Parental smoking and children’s attention to smoking cues
Kirsten Lochbuehler, Roy Otten, Hubert Voogd and Rutger CME Engels
J Psychopharmacol 2012 26: 1010 originally published online 27 February 2012
DOI: 10.1177/0269881112439254

The online version of this article can be found at:
http://jop.sagepub.com/content/26/7/1010

Published by:
SAGE
http://www.sagepublications.com

On behalf of:
British Association for Psychopharmacology

Additional services and information for Journal of Psychopharmacology can be found at:

Email Alerts: http://jop.sagepub.com/cgi/alerts
Subscriptions: http://jop.sagepub.com/subscriptions
Reprints: http://www.sagepub.com/journalsReprints.nav
Permissions: http://www.sagepub.com/journalsPermissions.nav

>> Version of Record - Jun 25, 2012
OnlineFirst Version of Record - Feb 27, 2012
What is This?
Parental smoking and children’s attention to smoking cues

Kirsten Lochbuehler¹, Roy Otten¹, Hubert Voogd² and Rutger CME Engels¹

Abstract

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

Keywords

Eye movements, selective attention, parental smoking, children

Introduction

A number of studies have shown that parental smoking is one of the strongest predictors of adolescents’ smoking behaviour (Avenevoli and 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 (Munafo and Johnstone, 2008), modelling and norm-setting processes (Avenevoli and 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., 2010). 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., 2010). 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., 2007). 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

¹Behavioural Science Institute, Radboud University Nijmegen, Nijmegen, the Netherlands
²Faculty of Social Sciences, Radboud University Nijmegen, Nijmegen, the Netherlands

Corresponding author:
Kirsten Lochbuehler, Behavioural Science Institute, Radboud University Nijmegen, PO Box 9104, 6500 HE Nijmegen, the Netherlands
Email: k.lochbuehler@pwo.ru.nl

Downloaded from jop.sagepub.com at Radboud Universiteit Nijmegen on December 12, 2012
may foster automatic approach action tendencies (e.g. Franken, 2003; Robinson and Berridge, 1993). According to dual process models, the presence of sufficient capacity and motivation can still inhibit this action tendency (Wiers et al., 2007).

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 put 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 and Berridge, 1993; Wiers et al., 2007), 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). 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 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 expectations. 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 and Cox, 2008; Field et al., 2009), 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; SD = 0.86) 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; SD = 0.83). 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 (SD = 0.92). 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 min, 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 min, 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-min 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., 2010). 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., 2010). 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 they smoke and whether they smoke in the presence of their child).

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’, ‘yes, I try smoking once in a while’.

Environmental smoking exposure. Environmental smoking exposure was assessed to receive additional information on children’s exposure to smoking. Parents and children were both asked whether the children knew other people, besides their parents, who smoke and whether other people are allowed to smoke at their house.

Film appreciation. Film appreciation was assessed in order that the two groups did not differ with regard to their liking of the movies. It was measured with eight items on a 4-point scale ranging from ‘definitely yes’ to ‘definitely not’. An example item is ‘I thought the film was interesting’ (Engels et al., 2009). Alpha was 0.74 (De Schippers van de Kameleon) and 0.75 (101 Dalmatians).

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 0.90. This measurement showed predictive validity (Harakeh et al., 2004).

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 0.72. An example item for the cons of smoking is: ‘If I were to smoke, it would be bad for my health’. Alpha was 0.89.

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 0.86–0.97 (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., 2006; 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 ($p = 0.36$), age ($p = 0.42$), whether participants had tried smoking before ($p = 0.41$) and whether they had already seen the movie ($p = 0.71$ and $p = 0.19$).

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 ($M = 3.14$; $SD = 0.45$) than the movie *101 Dalmatians* ($M = 2.98$; $SD = 0.42$).

Explicit smoking cognitions

Children had, on average, very unfavourable cognitions towards smoking. The results of a MANOVA showed no differences between groups (Wilks’ Lambda = 0.67, $F (3, 26) = 4.37, p = 0.01$) 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.

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, $F(3, 25) = 3.05, p = 0.047$; Wilks’ Lambda = 0.732; partial eta squared = 0.27. 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.

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

<table>
<thead>
<tr>
<th></th>
<th>Smoking parent Mean</th>
<th>Smoking parent SD</th>
<th>Non-smoking parent Mean</th>
<th>Non-smoking parent SD</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pro-smoking attitudes</td>
<td>1.69</td>
<td>1.32</td>
<td>1.51</td>
<td>0.53</td>
<td>0.27</td>
<td>0.61</td>
</tr>
<tr>
<td>Pros of smoking</td>
<td>1.31</td>
<td>0.45</td>
<td>2.33</td>
<td>0.98</td>
<td>10.36</td>
<td>0.003</td>
</tr>
<tr>
<td>Cons of smoking</td>
<td>6.47</td>
<td>0.60</td>
<td>5.50</td>
<td>1.86</td>
<td>2.84</td>
<td>0.10</td>
</tr>
</tbody>
</table>

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 ($M = 0.11, SD = 0.07$) directed their gaze significantly longer on smoking cues than children with non-smoking parents ($M = 0.08, SD = 0.03$). 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.

Association between attentional bias and cognitions towards smoking

The correlations between the dependent variables and the cognitions towards smoking are shown in Table 3. No significant correlations between each of the dependent variables and each of the smoking-related cognitions were found. The three dependent variables (number, duration and latency of fixations) were highly correlated.

Discussion

This study examined the association between parental smoking and children’s attention to smoking cues. Children with a smoking parent and children with non-smoking parents were exposed to two movie clips with smoking cues. Selective attention was assessed with an eye-tracking paradigm. It was found that children with a smoking parent, compared with children with non-smoking parents, fixated more often and for longer periods of time on smoking cues portrayed in movies. No difference between children with a smoking parent and children with non-smoking parents was found for latency of fixation.

Our results indicate that exposure to parental smoking may affect children before they smoke. This suggests that the development of automatic cognitive responses might not necessarily be based solely on one’s own experience with smoking, but also on the repeated exposure to environmental 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.
Table 2. Multivariate analysis of variance of the influence of parental smoking on attention to smoking cues

<table>
<thead>
<tr>
<th></th>
<th>Smoking parent</th>
<th>Non-smoking parents</th>
<th>F</th>
<th>p</th>
<th>η²</th>
<th>power</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of fixations (times)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition</td>
<td>45.55</td>
<td>35.26</td>
<td>7.525</td>
<td>0.01</td>
<td>0.22</td>
<td>0.75</td>
</tr>
<tr>
<td>Age</td>
<td>12.022</td>
<td>12.000</td>
<td>0.002</td>
<td>0.32</td>
<td>0.92</td>
<td></td>
</tr>
<tr>
<td>Duration of fixations</td>
<td>0.11</td>
<td>0.08</td>
<td>5.012</td>
<td>0.03</td>
<td>0.16</td>
<td>0.58</td>
</tr>
<tr>
<td>Age</td>
<td>8.717</td>
<td>0.007</td>
<td>0.25</td>
<td>0.81</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Correlations between attitude, pros of smoking, cons of smoking, number of fixations, duration of fixations and latency of fixations.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Attitudes</td>
<td></td>
<td>0.068</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Pros of smoking</td>
<td>0.062</td>
<td>-0.148</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Cons of smoking</td>
<td></td>
<td>-0.298</td>
<td>0.075</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Number of fixations</td>
<td>-0.188</td>
<td>-0.116</td>
<td>-0.486**</td>
<td>-0.531**</td>
<td></td>
</tr>
<tr>
<td>5. Duration of fixations</td>
<td>-0.108</td>
<td>0.123</td>
<td>0.941**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Latency of fixations</td>
<td>0.189</td>
<td>0.026</td>
<td>-0.05</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. ** p < 0.01

As previous research supports a potential role of familiarity or expertise on attentional biases (Chanon et al., 2010; Daglelish, 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., 2010). 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 strength 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., 2009). 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 and 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.

**Funding**

This study was supported by the Behavioural Science Institute, Radboud University Nijmegen, the Netherlands.

**Conflict of interest**

None declared.

**References**


