Long-term effectiveness of computer-generated tailored feedback in smoking cessation

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Abstract

Although tailored interventions consisting of only a few pages of information lead to more quitting than no intervention in the short term, the long-term efficacy of a single tailored intervention still has to be proven. In the present study smokers were reactively recruited and randomly allocated to one of four intervention conditions: (1) outcome information, (2) self-efficacy enhancing information, (3) both sorts of information or (4) no information. Smokers in the three experimental groups received computer-generated tailored feedback containing the condition-specific information, by mail. The results from the 14 months follow-up can be summarized as follows. Compared to the no information condition, all three experimental conditions led to significantly more smokers who had engaged in 24-h quit attempts. However, no experimental condition led to more 7-day quitting than the no information condition. With regard to continuous abstinence, the experimental condition offering a combination of outcome information and self-efficacy enhancing information had a significant effect, compared to the no information condition. It is concluded that a minimal six-page tailored intervention can be beneficial in supporting smokers to quit smoking, even after 14 months.

Introduction

Self-help materials in smoking cessation are designed to support smokers in their further unaided quit attempts (Cummings et al., 1988; Glyn et al., 1990; Lichtenstein and Glasgow, 1992). However, most self-help materials are directed at smokers in general and not at individuals. Hence, these standardized self-help interventions contain information which is often not applicable to an individual’s psychological state or situation. Tailoring information to individual features of a person has been shown to be a promising line of development in self-help interventions. It is considered to enhance the relevance of the offered information and to lead to larger behavioral effects (Velicer et al., 1993; Strecher et al., 1994; De Vries et al., 1995).

Because computer-generated tailored interventions mostly consist of only a few pages of information, decisions have to be made about which information is essential to behavior change (Dijkstra et al., 1998). Cummings et al. (1988) propose that self-help interventions need to contain the following information: (1) information about the health and social consequences of smoking; (2) specific strategies and exercises for successful quitting; and (3) specific strategies and exercises for the maintenance of non-smoking and the prevention of and coping with relapse. From a social cognitive theoretical point of view (Bandura, 1986), this information is considered to change cognitive anticipation of the outcomes of quitting (information 1) and to enhance perceived self-efficacy (information 2 and 3) (Dijkstra et al., 1998), which are two major determinants of...
behavior and behavior change (Bandura, 1986). Cummings et al. (1988) argue that the level of readiness to quit varies widely, even in smokers who seek advice on quitting and they recommend that future quit smoking self-help materials should include: '...information designed to increase motivation for quitting as well as suggestions on how to quit' (p. 215). In other words, a number of the smokers who show interest in smoking cessation have low readiness to quit and may benefit from outcome information. On the other hand, if the outcome information could be omitted from an intervention, other and more relevant information could be added. Such an innovation would be expected to enhance efficacy of the (tailored) intervention.

A primary test of the efficacy of self-help materials compares the effects with a no-intervention control group. Only when an intervention leads to more behavioral changes than no intervention is it useful to distribute and implement it. A search of the literature reveals that a single tailored intervention letter can indeed lead to more changes in behavior than no information. However, this conclusion can only be drawn with regard to short-term effectiveness (Campbell et al., 1994; Strecher et al., 1994; Kreuter and Strecher, 1996).

The first goal of the present study was to assess whether computerized tailored letters comprising about six pages of information led to more quitting than no intervention after 14 months. The second goal of the present study was to assess which type of information would be more successful: information on outcomes of quitting only, self-efficacy enhancing information only or a combination of both sorts of information. Additionally, the cognitive characteristics associated with successful quitting were examined.

**Method**

**Participant recruitment**

Smokers were recruited by advertisements in local newspapers throughout the Netherlands. They were asked to volunteer for a research project on minimal interventions for smoking cessation, including the possibility of being a control group member. In order to assure a high variation of readiness to quit in the sample, smokers without plans to quit were also explicitly invited to react. Participants were offered the opportunity of 10 bonus prizes amounting to $100. After participants had phoned the university in order to register (n = 1733), they were sent the pre-test questionnaire which could be returned with a pre-paid envelope. After 2 weeks, 1546 pre-test questionnaires (89.2%) had been returned (excluding 60 questionnaires of pipe or cigar smokers and questionnaires filled out incompletely).

**Design**

Smokers were randomly assigned to one of four conditions: only information on outcomes of quitting (OC condition, n = 386), only self-efficacy enhancing information (SE condition, n = 387), both sorts of information (BO condition, n = 387) or no information at all (CO condition, n = 386). Participants in the experimental conditions were sent the intervention material by mail, while participants in the control condition received a letter in which they were told they would get no information.

The present article presents the data of T1, the first post-test (T2; 2 weeks after the intervention) and the 14 months follow-up (T3). The data on the 3 months follow-up are published elsewhere (Dijkstra et al., 1996b) because specific short-term outcome measures were used.

Participants at T1 (N = 1546) were (14 months after the intervention) sent a short questionnaire which started with the announcement of a carbon monoxide-validation measurement in a sample of the participants who reported having quit smoking. This announcement was considered to act as a bogus pipeline (Jones and Sigal, 1971). Participants who returned the 14 months follow-up questionnaire were offered the opportunity of 20 bonus prizes amounting to $50. From the 1546 questionnaires sent, 990 (64%) were returned.

**Tailored feedback**

The computerized expert system to generate the tailored feedback was adapted from a previous
evaluation of a minimal intervention in smokers who were planning to quit (Dijkstra et al., 1998). The present intervention consisted of a four to seven page computer generated individualized report based on the pre-test questionnaire scores. Decision rules, developed in relation to the question, ‘What answer in the questionnaire leads to what information in the intervention?’, combined several potential parts of the message in one coherent message. The reports for the three experimental conditions contained the specific sort of information reported in the design section of this article, but were tailored to the individuals intention to quit, perceived outcomes, situational self-efficacy levels and smoking behavior. In order to personalize the letters, the name of the individual was mentioned three times in each letter.

**OC condition**
The letters for this condition contained information on possible positive outcomes of smoking and quitting, such as personal health consequences, social consequences like appreciation of quitting by a non-smoking partner and the consequences of not smoking for people in the environment. With regard to the negative outcomes of quitting, such as weight gain, loss of functions of smoking such as relaxation and expected withdrawal symptoms, restructuring information was offered.

**SE condition**
The letters for this condition contained information on skills to cope with social, emotional and/or addictive situations, depending on the individual confidence scores. If a smoker reported high confidence in refraining from smoking in a specific situation, the smoker was told this increased the individual’s chances of success in quitting. If a smoker had moderate or low confidence with regard to refraining from smoking in a specific situation, cognitive and behavioral skills were offered.

**BO condition**
The letters for this condition contained both sorts of information. All topics addressed in the OC and SE condition were also addressed in this condition. In order to prevent the amount of pages from exceeding seven, the expert system was programmed to use shorter messages when necessary.

**Questionnaire**
Three outcome measures were used at the 14 months follow-up. First, quit activity was measured by asking: ‘Have you engaged in a 24-h quit attempt since the last measurement?’ (yes/no). Second, point prevalence quitting was assessed by asking: ‘Have you smoked during the last 7 days? (even one puff)’ (yes/no). Third, continuous abstinence was assessed by asking: ‘Have you smoked since the last measurement?’ (yes/no). The time between the last measurement and the 14 months follow-up was approximately 12 months.

The pre-test questionnaire assessed gender, age, level of education, the number of cigarettes smoked, the number of years participants had smoked, a 24-h quit attempt in the last 12 months and the participants’ nicotine dependence. The nicotine dependence was assessed with the Fagerström Test for Nicotine Dependence (FTND; Heatherton et al., 1991) which assesses smoking habits: How much do you smoke? How soon after awakening? Is it hard not to smoke in public places? Do you smoke when you are ill? Do you smoke more in the morning and which cigarette is most difficult to give up? The item scores were added and the minimum possible score was 0, the maximum 10. Furthermore, perceived self-efficacy, intention to quit, and the pros and cons of quitting were assessed.

The pros-of-quitting scale was composed of 15 items referring to the positive consequences of behavior change. Cronbach’s α was 0.87. The cons-of-quitting scale was composed of six items referring to the negative consequences of behavior change ($\alpha = 0.57$). The scales had a significant but low correlation ($r = 0.24$) and were validated in an earlier study (Dijkstra et al., 1996a). The items of both scales could be scored from ‘not sure’ or ‘not expecting a certain outcome’ (0) to a ‘strong expectation of the outcome’ (3).

Two self-efficacy scales were used, assessing
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self-efficacy with regard to coping with social situations (four items, \( \alpha = 0.81 \)) and self-efficacy with regard to coping with negative emotions (three items, \( \alpha = 0.86 \)). All self-efficacy expectations were measured on a seven-point scale and could be scored from 'not sure at all whether I am able to refrain from smoking' (-3) to 'very sure I am able to refrain from smoking' (+3) and the item scores were added to scale scores.

The questionnaire at T2 contained six process evaluation items. Three items assessed to what extent the participants in the experimental groups experienced the interventions as containing information on: (1) the pros of quitting, (2) the cons of quitting and (3) skills to quit smoking. The remaining three items assessed to what extent participants in the experimental conditions: (1) perceived more pros of quitting, (2) perceived fewer cons of quitting and (3) learned skills to quit smoking, due to the tailored intervention. All six items could be scored from 'not at all' (1) to 'to a large extent' (10).

**Participant characteristics, randomization check and attrition**

Of the 1546 respondents, 59% were female, the average age was 39.7, and 22% were classified as low educated, 43% as medium educated and 35% as high educated. The respondents smoked an average of 20.3 cigarettes a day, they had smoked for an average of 21.8 years and 44.9% of the respondents had engaged in a serious quit attempt in the last 12 months. The average FIND score (the scale ranging from 0-10) was 4.6. With regard to the cognitive measures, the mean scores on the pros and cons of quitting (the scale ranging from 0–3) were 1.59 and 1.29, respectively. Self-efficacy mean scores with regard to emotional states and social situations (the scale ranging from minus 3 to +3) were -0.97 and -0.19, respectively. Finally the mean intention to quit (the scale ranging from 1-10) was 5.9.

To check whether the randomization was successful, the four conditions were compared on sex, age, level of education, FIND score, number of cigarettes a day, number of years smoked, quit attempts in the last 12 months, the pros and cons of quitting, both self-efficacy factors and intention to quit as measured at T1. Chi-square tests for the discrete variables and F-tests for the continuous variables revealed no differences between the conditions with respect to these variables.

Attrition from pre-test (T1) to the post-test at 14 months was 36% (\( n = 555 \)). Logistic regression analysis with attrition as the dependent variable and the T1 variables involved in the randomization check as predictors revealed that drop-outs perceived significantly (\( P < 0.05 \)) fewer pros of quitting but had a significantly higher intention to quit.

**Analyses**

First, to check whether the interventions in the experimental conditions were experienced as containing the different sorts of information, outcome information or self-efficacy enhancing information, the group means on the process evaluation items were compared using ANOVAs, adjusted for sex, age and level of education. The same procedure was used with regard to the experienced change in perception of the pros, cons and self-efficacy. All participants in the experimental conditions who responded at T2 and at the 14 months follow-up were selected in these analyses.

Second, to test whether and which of the experimental conditions still had an effect after 14 months, logistic regression analyses were used with 24-h quit attempt, 7-day quit and continuous abstinence as dependent variables, and Condition as the independent variable. The analyses were adjusted for sex, age and level of education. The factor Condition was dummy coded, using the control condition as the reference group. In case the effect in two or three experimental conditions exceeded the effect in the control condition, contrasts between the experimental conditions were computed.

Third, in order to examine the characteristics of smokers who had quit smoking, the pros and cons of quitting, both self-efficacy measures and the FIND scores at T1 were entered in a logistic regression to predict quitting after 14 months. The
Table I. Means of the process evaluation items by experimental condition, adjusted for sex, age, education and stage of change

<table>
<thead>
<tr>
<th>Outcome information (n = 208)</th>
<th>Self-efficacy information (n = 200)</th>
<th>Both sorts of information (n = 201)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>The letter was about: (scale 1–10)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>the pros of quitting</td>
<td>8.17</td>
<td>5.73</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>the cons of quitting</td>
<td>4.92</td>
<td>4.00</td>
<td>0.002</td>
</tr>
<tr>
<td>skills in smoking cessation</td>
<td>4.04</td>
<td>8.04</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>The letter made me: (scale 1–10)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>see more pros of quitting</td>
<td>6.04</td>
<td>5.35</td>
<td>0.003</td>
</tr>
<tr>
<td>see fewer cons of quitting</td>
<td>4.63</td>
<td>4.61</td>
<td>0.398</td>
</tr>
<tr>
<td>learn skills to quit smoking</td>
<td>4.80</td>
<td>6.58</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

analyses were adjusted for sex, age, level of education and ‘Condition’.

Results

Manipulation check

Table I shows the mean scores on the six process evaluation items by Condition. In both conditions offering outcome information (OC and BO condition), participants scored higher on the recognition of information on the pros and the cons of quitting, than in the condition designed to not contain this information (SE condition). In both conditions offering self-efficacy enhancing information (SE and BO condition), participants scored higher on the recognition of information on skills to quit smoking, than participants in the condition designed to not contain this information (OC condition). Also, participants in both conditions containing outcome information (OC and BO condition) stated that they perceived more pros of quitting after the intervention than participants in the SE condition. No differences occurred with regard to changes in the perceived cons of quitting. Participants receiving self-efficacy enhancing information (SE and BO condition) reported having learned more skills to quit smoking after the intervention, than participants in the OC condition. Except with regard to (the lack of) change in the perception of the cons of quitting, all differences were in the expected directions.

Effects on smoking cessation

Table II shows the percentage of quitters after 14 months by Condition and the odds ratios for the comparison with the control condition. With regard to engaging in a 24-h quit attempt since the last measurement, all three experimental conditions led to significantly higher (P < 0.05) percentages of quit attempts than the no information control condition: about 50% of the smokers in the experimental conditions reported having engaged in a quit attempt of at least 24 h since the last measurement, in comparison with 43% in the control condition. Contrast analysis revealed that the experimental conditions did not differ from each other. With regard to the 7-day quit criterion, no experimental condition led to more 7-day quitting than the control condition. In the control condition, but also in two of the experimental conditions, about 11% had quit for 7 days. With regard to continuous abstinence, the experimental condition offering a combination of outcome information and self-efficacy enhancing information (BO condition), led to significantly more (P < 0.05) participants reporting continuous abstinence than the no-information control condition. In the BO condition almost 5% reported having refrained from smoking since the last measurement, in comparison with 1.6% in the control condition. Both of the other experimental conditions (OC and SE condition) did not lead to significantly more continuous abstinence in comparison with the control group.
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Table II. A 24-h quit attempt since the last measurement, 7-day quit and continuous abstinence: percentages and odds ratios (OR) adjusted for sex, age and education

<table>
<thead>
<tr>
<th>Outcome variables</th>
<th>OC (%)</th>
<th>OC versus CO (OR)</th>
<th>SE (%)</th>
<th>SE versus CO (OR)</th>
<th>BO (%)</th>
<th>BO versus CO (OR)</th>
<th>CO (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24-h quit attempt</td>
<td>49</td>
<td>1.50*</td>
<td>50.4</td>
<td>1.57*</td>
<td>51.4</td>
<td>1.63*</td>
<td>42.8</td>
</tr>
<tr>
<td>7-day quit</td>
<td>8.5</td>
<td>0.78</td>
<td>11.5</td>
<td>1.07</td>
<td>11.3</td>
<td>1.05</td>
<td>11.2</td>
</tr>
<tr>
<td>Continuous abstinence</td>
<td>2.4</td>
<td>1.77</td>
<td>3.3</td>
<td>2.25</td>
<td>4.8</td>
<td>3.74*</td>
<td>1.6</td>
</tr>
</tbody>
</table>

Significant OR > 1.0 means that the percentage in the experimental condition is significantly higher than the percentage in the control condition (last column).

*P < 0.05.

OC = outcome information (n = 247); SE = self-efficacy information (n = 244); BO = both sorts of information (n = 249); CO = no information (n = 250).

Table III. Predicting quitting behavior at 14 months from pre-test scores on four cognitive measures and the FTND, adjusted for sex, age, education and condition

<table>
<thead>
<tr>
<th>Variables</th>
<th>Outcome measures</th>
<th>Continuous abstinence</th>
<th>7-day quitting</th>
<th>24-h quit attempt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>SE</td>
<td>OR</td>
<td>SE</td>
</tr>
<tr>
<td>Pros of quitting</td>
<td>1.06**</td>
<td>0.02</td>
<td>1.03*</td>
<td>0.01</td>
</tr>
<tr>
<td>Cons of quitting</td>
<td>0.95</td>
<td>0.06</td>
<td>0.99</td>
<td>0.03</td>
</tr>
<tr>
<td>Emotional self-efficacy</td>
<td>1.16*</td>
<td>0.07</td>
<td>1.05</td>
<td>0.04</td>
</tr>
<tr>
<td>Social self-efficacy</td>
<td>1.06</td>
<td>0.06</td>
<td>1.03</td>
<td>0.03</td>
</tr>
<tr>
<td>FTND</td>
<td>0.92</td>
<td>0.09</td>
<td>0.83***</td>
<td>0.05</td>
</tr>
</tbody>
</table>

*P < 0.05; **P < 0.01; ***P < 0.001. N = 990.

A significant OR > 1.0 means that the variable has a positive relation with quitting, whereas a significant OR < 1.0 means that the variable has a negative relation with quitting.

Characteristics of quitters

Table III shows the characteristics of smokers at T1 which are associated with quitting. Smokers who reported having been engaged in a quit attempt since the last measurement anticipated more pros of quitting, had higher self-efficacy with regard to coping with social situations and lower FTND scores. Smokers who reported having refrained from smoking for 7 days also anticipated more pros of quitting and had lower FTND scores at T1. Smokers who reported being continuously abstinent after 14 months anticipated more pros of quitting and had higher self-efficacy with regard to coping with negative emotions at T1.

Analyses including drop-outs

Because attrition could be predicted by the perceived pros of quitting and the intention to quit at T1, the present results might be influenced by selective drop-out. One way to address this problem was to use the last known measurement (T1 or T2) of each dropped-out smoker as a substitute for the T3 measurement and repeat all analyses. This 'intention to treat analysis' (Heyting et al., 1992) revealed that none of the significant results changed qualitatively. Only minor changes in betas, odds ratios and P values emerged. The 'intention to treat analyses' seem to support the present results.
All three sorts of tailored information led to more quit attempts of at least 24 h in the previous 12 months in comparison with no intervention, whereas no effect was found with regard to the 7-day quit criterion. A six-page tailored intervention containing a combination of outcome information and self-efficacy enhancing information led to more continuous abstinence than no intervention, even after 14 months. Since continuous abstinence is the most conservative and most desirable outcome of smoking cessation interventions, the present study suggests that a sample of reactively recruited smokers with varying readiness to quit can benefit from a combination of information on the outcomes of quitting and self-efficacy enhancing information.

Although the results with regard to continuous abstinence are clear, questions arise with regard to both of the other outcome measures. With regard to the 24-h quit attempt measure, it was found that all three experimental conditions had more effect than the control condition. In other words, it did not seem to matter which information they were offered, as long as they received information on smoking cessation. However, it might be questioned whether encouraging smokers to engage in 24-h quit attempts is an appropriate smoking cessation strategy. Because the retrospective report of a quit attempt of at least 24 h implies that the smoker has relapsed in the past, such a failed quit attempt might be regarded as detrimental. On the other hand, if a 24-h quit attempt is regarded as a learning experience (Orleans, 1993; Curry et al., 1995), all three sorts of information tested in the present experiment would seem beneficial.

None of the experimental conditions led to more 7-day quitting than the control condition. The fact that continuous abstinence was stimulated by a tailored message but engaging in a 7-day quit attempt was not, might be explained in the following way. Smokers who reported being continuously abstinent, started their quitting only a short time after the intervention, whereas most smokers who had refrained from smoking for the previous 7 days (smokers who were continuously abstinent were included in this measure) started this attempt later or had relapsed at an earlier attempt. The effect with regard to continuous abstinence might be brought about a short time after the intervention in smokers who have a decreased risk of relapse. This notion is supported by the finding that in the present study, smokers who were continuously abstinent had higher self-efficacy to cope with negative emotions at pre-test, while negative emotions are a major source of relapse (O’Connel, 1987; Shiffman et al., 1996; Swan et al., 1996). Moreover, whereas being a more nicotine-dependent smoker led to fewer 7-day quitting and fewer quit attempts since the last measurement, in the present sample, nicotine dependence did not influence the chances of becoming continuously abstinent. It may be the case that smokers with higher self-efficacy in coping with negative emotions have enough resources to abstain in spite of negative emotions caused by withdrawal from nicotine. Smokers who engaged in quit attempts since the last measurements had, at pre-test, higher self-efficacy to cope with social situations. This might mean that a high self-efficacy to cope with social situations helps to initiate a quit attempt, but is not sufficient in preventing relapse.

Concluding, a six-page tailored intervention was effective after 14 months. In the present sample with varying readiness to quit, an intervention containing outcome information as well as self-efficacy enhancing information was beneficial. The fact that smokers were able to identify the sort of information in the tailored intervention, as the manipulation check revealed, further supports the conclusion with regard to the sort of information smokers benefit from. Furthermore, quitting behavior was associated with the anticipation of many pros of quitting. High self-efficacy with regard to coping with negative emotions at pre-test was a cognitive characteristic of smokers who were continuously abstinent after 14 months.

The fact that the presently used minimal but tailored intervention was effective in supporting smokers to still refrain from smoking after 14 months is very promising. Future research might...
be directed at enhancing the effectiveness by further dismantling the content of smoking cessation interventions in order to decide which information is essential to behavior change in samples with differing readiness to change.

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References


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