-related cognitions (Chapter 4). Parental smoking was associated with positive personal smoking-related expectancies but only in a sample of 10 - 13 year old children (Chapter 3). In a slightly older sample (early adolescents aged 12 - 14), parental smoking was not associated with any explicit smoking-related cognition (Chapter 4). Regarding the exposure to movie smoking, previous research has provided strong evidence for the association between the exposure to smoking portrayal in movies and smoking initiation in adolescents (Arora, et al., 2012; Dalton, et al., 2003; Hanewinkel & Sargent, 2007, 2008; Hunt, et al., 2011; Jackson, et al., 2007; Morgenstern, et al., 2011; Sargent, et al., 2005; Sargent, et al., 2001; Thrasher, et al., 2008; Thrasher, et al., 2009; Titus-Ernstoff, et al., 2008; Wilkinson, et al., 2009; Wills, et al., 2007). However, to our knowledge, only two studies investigated the association between movie exposure and smoking-related cognitions (Tickle, et al., 2006; Wills, et al., 2008). These studies found an association between the exposure to smoking in movies and positive expectancies (Tickle, et al., 2006; Wills, et al., 2008) and one's identification as a smoker (Tickle, et al., 2006).

Regarding parental smoking, research has shown that children with smoking parents have an increased risk of smoking initiation later in life (Leonardi-Bee, et al., 2011). Yet, a recent review could identify only few studies investigating the association between parental smoking and children's smoking-related cognitions (Lochbuehler, Schuck, Otten, Ringleve, & Hiemstra, Unpublished work). Whereas the majority of studies were cross-sectional, only four studies investigated smoking-related cognitions as potential mediators in the association between parental smoking and child smoking (Flay et al., 1994; Harakeh, et al., 2004; Otten, Engels, & Prinstein, 2009; Wyszynski, Bricker, & Comstock, 2011). Although it is assumed on a theoretical basis that parental smoking affects children's smoking-related cognitions (Ajzen, 1991; Bandura, 1977), the empirical evidence is inconsistent and varies across different smoking-related cognitions (smoking-related attitudes, smoking-related perceptions, self-efficacy, and intentions to smoke, et cetera).

Thus, previous research on the effects of movie and parental smoking on explicit smoking-related cognitions is scarce and demonstrates inconsistent findings. However, parental and movie smoking has been found to affect the initiation of smoking and some studies reveal an effect of parental and movie smoking on explicit smoking-related cognitions. The magnitude of the effects and the reason for the lack of a consistent pattern of findings across studies still needs to be clarified. It needs to be mentioned that the sample sizes of our studies are fairly small, indicating that insufficient power might explain the lack of associations. In addition to insufficient power, the inconsistent findings across studies in the literature, and the lack of associations in our studies, might be attributed to the following factors.
First, as previous research has shown that unfavourable explicit smoking-related cognitions undergo a developmental shift and soften when children grow older (Chassin, et al., 1987; De Leeuw, et al., 2008a), it cannot be ruled out that the exposure to parental and movie smoking is associated with smoking-related explicit cognitions later in adolescence. Furthermore, in childhood and early adolescence, smoking might not yet be relevant. It could be the case that besides age, smoking-related explicit cognitions change when smoking becomes relevant. Relevance means that individuals become preoccupied with smoking, in the sense that they have friends who have tried smoking and they find themselves in situations where the opportunity to experiment with smoking arises. In these situations, it is possible that positive smoking-related cognitions become activated, particularly in children and early adolescents who have been exposed extensively to parental and movie smoking earlier in life. Also, early adolescents who have been exposed to environmental smoking might be more likely to subsequently seek peer environments characterized by smokers. Therefore, these individuals might also be more at risk to try smoking when they have the opportunity. A model which takes such opportunities into account when explaining substance use among adolescents is the Prototype-Willingness Model (Gibbons, Gerrard, & Lane, 2003). This model proposes that adolescents’ willingness to take risks in these types of situations (e.g. to smoke when the opportunity arises, such as when friends offer cigarettes at a party) determines whether adolescents use a substance (Blanton, Gibbons, Gerrard, Conger, & Smith, 1997). Opportunities to smoke the first cigarette might come about unexpectedly and the time frame in which these first opportunities might occur is relatively short (i.e. late childhood and early adolescence). Thus, it is possible that smoking-related cognitions change in a relatively short time period, which makes their assessment difficult.

Second, we have argued before that compared with friends’ smoking, parental smoking seems to be the main source of influence for smoking initiation in early adolescents (Vitaro, et al., 2004). Previous research on the relative influence of smoking by parents and peers on smoking initiation showed mixed results. A study by Vitaro et al. (2004) showed that for adolescents aged 13 - 14 years or older, friends are the main source of influence for the initiation of smoking, whereas for early adolescents (aged 12 - 13 years old), parents and friends both matter. In pre-adolescents, parental smoking behaviour is the main source of influence. Among 7th and 8th graders (aged 12 - 13), it has been found that friends smoking, compared to parental smoking, has stronger effects on the initiation of smoking (Flay, et al., 1994). These studies suggest a shift of influence from parents to peers with age. The time period between the ages of 11 and 14 years seems to be sensitive for age-related differences in parental and peer influence. It needs to be mentioned that these studies have been conducted almost two decades ago. It cannot be ruled out that this shift takes place earlier among today’s youth. Regarding the portrayal of smoking in movies, it remains unclear at what age children are susceptible to movie smoking and how the exposure to movie smoking contributes to the formation of explicit smoking-related cognitions compared to other sources in the social environment. Taking these aspects into account, smoking by peers might have a bigger impact on the formation of explicit smoking-related cognitions in early adolescents than parental and movie smoking. Differences in explicit smoking-related cognitions might therefore depend on differences in smoking behaviour and the attitudes towards smoking of peers. Up to now, the contribution of different sources in the social environment on the formation of explicit smoking-related cognitions is unclear.

Third, the relationship between different environmental sources and smoking-related cognitions might be moderated by situational and/or individual difference variables. This explanation is supported by research, which showed that the predictive effect of implicit attitudes and explicit expectancies on alcohol use was moderated by impulsivity (Rooke, et al., 2008) and working memory capacity (Thush, et al., 2008). Expectancies significantly predicted alcohol use better for participants who scored low on impulsivity (Rooke, et al., 2008) and participants with high working memory capacity (Thush, et al., 2008). Implicit attitudes predicted alcohol use better for highly impulsive participants (Rooke, et al., 2008) and for participants with relatively poor working memory capacity (Thush, et al., 2008). Possibly, individual factors like impulsivity might also moderate the relationship between environmental smoke exposure and smoking-related cognitions. Testing such moderation effects requires studies with large sample sizes.

In conclusion, we found little impact for the effect of parental and movie smoking on explicit smoking-related cognitions. With regard to short-term effects, our study revealed little impact for the exposure to smoking prompts in movies on explicit smoking-related cognitions in children. Explanations for this weak effect might lie in the age group, the salience and the kind of movie smoking prompts, and the possibility that children have not yet learned positive associations with movie smoking. We also found no association
between movie smoking exposure and explicit smoking-related cognitions. In addition, parental smoking was minimally associated with explicit smoking-related cognitions. As previous research on the effects of parental and movie smoking on explicit smoking-related cognitions is scarce and shows inconsistent findings, future research needs to investigate the magnitude of the effects and whether inconsistent findings can be attributed to other factors.

Smoking-related implicit cognitive processes

Similar to the development of explicit smoking-related cognitions, it is assumed that the development of implicit associations starts at an early age and is based on repeated experiences over a long period of time (Beevers, 2005). Although empirical evidence of the onset and the development of implicit smoking-related cognitions is scarce, one study has assessed implicit attitudes towards smoking among children. This study shows that children as young as in 5th grade endorse implicit associations towards smoking (Andrews, et al., 2010), indicating that children have implicit smoking-related associations before they have experimented with smoking. Due to the exposure to several sources in the social environment, and in line with explicit smoking cognitions, possibly both positive and negative implicit associations co-exist. Based on these indications, we expected children to develop implicit associations about smoking due to repeated exposure to parental and movie smoking. Early adolescents who were exposed to parental and movie smoking were expected to form stronger positive implicit associations than early adolescents who were not or less exposed. Again, we will first discuss the results of our experimental study testing the short-term effect of smoking movie prompts on smoking-related memory associations in children. Then, we will discuss the findings of our two studies, which investigated the association between lifetime exposure to movie and parental smoking and different facets of implicit smoking-related cognitions.

In our experimental study, we investigated the effect of short-term exposure to movie smoking on smoking-related memory associations (Chapter 2). Similar to explicit smoking-related cognitions, we assumed that regular exposure to smoking portrayal in movies over a longer period of time affects the formation of smoking-related memory associations. As smoking characters in movies are usually portrayed positively (Tanski, et al., 2009), we expected children to form an association between movie smoking and a positive affect or outcome. When children are exposed to smoking movie prompts in an experimental setting, it was expected that smoking movie prompts activate these positive associations, which then can be assessed in an implicit association task after movie exposure. However, no effect of smoking movie prompts on smoking-related memory associations was found. The explanations for the weak impact of movie smoking prompts on explicit smoking cognitions discussed above also apply in explaining the lack of effect on smoking-related memory associations.

Possibly, the smoking cues in the movies Lucky Luke (2005) and Love is All (2007) were not salient enough or not the kind of cues that could trigger positive smoking-related memory associations. Also, in the time from early to middle adolescence, it has been shown that older adolescents had stronger implicit positive than negative smoking associations whereas younger adolescents were ambivalent with regard to smoking (O'Connor, et al., 2007), indicating a developmental change. Therefore, in line with explicit smoking cognitions, smoking movie prompts might affect positive smoking-related memory associations in adolescents. Moreover, if children have not been repeatedly exposed to smoking portrayal in movies, the exposure to smoking movie prompts might not trigger positive associations towards smoking (see above for more details).

In addition to these explanations, the design of the study might also explain the lack of findings. The assessment of explicit prior to implicit smoking cognitions might have primed and therefore activated smoking-related associations among children in both groups, making it difficult to assess differences in associations that might have been caused by the experimental manipulation (the influence of smoking portrayal in movies) (Noel & Thomson, 2012). Research has indicated that assessing explicit cognitions (i.e. questions about alcohol and drug use) before implicit memory associations not only increased the number of alcohol associations produced, but also concurrently and prospectively predicted alcohol use (Krank, et al., 2005). Therefore, it cannot be ruled out that the order of assessments might have undermined the effect on smoking-related memory associations (Bosson, et al., 2000).

Only recently have researchers become interested in the influence of parental smoking on the development of implicit smoking cognitions. To our knowledge, no study has investigated whether the exposure to movie smoking
is associated with implicit smoking cognitions. Two studies have examined the association between the exposure to family members who smoke and implicit smoking cognitions. One study among 5th-graders (12-year olds) revealed that children with family members who smoked had more favourable implicit attitudes towards smoking than children with non-smoking family members (Andrews, et al., 2010). Another study found an association between mothers’ implicit attitudes towards smoking and adolescents’ implicit attitudes towards smoking. Mothers with more positive implicit smoking attitudes had children with more positive implicit smoking attitudes (Sherman, et al., 2009).

Two studies did not use computerized reaction-time tasks or eye tracking paradigms to assess young children’s implicit smoking-related cognitions, but observed children’s behaviour in role-playing tasks. It was found that young children with smoking parents view smoking as normative in social situations, as they show a tendency to model their parents’ smoking behaviour in role-playing tasks (Dalton, et al., 2005; De Leeuw, et al., 2010c).

In a pilot study (Chapter 3), we investigated the association between parental smoking and children’s attention to smoking cues. Based on the assumption that, compared with children of non-smoking parents, children with smoking parents would attribute a high salience to smoking-related cues due to repeated exposure to parental smoking, we expected an association between parental smoking and children’s attention to smoking cues. It was found that, compared to children of non-smoking parents, children with smoking parents focused more often and longer on dynamic smoking-related cues. No differences between children with smoking parents and children with non-smoking parents was found with regard to the latency of fixations.

In a study with the same set-up and a larger sample size, one of the aims was to replicate this effect (Chapter 4). The results of the pilot study could not be replicated completely. Differences between early adolescents with smoking parents and early adolescents with non-smoking parents were only found with regard to the number of fixations to smoking cues. Moreover, this effect was moderated by age. With emerging age, early adolescents with smoking parents focused more often on smoking-related cues than children with non-smoking parents. The attention to smoking-related cues of children with non-smoking parents developed the opposite way. In the group of 12-year olds, adolescents with smoking parents focused less on smoking cues than adolescents with non-smoking parents. Among 13-year olds, no differences between adolescents with smoking parents and adolescents with non-smoking parents were found. With regard to the group of 14-year olds, adolescents with smoking parents focused more often on smoking cues than adolescents with non-smoking parents. No significant difference between groups (parental smoking and age) was found with regard to the duration of fixations and the latency of cue fixations.

There are several explanations for the inconsistent findings in the pilot (Chapter 3) and the main study (Chapter 4). In the pilot study, we found differences between children with smoking parents and children with non-smoking parents with regard to the number and duration of fixations. No significant effect was found for the latency of fixations. This lack of effect can be explained by insufficient statistical power. Although the main study had a larger sample and the whole model had sufficient power (=.82), the power of the separate post-hoc tests for the three dependent variables varied substantially and the analyses on the duration of fixations and on the latency of fixations showed insufficient power (=.30 and .06). Therefore, no conclusive interpretations based on this study can be made on the effects of parental smoking on the duration and latency of fixations. Yet, it remains unclear why the power was sufficient for the post-hoc analysis on the duration of fixations in the pilot study but not in the main study. Possibly, a selection effect might explain the effect(s) in the pilot study. As our pilot study was an exploratory study, the sample size was relatively small. It is possible that the children with smoking parents in our pilot study did not represent the children with smoking parents in the population. It should be stressed that the problem of representativeness of the sample is an issue of concern in many small-scale studies examining implicit constructs related to substance use.

Still, the question remains why the effect of parental smoking on the number of fixations was moderated by age. The sample size of the pilot study was too small to test for interaction effects between parental smoking and age. The effects in the pilot study were found controlling for age, indicating that age plays a role in the association between parental smoking and attention to smoking cues. It seems to be the case that the development of attention to smoking cues differs for early adolescents with smoking parents and adolescents with non-smoking parents. For early adolescents with smoking parents, 14-year olds focused more often on smoking-related cues than 13-year olds, who in turn focused their attention more on smoking-related cues than 12-year olds. When compared to the development of smoking memory associations, research has shown that with emerging age, positive
associations become stronger than negative associations (O’Connor, et al., 2007). Based on this development, it is plausible that the valence of the attentional bias changes similarly to the valence of smoking-related memory associations. This explanation would imply that the attentional bias is associated with implicit smoking-related associations. Yet, the current study found no association between the attention to smoking cues and smoking-related memory associations. Also, no difference was found in smoking-related memory associations between early adolescents with smoking and early adolescents with non-smoking parents in different age groups. This explanation fails to clarify why the development of the attentional focus is the opposite among early adolescents with non-smoking parents. One explanation for the finding that 12-year-old adolescents with non-smoking parents focus more often on smoking-related cues than 13- and 14-year olds could be that they have been less exposed to smoking in their social environment. These children might either focus more often on smoking-related cues out of curiosity or because they have more difficulty placing instances of smoking in a context. In line with this, it needs to be mentioned that the existence of the effects of parental smoking on selective attention in the pilot and in the main study could potentially be explained by familiarity or expertise with smoking cues. Ryan (2002) argues that attentional processing is influenced by repetitive exposure to and the frequency of processing particular cues. As previous research supports a potential role of familiarity or expertise on attentional biases (Chanon, et al., 2010; Dalgleish, 1995; Ryan, 2002), the question remains whether the occurrence of an addiction-related attentional bias is based on addictive processes or familiarity with the cue (Chanon, et al., 2010).

In the main study (Chapter 4), we also investigated associations between parental and movie smoking and other facets of implicit smoking-related cognitions. Based on previous research (Andrews, et al., 2010; Pieters, et al., 2010; Van Der Vorst, et al., 2012), we expected early adolescents who are exposed to parental smoking to acquire more positive smoking-related memory associations than early adolescents who have not been exposed to parental smoking. To our knowledge, our study was the first to investigate the association between parental smoking and automatic approach tendencies toward smoking in non-smoking early adolescents. Therefore, no hypothesis has been formulated. Also no hypotheses have been formulated with regard to the associations between movie smoking and smoking-related memory associations and automatic approach tendencies toward smoking.

We found no relation between parental and movie smoking on the one hand, and smoking-related memory associations and automatic approach tendencies on the other (Chapter 4). Several possible explanations for the lack of these associations can be mentioned. The explanations for the lack of associations between parental and movie smoking and smoking-related explicit cognitions, which were described in the previous section, can also be provided for the lack of associations between parental and movie smoking and smoking-related memory associations and automatic approach behaviour toward smoking.

Possibly, as mentioned earlier, the age of the participants, the lack of relevance of smoking, the influence of other sources of smoking in the social environment (e.g. siblings, peers), as well as possible moderating factors might explain the lack of findings (see above for more details). In addition to these explanations, the assessment of the smoking-related memory associations and automatic approach tendencies might explain the lack of associations between parental and movie smoking and implicit smoking-related cognitions. The measures we used to assess implicit cognitive processes have been common measures in addiction research (e.g. Rooke, et al., 2008). Still, they have not been used frequently among children and adolescents in previous research. Therefore, it remains unclear how reliable and valid these measures are for the assessment of smoking-related implicit cognitions among children and early adolescents.

In conclusion, we found little impact for the influence of parental and movie smoking on smoking-related implicit cognitions. Short-term exposure to smoking movie prompts had no effect on smoking-related memory associations. Our studies revealed preliminary evidence for the effect of parental smoking on children’s attention to smoking cues. Movie smoking was not associated with attention to smoking cues. Also, no associations were found between parental and movie smoking and smoking-related memory associations and automatic approach tendencies. As researchers have only recently become interested in the effects of environmental smoke exposure on the development of implicit smoking-related cognitions, research in this relatively new research area is still rare. Our studies provide preliminary findings but as our studies were very exploratory and the sample sizes were small, future research is needed. It needs to be clarified whether and how environmental smoke exposure affects implicit smoking-related cognitions in children and adolescents who have not yet experimented with smoking.
Implications for theory and research

The next sections provide conclusions and examine some of the implications for theory and research based on the findings of our studies and on previous research. First, implications for theories and research will be discussed based on our studies on the associations between environmental smoke exposure and smoking-related cognitions. Then, we will discuss the implications of our study on the short-term exposure to smoking movie prompts on smoking-related cognitions.

In the introduction, we argued that the social environment shapes children’s and adolescents’ smoking-related cognitions and behaviour (e.g. Ajzen, 1991; Bandura, 1977; Rudman, et al., 2007; Van Der Vorst, et al., 2012; Wiers, et al., 2007a). We were particularly interested in the role of exposure to parental and movie smoking. Previous research has provided evidence to support the applicability of this theory to adolescent smoking behaviour (Leonardi-Bee, et al., 2011; National Cancer Institute, 2008). However, research on whether exposure to parental and movie smoking increases the likelihood of developing more favourable explicit smoking-related cognitions revealed mixed findings (Lochbuehler, et al., Unpublished work; Tickle, et al., 2006; Wills, et al., 2008; Chapters 3 & 4). Regarding the effects on implicit smoking-related cognitions, research revealed some preliminary evidence for the association between parental smoking and smoking-related cognitions, however to our knowledge only two studies have previously examined this association (Andrews, et al., 2010; Sherman, et al., 2009; Chapters 3 & 4). Based on the current knowledge, it is difficult to draw conclusions on the effects of environmental smoke exposure (parental and movie smoking) on the development of smoking-related cognitions. Several gaps in our knowledge remain. Returning to the theoretical assumptions and tying them to the empirical findings, we will discuss factors that might explain the lack of consistent findings among previous studies and that should be considered in future research.

One issue that may account for inconsistent findings among studies on the effect of parental smoking on smoking-related cognitions involves the assessment of parental smoking. Up to now, the majority of studies on parental influences assessed parents’ current smoking status (Lochbuehler, et al., Unpublished work). However, the exposure to environmental smoking, for example parental smoking, consists not only of the knowledge and the observation of others’ smoking, but also of their smoking-related cognitions and the exposure to second-hand smoke. Smoking-related cognitions may be more strongly related to other aspects of parental smoking than the smoking status (e.g. whether parents actually smoke in close proximity of the child), which was commonly assessed in previous research. Yet, the processes through which and the aspects of parental smoking that influence smoking-related cognitions remain unanswered. It needs to be understood what constitutes exposure to smoking and whether the knowledge of someone smoking is enough to affect the formation of smoking-related cognitions. Recent research supports the argument that physiological processes might also represent a pathway through which smoking-related cognitions could be formed. The sensitivity to second-hand exposure has been linked to the susceptibility to smoking in youth who had never smoked. Preteens who have more aversive experiences with second-hand smoke exposure tend to be less susceptible to smoking than those who experience fewer aversive reactions (Lessov-Slaggar et al., 2011). Environmental smoke exposure has also been found to be related to nicotine dependence symptoms (Kleinjan et al., 2009). Previous research has provided preliminary evidence for the development of nicotine dependence symptoms in non-smoking children who have been exposed to second-hand smoke (Belanger et al., 2008; Schuck, Kleinjan, Otten, Engels, & DiFranza, 2013), which in turn might affect the formation of smoking-related cognitions. These studies demonstrate that exposure to environmental smoking consists of several aspects and that our understanding of how parental smoking contributes to the formation of smoking-related cognitions is still limited. Future research needs to assess different aspects of environmental smoke exposure in order to advance our knowledge on the mechanisms by which sources in the social environment (like parents, peers, siblings, etc.) affect smoking-related cognitions.

The inconsistent findings in previous research might be due to the failure of addressing the complexity of environmental smoke exposure. We have described that children’s and adolescents’ smoking-related cognitions are formed based on different sources of environmental smoking (i.e. parents, siblings, peers, media, and the society as a whole). Most studies have focused on the exposure to one of the sources of environmental smoke exposure (Lochbuehler, et al., Unpublished work). Moreover, it can be assumed that the role of different sources in the social environment varies, with the degree of impact shifting among different age groups (Flay, et al., 1994; Vitaro, et al., 2004). Therefore, it is possible that the processes of environmental smoke exposure are too complex for taking only some of the sources into account.
Inconsistent findings might be partly explained by the lack of inclusion of other sources of environmental smoke exposure. Our study (Chapter 4) did not support a dose-response association with adolescents being at greater risk for developing more favourable smoking-related cognitions when they have been exposed to parental and movie smoking. However, the complexity of the exposure to smoking in the social environment needs to be better understood and examined more carefully (considering larger social contexts like the family, peers and the media). Further research is needed to investigate the contribution of different sources in the social environment to the formation of smoking-related cognitions.

Although none of these aspects has been assessed in our studies, how positive and negative smoking-related cognitions develop and how they are related to the initiation of smoking should be discussed. Regarding the associations between explicit smoking-related cognitions and the initiation of smoking, longitudinal studies revealed mixed results (for a review see: Conrad, et al., 1992; De Leeuw, et al., 2008a; Flay, et al., 1994; Harakeh, et al., 2004; Hiemstra, Otten, de Leeuw, van Schayck, & Engels, 2011; Otten, et al., 2009; Spijkerman, et al., 2005; Tyas & Pederson, 1998; Wyszynski, et al., 2011). One study examined whether implicit smoking-related cognitions predict the onset of smoking in adolescents and found significant indirect effects of mothers’ implicit attitudes on adolescents’ smoking initiation through adolescents’ implicit attitudes. Mothers with more positive implicit attitudes had children with more positive implicit attitudes and those children were more likely to initiate smoking (Sherman, et al., 2009). Moreover, adolescents’ positive implicit attitudes predicted the onset of smoking prospectively above and beyond the effects of explicit attitudes (Sherman, et al., 2009). However, based on these studies it remains unclear how positive and negative smoking-related cognitions are related to the onset of smoking. It may be expected that positive smoking-related cognitions increase the risk of initiation, while negative cognitions prevent the uptake of smoking. The initiation of smoking could depend on whether positive smoking-related cognitions outweigh negative smoking-related cognitions, but also on whether smoking is personally relevant yet for adolescents.

With regard to the interplay of explicit and implicit smoking-related cognitions, our studies (Chapters 3 and 4) showed no associations between explicit and implicit smoking-related cognitions. From a theoretical point of view, it is expected that implicit and explicit smoking-related cognitions underpin different cognitive motivational systems; they should be relatively independent from each other and should stem from different sources (Huijding & de Jong, 2006; Rudman, et al., 2007; Wiers, et al., 2007b). It has been stated that explicit cognitions represent more recent events, while implicit cognitions reflect past experiences (Greenwald & Banaji, 1995; Rudman, et al., 2007). Therefore, if explicit and implicit smoking-related cognitions stem from different sources, they would not be expected to be related (Rudman, 2004). One empirical study showed that explicit and implicit smoking-related cognitions uniquely predict the onset of smoking (Sherman, et al., 2009). Prospective, longitudinal studies are needed to investigate how explicit and implicit processes develop and interact with each other to influence the initiation of smoking.

A relevant question in the research area of the effects of environmental smoke exposure and smoking-related cognitions is how stable smoking-related cognitions are among children and early adolescents and whether these cognitions can be affected by single exposure to social influence prompts. As adolescence is a time period with tremendous changes in the physical, cognitive and social-emotional development, children and adolescents might be particularly susceptible to salient social influence prompts, affecting both positive and negative smoking-related cognitions. In our experiment, we investigated the effects of movie smoking prompts on smoking-related cognitions (Chapter 2). We expected that compared to the movie without any smoking portrayal, the movie with smoking prompts would activate positive smoking-related associations in children. We found no effect for a single exposure to movie smoking prompts on smoking-related cognitions. Our result suggests that smoking-related cognitions in children are stable in the sense that a single exposure to movie smoking prompts did not activate positive smoking-related cognitions. In a previous study with a similar set-up among adolescents, a single exposure to a movie preview with smoking portrayal affected adolescents’ beliefs about how smokers perceived themselves (Pechmann & Shih, 1999). The study by Pechmann & Shih (1999) indicates that a single exposure to smoking movie prompts could possibly change smoking-related cognitions in adolescents.

There are at least two factors that could play a role in the susceptibility to single smoking prompts in the social environment. First, individuals form smoking-related associations based on the repeated exposure to smoking and its consequences in their social environment (Beevers, 2005). This
formation may depend on the frequency, duration and intensity of exposure to significant others (Bandura, 1977; Van Der Vorst, et al., 2012), suggesting individual differences in the formation and strength of smoking-related cognitions. Moreover, children and adolescents might differ with regard to the strength of smoking-related associations with smoking, simply because they have had more opportunities of being exposed to several sources of environmental smoking. This might affect the susceptibility to smoking prompts in the social environment. Among children, it is likely that more than a single exposure to smoking movie prompts is required to affect smoking-related associations.

Second, the relevance of smoking might be another factor that affects the susceptibility to smoking prompts. Compared with children, smoking might have been more relevant to adolescents due to increasing opportunities to experiment with smoking and to an increasing number of smoking peers. Late childhood and early adolescence are considered as a risk-period for the initiation of smoking (Stivoro, 2012c), however, up to now, it remains unclear whether the susceptibility to smoking prompts in the social environment is affected by opportunities to smoke.

Research on the stability of smoking-related cognitions is important for the prevention of smoking initiation. Tobacco control initiatives regulating the exposure to movie smoking profits from research investigating whether the exposure to smoking portrayal in movies influences viewers’ positive smoking-related cognitions. Moreover, the development and implementation of anti-tobacco PSAs (public service announcements) benefits from research on the stability of smoking-related cognitions and how smoking-related cognitions can be changed by the exposure to social influence prompts.

Limitations

In this section, we will discuss briefly the limitations our three studies share. The limitations of the single studies can be found in more detail in the discussion sections of Chapters 2 and 3. First, the selective attention to smoking-related cues was not compared to the attention to matching control cues. It cannot be ruled out and is possible that children of smokers versus non-smokers differ in their attentional styles more generally and do not only focus on smoking cues, but on salient stimuli in general. Therefore, in future research it is recommended to include control cues (e.g. food cues) to which the attention to smoking-related cues can be compared. This inclusion provides the advantage of making causal interpretations of the relationship between environmental smoke exposure and attention to smoking-related cues.

Second, the measure of parental smoking was limited to the assessment of the smoking status of the parents. In order to better understand whether and how environmental smoke exposure affects smoking-related cognitions, it should also be assessed whether parents smoke in the presence of their children, whether children are exposed to second-hand smoke and the parents’ attitudes towards smoking. Moreover, we suggest assessing the smoking behaviour and the smoking-related attitudes of different sources in the social environment (i.e. parents, peers, siblings, media, etc.) to draw a more comprehensive picture of environmental smoke exposure.

Third, the implicit measures of smoking-related cognitions might have had limited validity and reliability. We did not find any associations between the different facets of implicit smoking-related cognitions (selective attention, smoking-related memory associations, and automatic approach tendencies toward smoking). However, the association between these constructs can only be established if they can be assessed in a reliable and valid way (Wiers, et al., 2007b). Future research needs to investigate whether all facets of implicit cognitions are equally related to the exposure to smoking in the social environment. This would provide useful information on whether implicit cognition is best characterized as a single system, a set of subsystems, or a set of modules that operate more or less independently of each other (Rooke, et al., 2008).

Fourth, as most important limitation of our studies, the small sample sizes must be noted. In our experimental study, our sample size (N = 206) was not powered to detect a small population effect regarding explicit smoking-related cognitions, and this can therefore not be ruled out. As only a sub-sample performed the implicit association task, our study might not have had sufficient power to demonstrate a small to moderate effect of the exposure to smoking movie prompts on smoking-related memory associations. Moreover, the samples of our studies presented in Chapters 3 and 4 were also fairly small, which is also related to the practical complexities of doing research using rather time-consuming implicit measurements (like the eye-tracking assessment).
investigate the development of smoking-related cognitions. In order to control that the two experimental groups do not differ with regard to baseline cognitions, a pre-assessment of smoking-related cognitions could take place two months prior to the first exposure. Such a design would allow researchers to monitor the development of smoking-related cognitions over a relatively short period of time and answer the question whether cumulative exposure to movie smoking makes children’s smoking-related cognitions more favourable over time. To be able to attribute the effect (or lack thereof) to the exposure to movie smoking, possible other exposures to smoking in the social environment need to be assessed and controlled for in the analysis.

Another advantage of such a design is the possibility to test differences in the development of smoking-related cognitions among different groups. For example, it could be investigated whether children who have strong unfavourable smoking-related cognitions at baseline differ in their development from children who were less negative with regard to smoking at baseline. Another interesting question that could be tested with such a design is whether certain subgroups (e.g. children with smoking parents) are at higher risk for the development of positive smoking-related cognitions and whether children with smoking parents differ in their development of smoking-related cognitions from children with non-smoking parents.

Other explanations for the lack of group differences in our experimental study were the age of the participants and the movies that were used as stimulus material. Smoking movie prompts from cartoons and family-oriented movies might be less salient than smoking depictions in movies rated for older adolescents and adults, because characters who smoke in family-rated movies might deliver a different message than smoking characters in movies rated for older audiences. Although children often watch adult-rated movies, it is ethically challenging to conduct experimental studies on the effects of adult-rated movies in children. An experiment among adolescents would provide the advantage to assess the effects of PG-13-rated movies on smoking-related cognitions. Therefore, we recommend assessing the influence of smoking cues in PG-13-rated movies among 13 - 14 year olds.

Differences in the effects of different movie smoking prompts could be assessed in experimental studies with several experimental conditions. Using the same experimental set-up that was used in Chapter 2, it could be assessed whether movies with different rating categories differ in their effects on
research should provide a more substantial assessment of the social environment. Moreover, it is important to investigate mechanisms explaining the effects of environmental smoke exposure on smoking-related cognitions and the initiation of smoking. As the effects of parental smoking on smoking-related cognitions are inconsistent and show mixed results, it needs to be investigated whether the knowledge of smoking of a significant other is sufficient to shape smoking-related cognitions (Kobus, 2003). Therefore, we not only suggest assessing several sources of the social environment (e.g. family, peers, media), but also different aspects of environmental smoke exposure. In order to better understand the processes of how the social environment influences smoking-related cognitions, it is valuable to assess in addition to smoking status, the smoking-related attitudes of different sources in the social environment, as well as whether parents/siblings/friends smoke in close proximity of the child (thus, whether the child is exposed to second-hand smoke).

Second, future research should take other relevant variables into account, which may moderate the relationship between environmental smoke exposure and the development of smoking-related cognitions. A relevant factor that might moderate the relationship between parental smoking and smoking-related cognitions and which relates to the complexity of environmental smoke exposure (see paragraph above) is smoking-specific parenting. Previous research has shown that parents who discuss smoking-related issues in a respectful and constructive way can prevent their children from starting smoking (De Leeuw, Scholte, Vermulst, & Engels, 2010a; De Leeuw, Scholte, Sargent, Vermulst, & Engels, 2010b; De Leeuw, Scholte, Harakeh, van Leeuwe, & Engels, 2008b; Harakeh, Scholte, de Vries, & Engels, 2005; Otten, Engels, van de Ven, & Bricker, 2007a). These studies indicate that smoking-specific parenting is a protective factor for the uptake of smoking. In the same vein, it has been shown that children with parents who restrict watching R-rated movies were at lower risk for trying smoking (De Leeuw et al., 2011). Therefore, we recommend investigating in future research whether smoking-specific parenting can also buffer and prevent children from developing favourable smoking-related cognitions.

Exposure to environmental smoking and smoking-related cognitions

Due to scarcity of research on the effect of environmental smoking on the development of explicit and implicit smoking-related cognitions, three fundamental research questions could be examined with longitudinal designs. First, future research calls for longitudinal studies investigating the developmental pattern of positive and negative explicit and implicit smoking-related cognitions (Sherman, et al., 2009; Van Der Vorst, et al., 2012). It is important to gain better insight into how positive and negative explicit and implicit smoking-related cognitions develop with emerging age. For prevention purposes it is also valuable to investigate at what age children become susceptible to the social environment (e.g. to smoking portrayal in movies) and how early implicit smoking-related associations are formed. Second, the initiation of smoking could depend on whether positive smoking-related cognitions outweigh negative smoking-related cognitions. In future research it should be investigated which development of positive and negative smoking-related cognitions affects the initiation of smoking and whether explicit or implicit smoking-related cognitions are one of the main driving forces in smoking initiation. Third, we recommend investigating how the social environment affects the development of these cognitions and in which way different sources of the social environment contribute to the formation of smoking-related cognitions. In the following paragraphs, we will discuss several aspects that should be considered when investigating these research questions.

First, we have argued earlier that previous studies did not take the complexity and different aspects of environmental smoke exposure into account. In order to better understand how the social environment affects the formation of smoking-related cognitions and how different sources in the social environment contribute to the development of smoking-related cognitions, research should provide a more substantial assessment of the social environment. Moreover, it is important to investigate mechanisms explaining the effects of environmental smoke exposure on smoking-related cognitions and the initiation of smoking. As the effects of parental smoking on smoking-related cognitions are inconsistent and show mixed results, it needs to be investigated whether the knowledge of smoking of a significant other is sufficient to shape smoking-related cognitions (Kobus, 2003). Therefore, we not only suggest assessing several sources of the social environment (e.g. family, peers, media), but also different aspects of environmental smoke exposure. In order to better understand the processes of how the social environment influences smoking-related cognitions, it is valuable to assess in addition to smoking status, the smoking-related attitudes of different sources in the social environment, as well as whether parents/siblings/friends smoke in close proximity of the child (thus, whether the child is exposed to second-hand smoke).

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Third, another aspect that should be considered in future research regards the assessment of smoking-related cognitions, especially the assessment of implicit smoking-related cognitions among children. A common approach to assess implicit attitudes is the implicit association test (IAT), which involves...
measuring response latencies (the speed by which a task is performed) (Rudman, 2011). This measure has been adapted and developed to assess implicit attitudes among children (Baron & Banaji, 2006) and pre-schoolers (Cvencek, Greenwald, & Meltzoff, 2011). Up to now, these measures have mainly been used in research on prejudice and discrimination but may provide an opportunity to also assess implicit smoking-related cognitions. A measure which has been used to assess the strength of memory associations is the Word Association Test (WAT) (Stacy, 1995). Participants are requested to respond to a word with dual meaning and write down the first word that comes to their mind. Using the WAT provides the advantages that spontaneous responses that are triggered do not require analytic deliberation (Nelson, McEvoy, & Dennis, 2000) and that it does not rely on response latencies (Rudman, 2011). It may therefore be a good measure among children and early adolescents. However, although the WAT showed predictive validity (e.g. Stacy, 1997; Wiers, et al., 2007a), it fails to assess the affect of memory associations (Van Der Vorst, et al., 2012). Another measure of implicit cognitions, which has the same problem and which we used in two of our studies (Chapters 3 and 4), is children’s and early adolescents’ attention to smoking-related cues. Compared to smokers, up to now, the role of selective attention to smoking cues in the process of smoking initiation is still unclear. Therefore, as mentioned before, we suggest assessing the attention to smoking-related cues in combination with a measure that allows an interpretation of the valence of the attentional focus (e.g. an implicit association test). One study used an indirect measure to assess children’s smoking-related attitudes by observing children’s play with fake cigarettes in role-playing tasks (De Leeuw, et al., 2010c). Although this is an interesting approach to use among young children, it needs to be mentioned that as this method infers children’s attitudes on the basis of how they behave in a role-playing task, no conclusive interpretation can be made on the affect of children’s attitudes toward smoking. Therefore, it remains a possibility that this measure mirrors more children’s familiarity with smoking than their preference.

One of the challenges in future research on development of implicit smoking-related cognitions will be to adapt and develop measures that are reliable among children and early adolescents. A paradigm, which has been used in prejudice and discrimination research, may offer a valuable model for the investigation of smoking-related cognitions. A study by Dotsch and Wigboldus (2008) assessed how prejudiced implicit associations affect automatic behavioural responses by using virtual reality technology. Native Dutch participants were immersed in a virtual environment and asked to walk around an avatar and remember the combination of the name, which was written on his chest and the number, which was written on his back. In this study, participants had to approach both avatars with White and Moroccan facial features and their distance to the avatars was used as measure of automatic behavioural responses. Afterwards, participants’ implicit attitudes towards Moroccan and Dutch people were assessed using an IAT. This paradigm not only allows assessing automatic approach tendencies, but also links these to implicit attitudes. Translated to research on smoking-related cognitions, children and early adolescents could be requested to encounter smoking and non-smoking peers and it could be examined whether different risk groups (e.g. children with smoking parents) differ in their automatic approach tendencies. Moreover, it could be investigated whether implicit smoking-related associations (assessed with the Child IAT (Baron & Banaji, 2006)) are related to approach behaviour toward smoking peers.

As mentioned before, the relevance of smoking might play a role in the development and change of smoking-related cognitions. The time window in which the first opportunities to try smoking is relatively short (i.e. late childhood and early adolescence). To gain a better understanding of whether these opportunities play a role in the development of smoking-related cognitions, it might be valuable to assess the frequency of these opportunities and their effect on smoking-related cognitions especially in the sensitive time period between late childhood and early adolescence. An appropriate way of assessing changes in smoking-related cognitions and the way these changes are related to opportunities to try smoking might be EMA (Ecological momentary assessment) (Shiffman, et al., 1997; Shiffman, et al., 1996). However, it needs to be mentioned that such designs require large sample sizes.

Conclusion

The aim of the studies in this part of this dissertation were to investigate the association between the exposure to parental and movie smoking and children’s and adolescents’ smoking-related cognitive processes. Overall, our studies - and previous research - on the role of environmental smoke exposure in smoking-related cognitions has only scratched the surface. Moreover, interpretations of the findings of environmental smoking on smoking-related
cognitions, and their developmental trajectories, are limited due to scarcity
of research and inconsistent findings. Research is needed to improve our
understanding of the contribution of different sources in the social
environment on the formation of smoking-related cognitions. Also, research
that examines changes in cognitions more closely in the developmental period
between late childhood and early adolescence and changes due to social
influence prompts is warranted.
Nederlandse Samenvatting


In dit proefschrift is onderzoek gedaan naar de gevolgen van een rook-omgeving (‘environmental smoking’) op rokers en niet-rokers. In deel I ligt de nadruk op rokers en wordt onderzocht of en hoe rokers worden beïnvloed door rook cues in films. In deel II staan de effecten van een rookomgeving – blootstelling aan rokende ouders en aan roken in films – op niet-rokende kinderen en adolescenten centraal.

Deel I
Blootstelling aan roken in films: effect op rokers

Het doel van de studies die worden behandeld in het eerste deel van dit proefschrift was om onderzoek te doen naar de reactie van rokers op dynamische rook cues in films. Om dit te bereiken, zijn experimenten gedaan waarbij tijdens of na blootstelling aan roken in films het onmiddellijke rookgedrag, de craving en de aandacht voor rook cues zijn gemeten.

In de studie die in hoofdstuk 2 wordt behandeld, is geprobeerd inzicht te verkrijgen in de vraag of rokers, die worden geconfronteerd met rokende karakters in een film, tijdens het kijken van de film meer sigaretten roken dan rokers die geconfronteerd worden met filmkarakters die niet roken. Gebleken is dat dynamische rook cues in films een effect hebben op het aantal sigaretten dat tijdens een film gerookt wordt, zoëi het dat dit slechts geconcludeerd kan worden voor rokers die zich volgens het onderzoek minder inleefden op de film (zgn. ’transportation’). Voor die groep van mensen die zich minder inleefden, gold dat degenen die een film bekeken waarin de karakters rookten, significant meer sigaretten rookten dan degenen die geen rokende karakters zagen in de film. Hoofdstuk 3 behandelt een replicatie van dezelfde studie als beschreven in hoofdstuk 2. In deze studie is onderzocht of hetzelfde effect ook aangetoond kon worden bij adolescenten, en of het effect zou optreden bij rokers met een verschillende rookhistorie en met verschillende fases van verslaving. De studie biedt geen bewijs voor het effect van rook cues in films op het onmiddellijke rookgedrag van adolescenten rokers. Dit resultaat wordt niet beïnvloed door diverse rook- en filmsgerelateerde variabelen. Hoofdstuk 4 beschrijft een experimentele studie, waarin gekeken is naar het effect van rook cues in films op craving bij rokers. Dynamische rook cues hebben onder rokers niet geleid tot een drang om te roken na afloop van de film. Er is geen verschil in craving gevonden tussen rokers die keken naar een film met rokende karakters en rokers die keken naar een film zonder rokende karakters. Teneinde meer inzicht te krijgen in de ontwikkeling van craving tijdens het kijken van een film met rook scènes, is het design van de studie uitgebreid en is craving op vier momenten gemeten: voor en na de film en tijdens twee reclameblokken gedurende de film. Ook is gekeken of het DRD4 VNTR polymorfisme een invloed heeft op de reactiviteit op dynamische rook cues in films (hoofdstuk 5). Dynamische rook cues in films hebben geen invloed op rokers’ craving tijdens het kijken van een film en dit wordt niet beïnvloed door het DRD4 genotype. Echter, rokers die dragers zijn van het DRD4 7-repeat allele ontwikkelden hogere
Deel II
Blootstelling aan rokende ouders en roken in films: effect op niet-rokers

Het doel van de studies die behandeld worden in het tweede deel van dit proefschrift was om inzicht te krijgen hoe de blootstelling aan een rookomgeving van invloed is op mechanismen die waarschijnlijk ten grondslag liggen aan het beginnen met roken. Uit onderzoek is gebleken dat omgevingsfactoren zoals rokende ouders en roken in de media bijdragen aan het beginnen met roken. Er is echter weinig bekend over de wijze waarop de blootstelling aan de rookomgeving eraan bijdraagt dat adolescenten gaan roken. In een drietal studies is onderzoek gedaan of er een verband is tussen energyjs rokende ouders en roken in films en anderzijds expliciete en impliciete rook cognities bij kinderen en adolescenten.

In de studie in hoofdstuk 2 is onderzoek gedaan naar de effecten van korte termijn blootstelling aan roken in films op expliciete en impliciete rook cognities bij kinderen. In het experiment kregen kinderen een film clip te zien met of zonder rook scènes, waarbij hun rook-gerelateerde cognitieve responses werden gemeten na afloop van het zien van de film. Korte termijn blootstelling aan roken in tekenfilms en familiefilms heeft weinig onmiddellijke impact op expliciete en impliciete rook cognities bij kinderen. Blootstelling aan roken in films heeft geen effect op impliciete associaties met roken. Wat betreft expliciete rook cognities, zijn er slechts kleine effecten gevonden en qua statistische relevantie alleen effecten voor sociale normen over roken. Hoofdstuk 3 bevat een studie, waarin onderzoek is gedaan naar selectieve aandacht voor rook cues (een van de facetten van impliciete verwerking – 'implicit processing'). De studie behandelt de vraag of er verband bestaat tussen rokende ouders en aandacht voor omgeving-gerelateerde rook cues ('environmental smoking cues') bij kinderen. Door middel van een eye-tracking paradigma is onderzocht of kinderen, waarvan de ouders roken, in verhouding tot kinderen van niet-rokers, anders reageren wat betreft hun selectieve aandacht voor omgeving-gerelateerde rook cues. Uit deze studie blijkt een verband tussen rokende ouders en de aandacht van kinderen voor rook cues. Kinderen van rokers focussen vaker en langer op dynamische rook-gerelateerde cues dan kinderen met niet-rokende ouders. Wat betreft latentie bij fixaties is geen verschil gebleken tussen kinderen van rokers en niet-rokers. Het doel van de studie uiteengezet in hoofdstuk 4 was om te onderzoeken, welk verband er bij jonge adolescenten bestaat tussen de rookomgeving (ouders die roken en roken in films) en energyjs en expliciete en verschillende facetten van impliciete rook cognities anderzijds. In deze studie werd weinig impact gevonden van de blootstelling aan rokende ouders of roken in films op impliciete en expliciete rook-gerelateerde cognities bij jonge adolescenten. Er is geen verband gevonden tussen de blootstelling aan roken in films en enige impliciete of expliciete rook-gerelateerde cognitie bij jonge adolescenten. Daarnaast werd er slechts een verschil gevonden tussen adolescenten met rokende ouders versus niet- rokende ouders bij het aantal fixaties bij rook cues en dit hield verband met de leeftijd van de adolescenten. Er werd geen onder- scheid vastgesteld tussen jonge adolescenten met rokende ouders en jonge adolescenten met niet-rokende ouders, waar het gaat om de duur en de latentie op de fixatie op de rook cue.
Alles beschouwd vormen deze studies, in combinatie met eerdere onderzoeken, slechts een begin voor het vaststellen van de rol van de blootstelling aan een rookomgeving op het gebied van rook-gerelateerde cognities. Daarbij wordt de interpretatie van de resultaten van onderzoek naar de rookomgeving in verband met rook-gerelateerde cognities bemoeilijkt door een gebrek aan onderzoek en wisselende resultaten. Onderzoek is noodzakelijk om een beter begrip te krijgen van de bijdrage van diverse oorzaken in de sociale omgeving op de vorming van rook-gerelateerde cognities. Verder is er behoefte aan onderzoek waarbij nadrukkelijker gekeken wordt naar de verandering in cognities in de ontwikkelingsperiode tussen late kindertijd en jonge adolescентie en naar veranderingen veroorzaakt door sociale invloeden.
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Publications

This thesis


Other publications


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Spijkerman, R., Lochbuehler, K., & Engels, R.C.M.E. (Resubmitted). Identification with favorite characters in soap operas: Do viewers experience higher levels of identification when they perceive characters as positive, similar or desirable? Psychology of Popular Media Culture.
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Curriculum Vitae

Kirsten Lochbühler was born on July 26th 1979 in Seeheim-Jugenheim, Germany. She completed her secondary education (Abitur) at Wagenburg Gymnasium in Stuttgart in 1998. After graduating she did a year of volunteer work in the context of a ‘voluntary social year’ at a kindergarten in Stuttgart. In the meantime she took courses in Behavioural Science at the Fernuniversität Hagen. She continued her studies at the University of Vienna, Austria where she obtained a degree in Psychology in 2007. For her master thesis she conducted research on friendships in multicultural school classes as an indicator of integration. During her studies in Vienna, she spent a semester at the University of Sussex, Brighton, UK in 2003 and completed an internship in clinical psychology at the department of pediatric endocrinology at the Pediatric Center Olgahospital in Stuttgart in 2005. Being at a treatment center for children and adolescents with diabetes, she got the opportunity to engage in the summer program devoted to children with diabetes to improve their competence and skills to handle their illness. After her studies she did an internship in Amsterdam at an NGO (Stichting Alexander), in the area of participatory youth research. In December 2007, she started her PhD at Radboud University Nijmegen, the Netherlands. During her PhD, she presented her work at international conferences (Joint conference of SRNT and SRNT-Europe, Dublin, Ireland, 2009; SRNT Europe, Bath, England, 2010; SRNT’S 17th Annual meeting, Toronto, Canada, 2011; European Conference Tobacco or Health, Amsterdam, The Netherlands, 2011; SRNT’S 18th Annual meeting, Houston, TX, USA, 2012) and participated in international summer schools (2nd Workshop for PhD students on Developmental Psychology, Jena, Germany, 2008; EARA/SRA Summer School, Tucson, AZ, USA, 2011). Moreover, she had the opportunity to undertake work visits to Prof. James Sargent (Geisel School of Medicine at Dartmouth, Dartmouth College, NH, USA, 2010, 2011), Prof. Marcus Munafò (Department of Experimental Psychology, University of Bristol, UK, 2010), and Prof. Thomas Brandon and Prof. David Drobes (Moffitt Cancer Center, University of South-Florida, FL, USA, 2011).

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