Smoking and the Ø pattern; predictors of transitions through the stages of change

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Abstract

Pre-contemplators, contemplators and preparers have previously been described by distinct scores on pros, social influence and self-efficacy, the Ø pattern. The objective of this study was to replicate this pattern in a sample of adult smokers (n = 554), to longitudinally observe stage sequence and identify predictors for forward and backward stage transition. Three hypotheses were formulated: (i) forward transition from pre-contemplation will be predicted by a higher perception of pros concerning smoking cessation, (ii) backward transition from contemplation will be predicted by a lower perception of pros of quitting smoking and (iii) forward transition from preparation will be predicted by a higher self-efficacy perception concerning smoking cessation. The Ø pattern was replicated successfully. Smokers appeared to be more likely to transition to an adjacent stage than to skip a stage in the sequence. For prediction of stage transition, separate analyses were conducted for pre-contemplators, contemplators and preparers. Respondents transitioning forward were compared with respondents remaining in the same stage or transitioning backward and vice versa. Hypothesis (i) and (iii) were confirmed. Additionally, self-efficacy predicted forward transition from pre-contemplation. Implications towards improving interventions and research concerning stage transition are discussed.

Introduction

Behaviour change is recognized as a process rather than a static moment in time in which behaviour alteration occurs. The stages of change, as proposed by Prochaska and DiClemente [1] in the transtheoretical model, are the product of this line of thinking. According to the stages of change, smokers do not simply change into non-smokers overnight, but go through different stages of intention in order to reach behavioural change. These stages are based on the time indicated by the individual between the current moment and the intended behaviour change and are classified as pre-contemplation (do not wish to quit within 6 months), contemplation (wish to quit within 6 months) and preparation (wish to quit within 1 month and has seriously attempted to quit smoking in the last year). After the behavioural change has taken place (action), the changed behaviour can be continued (maintenance) or discontinued (relapse) [2].

These stages are incorporated in the I-Change Model [3], the theoretical background of this study. This model, succeeding the ASE (Attitude-Social Influence-Efficacy) Model, is based on several cognitive models and its concepts have been used as a theoretical basis for a number of studies...
concerning behaviour change [4–6]. The motivational concepts of pros, social influence and self-efficacy are acknowledged to be of influence on the intention to change behaviour, the stages of change. These three core elements are in turn influenced by predisposing factors. The I-Change Model differs from the ASE Model in that it also takes awareness factors (knowledge, risk perception and cues to action) and information factors (the quality, channel and source of information concerning the behaviour change) into account. Studies on the characteristics of smokers concerning the motivational concepts across the stages of change within the context of the I-Change Model showed a specific pattern of pros, social influence and self-efficacy scores shaped as a Ø (see Fig. 1), demonstrating differences in scores on these three concepts across the stages. De Vries and Backbier [7] initially described the Ø hypothesis in a population of Dutch adult smokers, where pre-contemplators perceived less advantages or pros of smoking cessation than contemplators and contemplators seemed to have a lower score on self-efficacy compared to those individuals in the action stage. In addition, perceived social support increased steadily across the stages towards action. Later studies confirmed these findings in samples of cross-sectional [8] and longitudinal data [9, 10] for smoking cessation. Results of these latter studies indicated that forward transition from pre-contemplation was predicted by seeing more pros of quitting smoking, whereas a higher self-efficacy score predicted forward transition from preparation to action. Backward transition from contemplation was predicted by perceiving less pros of quitting. However, the number of longitudinal studies on stage transition in a population of smokers is limited and results are not always conclusive. Additionally, not all studies have used the stage of change algorithm.

Although the stages of change have been widely applied in social science research, they have also received a fair amount of criticism. The main concern is that the stages of change might not be ‘real’ stages of which transition can be predicted by increases or decreases in cognitive concepts, but are merely pseudo-stages that are concealing a continuum of these concepts [11, 12]. This would imply no stage-transition-specific predictors. Additionally, the time cut-off points between the stages are considered arbitrary [13]. Weinstein et al. [11] suggest four types of research to test the validity of the stages of change. This study includes three of these suggested research methods: cross-sectional comparisons between characteristics of subjects in the different stages of change (by replicating the Ø pattern), examination of stage sequences over time and longitudinal prediction of backward and forward stage transitions from the stages pre-contemplation, contemplation and preparation in a sample of adult smokers. The fourth suggested test, experimental studies of matched and mismatched interventions, was not within the scope of the present study. Three hypotheses regarding stage transitions were formulated, based on results from a previous study [9]: (i) forward transition from pre-contemplation will be predicted by a higher perception of pros concerning smoking cessation, (ii) backward transition from contemplation will be predicted by a lower perception of pros of quitting smoking and (iii) forward transition from preparation will be predicted by a higher self-efficacy perception concerning smoking cessation. As the Ø pattern describes the influence of social influence as gradually increasing over the stages [9], and earlier studies did not find a significant predictive value concerning stage transition, no specific hypothesis was formulated. Additionally, the influence of cons of smoking cessation was assessed.

Fig. 1. The Ø hypothesis.
Methods

Design
Data were collected in order to test the effectiveness of a computer-generated tailored smoking cessation expert system in a Dutch community pharmacy setting. Respondents were randomly assigned to either the experimental group (receiving a computer-generated personalized advice letter) or the control group (receiving only a thank you letter, no additional information). As respondents from both groups were included in this study, all analyses were controlled for condition. Three and twelve months after baseline measurement, all respondents were contacted by telephone for follow-up. Only respondents with a valid measurement on baseline and both follow-ups were included in the analyses; respondents whose gender was unknown and cases with >10% missing values at one or more measuring points were excluded.

Procedure
Respondents were recruited for a randomized control trial via 65 community pharmacies throughout the Netherlands, offering them the chance to receive computer-generated personalized smoking cessation advice. Eligible participants were informed that one in two smokers would receive this advice. Smokers who had smoked in the last 7 days and were over 18 years of age were eligible for participation. Participants were asked to fill in a baseline questionnaire. A total of 915 smokers filled in this questionnaire and returned it.

Intervention
The expert system collects information on a smoker by means of a baseline written questionnaire (content is described below). This questionnaire was experimentally tested in a previous study [14, 15] and is now serving as the screening instrument for a computer-generated tailored smoking cessation programme distributed nationwide by the Dutch Foundation on Smoking and Health (Stivoro). Respondents send their questionnaires to a central processing centre; the answers given are used to generate a personalized letter, which the respondents receive at their home address. The content of the letter is stage-tailored and provides feedback on a smoker’s personal attitudes towards smoking and cessation, self-efficacy in various situations and actions plans when trying to quit.

Baseline questionnaire
A written baseline questionnaire consisting of 54 questions was used to collect demographic data (gender, age, addiction level, the occurrence of cardiovascular and respiratory diseases), number of previous quit attempts, intention to quit smoking (stage of change) and the concepts of attitude, social influence and self-efficacy.

Addiction level was measured with three items, using the abbreviated Fagerström scale [16]: the type of tobacco product smoked, the number of tobacco products smoked per day and time passed before smoking after getting out of bed, from which a sum score was calculated (range 0–6).

The occurrence of cardiovascular and respiratory diseases was measured by one dichotomous item each.

Previous quit attempts were assessed by asking respondents how often they had attempted to quit smoking in the past.

Questions concerning attitude and self-efficacy were formulated as statements; respondents could indicate on a five-point scale to what extent they agreed with the statement given.

Attitude was assessed using 16 items. Factor analysis revealed two attitude factors: the advantages of smoking cessation/pros (e.g. improving one’s own health and that of people around the smoker, financial saving; 11 items, \( \alpha = 0.83 \)) and disadvantages of smoking cessation/cons (e.g. gaining weight, boredom, symptoms of withdrawal; five items, \( \alpha = 0.52 \)).

Self-efficacy was measured by 15 items on a five-point scale; respondents were asked to indicate if they would be able to refrain from smoking in emotional situations (e.g. when being angry, when being stressed; four items), habitual situations (e.g. after dinner, on a break, drinking coffee or tea; four items), in social situations (when being offered...
a cigarette, when seeing someone else enjoying smoking; four items) and when being confronted with negative outcomes of the cessation attempt (e.g. when craving for a cigarette, when noticing weight gain; three items). All items were combined into one self-efficacy factor (α = 0.92).

Two items measured social influence (modeling), assessing smoking status of partner and children in residence.

Intention to quit smoking was assessed by asking respondents to state on a seven-point scale when they intended to quit smoking. Respondents were then classified as preparers (intention to quit within a month), contemplators (intention to quit within the next 6 months) or pre-contemplators (no intention to quit within the next 6 months).

Follow-ups
In both telephonic follow-up measurements, respondent’s stage of change (pre-contemplation, contemplation, preparation) and current smoking status (whether or not the respondent had been smoking in the past 7 days) were measured, as well as quitting behaviour between baseline and follow-up; respondents were asked whether they had attempted to quit smoking during the study period. Educational level and year of birth were also assessed.

Analyses
Smokers were grouped according to their self-reported intention to quit smoking (stage of change) at all three measuring points. At baseline, respondents were identified as preparers, contemplators or pre-contemplators. Classification for the follow-ups was conducted accordingly; respondents who were not smoking at follow-up were then classified as actors. By comparing the stage of change from the follow-up to the stage of change at baseline, it was determined whether a respondent had moved forward (a positive shift towards the action stage), backward (a negative shift towards the pre-contemplation stage) or had not moved.

First, attrition analyses were conducted in order to determine whether respondents lost to follow-up were significantly different from those who were available for follow-ups. Second, z-scores were calculated for items and factors concerning attitude, social influence and self-efficacy. The calculation of z-scores was performed for the total sample and for respondents in preparation, contemplation and pre-contemplation separately.

Third, univariate General Linear Models with Sidak contrasts were calculated from cross-sectional data of the baseline measurement between preparers, contemplators and pre-contemplators, in order to cross-sectionally replicate the Ø pattern.

Fourth, in order to determine predictors of both forward (positive) and backward (negative) stage transitions from preparation, contemplation and pre-contemplation, 3 and 12 months after baseline, stepwise logistic regression analyses were conducted. Respondents who had moved forward were compared with respondents who had remained at the same stage or had moved backward. The same procedure was followed for backward transitions from each stage: respondents who had moved backward were compared with those who had remained in the same stage or had moved forward. Items and factors were included in the regression in two blocks: (i) demographic variables and (ii) attitudes, social influence and self-efficacy. To ascertain that only significant demographic variables were entered into the analysis, the forward method was used on both blocks. The exclusion criterion was increased to 0.20, as recommended by Hosmer and Lemeshow [17] in order to compensate for stepwise analysis. To neutralize any effect the intervention might have had on transitions through the stages, the concept of condition remained in the analyses as a covariate, regardless of its significance level. As motivational determinants were not assessed at either follow-up, analyses comparing transition between first and second follow-up could not be conducted.

Results
Sample
Analyses included a total of 554 respondents. The sample included slightly more females (56%) and the mean age was 46 years. Fifty-eight (11%)
respondents indicated that they suffered from cardiovascular diseases and chronic pulmonary diseases were reported by 113 (20%) respondents. Three respondents were pregnant when filling out the questionnaire. A minority only received basic education (n = 35, 6%), one-fifth (n = 116, 21%) attended only high school, 100 (18.1%) respondents received primary vocational training, 156 (28.2%) respondents received secondary vocational training and one-quarter (n = 147, 26.5%) attended higher vocational training or university. Most respondents (66%) smoked manufactured cigarettes, 49% smoked hand-rolled cigarettes and 4% smoked cigars (some respondents smoked more than one type of tobacco). Only three respondents smoked pipe tobacco. Mean amount of tobacco product smoked per day was 22. Mean amount of previous cessation attempts was three, the average respondent had a mild nicotine addiction level (3.29). At baseline, 210 (38%) respondents were classified as pre-contemplators, 144 (26%) respondents were contemplators and 200 (36%) respondents were identified as preparers.

Among respondents in the experimental group (n = 276), 55% were female, compared with 57% in the control condition (n = 278). In both conditions, mean age was 46 years. In the experimental condition, 7% received basic education, 21% attended only high school, 17% received primary vocational training, 30% received secondary vocational training and 26% attended higher vocational training or university. For the control condition, these percentages are 6, 21, 19, 27 and 27, respectively. In the experimental group, 40% was classified as pre-contemplator at baseline compared with 36% in the control condition; percentages for contemplation and preparation were 24 and 36% in the experimental group and 28 and 36% in the control group, respectively. In both groups, the average respondent had a mild nicotine addiction level.

Attrition analyses revealed that respondents included in the analyses were significantly older (OR 1.02, P < 0.01) than respondents not included in the analyses (n = 371). Collinearity diagnostics revealed no existing multicollinearity or singularity.

Characteristics of pre-contemplators, contemplators and preparers, the Ø pattern

Pre-contemplators (PC) and preparers (PR) appeared to differ significantly concerning the number of previous cessation attempts (PC < PR), educational level (PC > PR) and the occurrence of cardiovascular diseases (PC < PR). Means for z-scores of attitudes, social influence and self-efficacy, adjusted for these variables, are shown in Table I. Figure 2 shows the cross-sectional curve of attitudes, social influence and self-efficacy across the stages of pre-contemplation, contemplation and preparation in this sample.

Pre-contemplators saw significantly less pros of quitting compared to contemplators and preparers. Contemplators saw significantly more cons of quitting than preparers, but pre-contemplators, contemplators and preparers did not differ significantly on the cons of smoking. Having a smoking partner or residential children smoking was not characteristic for any of the three stages. Preparers expressed a higher self-efficacy when trying to

<table>
<thead>
<tr>
<th>Table I. Differences at baseline between stages concerning z-scores of attitudes, social influence and self-efficacy</th>
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<td></td>
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<tr>
<td>Pros</td>
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<tr>
<td>Cons</td>
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<td>Smoking partner</td>
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<tr>
<td>Smoking residential children</td>
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<tr>
<td>Self-efficacy</td>
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</tbody>
</table>

Means are adjusted for condition.
refrain from smoking than both contemplators and pre-contemplators did.

**Predictors of stage transition 3 months after baseline**

After 3 months, 246 (44%) respondents did not move from one stage to another, 108 (19%) respondents moved backward and 200 (36%) respondents moved forward through the stages. A complete summary can be found in Table II. Of the smokers transitioning forward from their baseline stage, most transitioned to the adjacent stage (for instance, more pre-contemplators ended up in contemplation than in preparation or action). Due to limited sample size, we could not test these differences.

Smokers experiencing a forward transition from pre-contemplation to the contemplation, preparation or action stage perceived significantly more pros of quitting smoking than pre-contemplators who did not move through the stages (OR 1.40, 95% CI 1.05–1.86, \(P < 0.05\)). Having attempted to quit more often in the past showed a trend towards forward transition from pre-contemplation (OR 1.13, 95% CI 1.00–1.28, \(P = 0.05\)). Respondents moving forward from contemplation to the preparation or action stage had suffered more often from chronic pulmonary diseases (OR 2.76, 95% CI 1.21–6.29, \(P < 0.05\)) and were more confident to resist smoking (OR 1.47, 95% CI 1.04–2.09, \(P < 0.05\)) than those who did not. Smokers experiencing a backward transition from contemplation to the pre-contemplation stage were more likely to be male (OR 0.3, 95% CI 0.12–0.77, \(P < 0.05\)).

**Predictors of stage transition 12 months after baseline**

When comparing baseline data with those of the second follow-up 12 months later, 208 (38%) respondents did not move from one stage to another, 173 (31%) respondents moved backward.

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**Table II. Stage transitions between baseline (T0) and first follow-up**

<table>
<thead>
<tr>
<th></th>
<th>Pre-contemplation at follow-up</th>
<th>Contemplation at follow-up</th>
<th>Preparation at follow-up</th>
<th>Action at follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 158, 29%)</td>
<td>(n = 171, 31%)</td>
<td>(n = 172, 31%)</td>
<td>(n = 53, 10%)</td>
</tr>
<tr>
<td>Pre-contemplation at baseline ((n = 210, 38%))</td>
<td>100 (48%)</td>
<td>65 (31%)</td>
<td>27 (13%)</td>
<td>18 (9%)</td>
</tr>
<tr>
<td>Contemplation at baseline ((n = 144, 26%))</td>
<td>23 (16%)</td>
<td>56 (39%)</td>
<td>55 (38%)</td>
<td>10 (7%)</td>
</tr>
<tr>
<td>Preparation at baseline ((n = 200, 36%))</td>
<td>35 (18%)</td>
<td>50 (25%)</td>
<td>90 (45%)</td>
<td>25 (13%)</td>
</tr>
</tbody>
</table>

Values on the diagonal indicate respondents who have not moved from one stage to another, values under the diagonal indicate respondents who moved backward and values above the diagonal indicate respondents who moved forward.
and 173 (31%) respondents moved forward through the stages. A complete summary can be found in Table III. Of the smokers transitioning forward from their baseline stage, most transitioned to the adjacent stage. Due to limited sample size, we could not test these differences.

Respondents moving forward from pre-contemplation had experienced more previous cessation attempts in the past (OR 1.18, 95% CI 1.04–1.35, \( P < 0.05 \)), perceived more pros of smoking cessation (OR 1.55, 95% CI 1.15–2.10, \( P < 0.01 \)) and showed a higher self-efficacy rate to be able to refrain from smoking once they have quitted (OR 1.48, 95% CI 1.10–1.99, \( P < 0.05 \)). Smokers moving forward from contemplation could be predicted by the occurrence of cardiovascular diseases (OR 2.94, 95% CI 1.06–8.19, \( P < 0.05 \)); backward transition could not be predicted by the variables entered in the analyses. Smokers progressing to the action stage from preparation were more confident they would be able to refrain from smoking when trying to quit (OR 1.48, 95% CI 1.01–2.17, \( P < 0.05 \)) than smokers who did not progress forward from preparation. Backward transition from preparation after 12 months was predicted by a smaller number of previous cessation attempts (OR 0.89, 95% CI 0.80–0.98, \( P < 0.05 \)).

**Discussion**

**Summary of the findings**

In this study, three of the four research types suggested by Weinstein et al. [11] have been incorporated; cross-sectional comparisons between stages, stage sequencing and longitudinal prediction of stage transitions.

The first goal of this study was to compare stages with respect to cross-sectional differences in cognitive factors by replicating the \( \Theta \) pattern in a sample of Dutch adult smokers. We were successful in replicating this pattern; our results show that pre-contemplators perceived significantly less pros of quitting smoking, whereas preparers showed higher self-efficacy to refrain from smoking once quitted.

The second goal was to examine stage sequencing. Smokers appeared to be more likely to transition to an adjacent stage than to skip a stage in the sequence. Due to limited sample size, we were not able to test the differences found.

The third goal was to examine possible predictors of stage transition over periods of 3 and 12 months, respectively. For this purpose, three hypotheses were formulated. Concerning the first hypothesis (forward transition from pre-contemplation can be predicted by a higher perception of pros concerning smoking cessation), forward transition from pre-contemplation was predicted by perceiving more pros of quitting at baseline at both 3 and 12 months follow-up. No evidence was found to support the second hypothesis (backward transition from contemplation will be predicted by a lower perception of pros of smoking cessation). The third hypothesis (forward transition from preparation will be predicted by a higher self-efficacy perception concerning smoking cessation) was also confirmed; preparers who had moved forward to action after 12 months displayed more confidence to be able to refrain from smoking than those that moved backward or stayed in preparation.

**Table III. Stage transitions between baseline (T0) and second follow-up**

<table>
<thead>
<tr>
<th></th>
<th>Pre-contemplation at follow-up ( (n = 234, 42%) )</th>
<th>Contemplation at follow-up ( (n = 149, 27%) )</th>
<th>Preparation at follow-up ( (n = 87, 16%) )</th>
<th>Action at follow-up ( (n = 84, 15%) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-contemplation at baseline ( (n = 210, 38%) )</td>
<td>115 (55%)</td>
<td>41 (20%)</td>
<td>21 (10%)</td>
<td>33 (16%)</td>
</tr>
<tr>
<td>Contemplation at baseline ( (n = 144, 26%) )</td>
<td>47 (33%)</td>
<td>54 (38%)</td>
<td>27 (19%)</td>
<td>16 (11%)</td>
</tr>
<tr>
<td>Preparation at baseline ( (n = 200, 36%) )</td>
<td>72 (36%)</td>
<td>54 (27%)</td>
<td>39 (20%)</td>
<td>35 (18%)</td>
</tr>
</tbody>
</table>

Values on the diagonal indicate respondents who have not moved from one stage to another, values under the diagonal indicate respondents who moved backward and values above the diagonal indicate respondents who moved forward.
Previous research shows some similarities with results found in this study, as well as some differences. Perceiving more pros predicting forward transition from pre-contemplation was found by several other recent studies concerning smoking and fruit and vegetable intake [9, 18, 19]. A higher self-efficacy predicting forward transition from preparation is also a common find. However, 12 months after baseline, self-efficacy also predicted a forward transition from pre-contemplation and contemplation. This was not expected, as self-efficacy is thought to play a role in later stages. As pre-contemplators at baseline who had remained in this stage at follow-up were compared with pre-contemplators moving forward to any stage (also preparation and action), this might have influenced this find. However, other studies using a similar classification did not find self-efficacy to be predictive of forward transition from pre-contemplation [9, 18].

Although some studies [9] found that perceiving less pros predicted backward stage transition from the contemplation stage, Dijkstra et al. [19] did not find predictors for this transition. Velicer et al. [20] described contemplation as an unstable stage; contemplators are in conflict concerning their smoking behaviour, but have not yet made the decision to either prepare for a quit attempt (preparer) or remain a smoker for the time being (pre-contemplator). They may have thought about the benefits of cessation, but are not yet sure that they will be able to quit themselves. This is confirmed by the fact that perceiving more pros predicted forward transition from pre-contemplation and a higher self-efficacy score predicted forward transition from contemplation.

Some studies [9, 20] have suggested that perceiving less cons of smoking cessation may predict transition from pre-contemplation, but no predictive role was found for cons in this study for transition from any of the stages.

Limitations

This study has some limitations. Respondents included in this study were participating in a smoking cessation intervention; they may have been more motivated to make a forward transition through the stages in comparison with other smokers. However, during recruitment, smokers were informed that they would be participating in a study concerning smoking behaviour and that they were eligible for participation regardless if they wanted to quit or not.

Although the smokers in the experimental group received an intervention, which was focused on changing motivational determinants, all analyses were statistically controlled for the intervention to neutralize any influence on stage transition.

Longitudinal analyses could not be conducted for all specific stage transitions (e.g. pre-contemplation to contemplation, pre-contemplation to preparation and pre-contemplation to action) due to limited sample size. Additionally, respondents making a specific transition were compared with respondents who either remained in the same stage or made the opposite transition. Again, due to sample size, we could not investigate these groups separately.

Some concepts’ measures, such as social influence, were limited; we did not assess social pressure and social support and only domestic modelling was measured. However, only a small number of other studies concerning stage transition included social influence in their analyses; they did not find conclusive evidence that these concepts predicted stage transition [9].

The I-Change Model’s operationalization of preparation differs from that originally proposed by Prochaska et al. [21], excluding the additional criterion of having made a serious quit attempt in the last year. This addition to the operationalization has received much criticism [22], as this contradicts the paradigm itself that no stages are skipped. When including the second criterion, a contemplator without recent quitting experience could never become a preparer and would therefore have to skip preparation and move straight to action. Previous research has also excluded this second criterion [14, 18].

Recommendations for further research

Some of the findings are in line with results from previous studies. However, a more unusual finding
also surfaced; although self-efficacy is thought to become important when planning to quit in the very near future, our results show that forward transitions from all stages are predicted by a higher self-efficacy rate, including transition from pre-contemplation and contemplation. These findings are not consistent on both follow-ups, though. However, this suggests that self-efficacy is not a stage-specific predictor, but is an important factor for any smoker moving towards quitting smoking. This is in line with Bandura’s self-efficacy theory [23] and the assumption that the stages of change are pseudo-stages representing a continuum. However, the results of this study only show a significant influence through the stages for self-efficacy and not for pros, cons or social influence. Although self-efficacy is a continuous predictor of forward stage transition, other cognitive concepts might not be.

Another explanation for the predictive quality of self-efficacy in transitions from pre-contemplation could be the relative heterogeneity of the smokers classified in this stage. All smokers not willing to quit within 6 months are considered to be pre-contemplators, regardless of what grounds they might have had for their decision [12]. However, in previous studies significantly different sub-samples with the pre-contemplation stage have been described [24, 25]. Future research could focus on predicting transitions between these sub-classifications as well as to contemplation, preparation and action.

Backward transition from contemplation and preparation appeared not to be predicted by any of the cognitive variables included in the analyses. This was unexpected, as previous studies have found significant cognitive predictors of relapse, i.e. regression from action to preparation, contemplation or pre-contemplation [26, 27]. We would then have to assume that smokers regress only after a quit attempt. However, from the 108 respondents who did regress to earlier stages within 3 months, only 35 (32%) indicated to have attempted to quit during that period. After 12 months, 60% (n = 104) of the regressing respondents had attempted to quit smoking after baseline. These figures indicate that not all respondents regressing through the stages have actually relapsed. A change in intention to quit smoking without actually quitting might be predicted by factors other than those measured in this study.

According to Weinstein et al. [11], the next step in stage transition analyses is examining the effect of matched and mismatched interventions on stage transitions. Although this is a theoretically sound suggestion, the ethical aspect of knowingly providing smokers with possibly unsuitable information might complicate the implementation of deliberately mismatched interventions. However, as it is still not clear whether the stage of change paradigm is a suitable framework on which to base interventions, more research will be necessary to uncover its worth. In particular, backward transition is difficult to predict using cognitive predictors, whereas this phenomenon is important. Known non-cognitive predictors of relapse back to smoking might provide a starting point for studies concerning backward transitions from all stages. These include negative affect and nicotine dependence [28, 29]. Furthermore, it is questionable whether assessing the stage of change at baseline and follow-ups is sufficient, as it does not take into account that respondents might have experienced other transitions in between measurements, but is a rather random indication of motivation to change. Although this analysis method has been used in a number of previous studies on stage transition [9, 18] and it has been acknowledged that persons can move back and forth through the stages [30], future studies should take into account that respondents might not follow the stages of change paradigm in a linear fashion. Therefore, study designs should include more frequent recalls of motivation to change by respondents and acquiring smoking behaviour information from the period between two measurement points. An active role from the smoker and use of new media, for instance self-report via Internet, might accommodate this more intensive measurement. Not until we can truly map stage transitions over time, do we have an overall view of whether the stage of change paradigm is valuable in the describing behaviour change.
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Conflict of interest statement

None declared.

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