The influence of having a quit date on prediction of smoking cessation outcome

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Abstract
The aim of this study was to explore whether factors predicting making a quit attempt are uniform within the preparation stage of the transtheoretical model (TTM). Participants were 283 smokers, all planning to quit in the next 30 days (preparation stage), who used a computer-generated tailored advice programme. Evidence of differences in prediction of making a quit attempt was found between smokers with and without a quit date, with the predictive power of a multivariate model markedly higher among those with a set date. In particular, one aspect of pros of smoking (smoking helps you feel better when things are bad) was predictive of progression among those with a quit date, but not among those without. The results suggest that factors predicting stage progression are not uniform within the preparation stage. The results complement other recent research that has questioned the stage definitions used in the TTM and provide evidence in support of an alternative stage boundary defined by the commitment of setting a quit date.

Introduction
This study is part of a research programme designed to explore the possibility that there may be discontinuity in the process of smoking cessation. In most extant models of health behaviour change, the same factors influence progression towards cessation independently of any categorization [1, 2]. However, it is plausible that there may be some discontinuity in how predictors relate to outcome (hereafter called ‘discontinuity in prediction’), corresponding with identifiable changes in the way the person thinks about the target behaviour or the nature of the task facing them. For example, the tasks involved in encouraging a smoker not interested in quitting to engage with the process of quitting may differ from those involved in helping a smoker preparing to quit to implement his/her decision. If such differences exist, it would have profound implications for designing interventions.

Stage models (a subset of discontinuity-based models) posit a sequence of stages through which all individuals must progress in order to successfully change behaviour. Individuals in different stages of change should be qualitatively different with regard to prediction of progression, not merely more or less advanced along some continuum. The transtheoretical model (TTM) [3], the most widely known stage model, has recently been widely criticized for the arbitrary way in which its five stages of change are operationalized [4]. There is remarkably little evidence supporting these stage boundaries, only weak cross-sectional evidence [5] and studies of predictors of stage progression which do not focus on transition points [6]. Where stage boundaries are defined by arbitrary time periods,
there is little reason to believe that they would be associated with discontinuity in prediction. If such discontinuities exist, they are likely to be at points of psychologically salient shifts in thinking regarding the target behavioural outcome. Our research to date is consistent with this [7, 8]; we found no evidence of discontinuity of prediction around the pre-contemplation–contemplation boundary but some evidence for a discontinuity around being open to the possibility of quitting (versus having no interest).

The main aim of this study is to investigate whether there is discontinuity within the TTM preparation stage (planning to quit in the next 30 days) in prediction of progression to the action stage (making a quit attempt). Conceptually, the most plausible discontinuity point would be committing to a quit attempt by deciding on setting a quit date. Such a commitment is analogous to that of an implementation plan as described by Gollwitzer [9] but focuses on ceasing the behaviour overall rather than dealing with specific instances of it. Gollwitzer states that specifying a ‘when, where and how’ of a behaviour change goal enables intentions to be implemented more effectively for discrete instances of behaviour and has been shown to predict better outcomes [e.g. 10].

Among preparers, setting a quit date has been associated with greater likelihood of making and maintaining a quit attempt [11]. However, it is unclear whether predictors of making a quit attempt differ for those with and without a quit date. A clear commitment to quit might change the impact of focusing on concerns about quitting (likely in the lead up to an attempt) from reasons for not acting to barriers to be overcome. Indeed, Segan et al. [11] found that questioning whether quitting was worthwhile predicted short-term quit success in a group of smokers with a quit date.

As a subsidiary aim, we also explored the potential moderation of any discontinuity in prediction found as a function of recent prior quitting experience, for which we have elsewhere found some evidence of differences in prediction among those in the TTM preparation stage [12].

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**Materials and methods**

**Participants**

The data were sourced from the intervention arm of a randomized controlled trial of the effectiveness of a computer-generated tailored cessation advice programme conducted in 2002.

Participants in this study were 283 smokers in the preparation stage of change that provided outcome data 1 month after recruitment into the trial. This represented 89.3% of the initial eligible sample ($n = 317$). Participants were recruited from callers to the Victorian Quitline, a community telephone service providing information and advice on all aspects of smoking cessation.

The eligible sample was 51% female, with a mean age of 31 [standard deviation (SD) = 10.4] years, smoked a mean of 18.7 (SD = 9.4) cigarettes per day and 87% had tried to quit, 45% in the past year.

**Measures**

The preparation stage was defined as planning to quit in the next 30 days, as opposed to the conventional TTM definition which also includes a 24-hour quit attempt in the previous year. Combining intention and prior behaviour in the definition has been criticized [13], and consequently, several recent studies by the authors of the TTM, for example [14] have dropped this criterion.

Participants were asked ‘Have you set a quit date?’ (and if yes, asked to provide it), and ‘In the last week, have you reduced the number of cigarettes you smoke (in getting ready to quit)?’. Those who responded no were asked, ‘Do you plan to cut down before you quit?’ Those who answered ‘yes’ to either question were asked to indicate how long they believed it would take them to stop smoking altogether.

Three operationalizations of a commitment were compared: (i) having set a quit date within the next 2 weeks (80 smokers met this criterion); (ii) having set a quit date, regardless of how far in the future (a further 10 met this criterion, making 90 in total) and (iii) also including smokers who were cutting down to stop within the next 2 weeks (a further 25 smokers: $n = 115$).
Outcome measures

The outcome measure for the predictive analyses was the making of a 24-hour quit attempt at any time in the month following commencement of the intervention. This defines transition out of preparation. Participants were typically assessed at least twice during this period as part of the intervention. Those who were still smoking at each assessment were asked whether they had made a quit attempt since the last assessment and when the quit attempt took place. With this frequent questioning, it is unlikely we missed attempts [15].

Predictors of change

Predictors of progression were assessed at baseline and included TTM variables (processes of change, pros of smoking, situational temptations to smoke and self-efficacy), and two non-TTM factors (negative processes of change and nicotine dependence) that have shown predictive capacity in previous studies [11]. The TTM variable cons of smoking was not included because this is not considered to be important for predicting progression from the preparation stage of change [16].

Self-efficacy

Self-efficacy was measured using a composite of four items ($\alpha = 0.65$), each stemmed by ‘How confident are you that you …; (i) Will be able to quit for good on this attempt? (ii) Can resist all the temptations to smoke that you get? (iii) Can cope in stressful situations without smoking? and (iv) Can put in the time and effort it will take to succeed?’ All were scored on five-point scales from 1 (not at all) to 5 (extremely).

Temptations to smoke

Three two-item scales measured difficulty resisting temptations to smoke, corresponding with the factors proposed by Velicer et al. [17]. Each item was stemmed by, ‘How tempted are you to smoke …’ and measured in terms of frequency of occurrence on a five-point scale ranging from 1 (never) to 5 (all the time). Negative effect temptations ($\alpha = 0.84$) were assessed by the items (i) when you feel anxious or stressed and (ii) when things are not going your way and you’re frustrated. The positive/social temptation items ($\alpha = 0.61$) were (i) when you are socializing with smokers and (ii) when you are offered a cigarette. The habit/addictive temptation items ($\alpha = 0.44$) were (i) when you are having a break and (ii) when you first get up in the morning. Because of low scale reliability, the habit/addictive temptation items were analysed separately.

Processes of change

Three experiential (consciousness raising, self-re-evaluation and environmental re-evaluation) and three behavioural (self-liberation, counter-conditioning and stimulus control) processes of change were assessed. An additional process, named ‘non-smoking preference’, was included as an empirically based modification of the TTM experiential process social liberation [18]. Each item was stemmed by, ‘How often do you …’. Consciousness raising ($\alpha = 0.65$) was measured by (i) think about the benefits of quitting smoking and (ii) think about how to quit smoking. The self-re-evaluation items ($\alpha = 0.76$) were (i) get upset when you think about your smoking and (ii) feel disappointed in yourself because of your need for cigarettes. Environmental re-evaluation ($\alpha = 0.43$) was measured by (i) notice cigarette butts littering the environment and (ii) find the smell of cigarette smoke unpleasant. These were analysed separately because of low reliability. Self-liberation ($\alpha = 0.56$) was assessed by (i) tell yourself ‘I can quit smoking if I want to’ and (ii) tell yourself that you are going to succeed in quitting. The counter-conditioning items ($\alpha = 0.61$) were (i) resist urges to smoke and (ii) tell yourself you don’t need one, when tempted to smoke. Stimulus control was measured by a single item, ‘How often do you seek out places where you can’t smoke?’, as was non-smoking preference (‘How often do you enjoy being in places where smoking is not allowed?’).

Negative processes of change

Three negative processes of change were assessed. ‘Doubting ability’ ($\alpha = 0.64$) was measured by (i) doubt your ability to quit and (ii) have the feeling
that quitting will be just too hard. ‘Doubting worth’ ($\alpha = 0.31$) was measured by (i) doubt whether quitting is worth the effort and (ii) have thoughts like ‘Now isn’t a good time to quit’. These were analysed separately because of low reliability. In addition, a behavioural process capturing the frequency of exposure to smoking cues (environmental presence, $\alpha = 0.78$) was measured by (i) go to places where lots of people smoke and (ii) people you are with smoke.

**Pros of smoking**
Pros of smoking ($\alpha = 0.54$) were measured using a three-item scale; to what extent do you believe (i) smoking helps you feel better when things are bad; (ii) you need smoking to make socializing easier and (iii) you need smoking to help break up your day. Scores ranged from 1 (not at all) to 5 (completely).

**Nicotine dependence**
Nicotine dependence was measured using the Heaviness of Smoking Index—alternate version [19], calculated as the square root of daily cigarette consumption minus the natural logarithm of time to first cigarette of the day. This algorithm results in a normally distributed measure that correlates $r = 0.89$ ($P < 0.001$, $n = 4686$) with the Heaviness of Smoking Index (H. Yong, personal communication, 11 May 2007).

**Recent quitting experience**
Recent quitting experience was defined as a 24-hour quit attempt in the previous month. This definition was used in preference to the TTM definition as there is evidence that it differentiates groups with different predictors of change more effectively [12].

**Procedure**
Participants in the intervention completed at least two telephone-administered assessments of their smoking, followed by a mailed letter of tailored cessation advice. The frequency of assessment differed considerably from individual to individual. Typically, however, the intervention was relatively intensive in the preparation stage (with assessments conducted every 1–2 weeks) and became less intensive when the participant either decided to defer their quit attempt or became a stable non-smoker. No counselling was provided over the telephone. The intervention achieved approximately double the cessation rate of a self-help resource [20].

**Data analysis**
Discontinuity in prediction was explored using a multivariate approach first described by Balmford et al. [7]. If a multivariate set of theoretically relevant predictors are linearly related to outcome (i.e. there is no underlying discontinuity in prediction), then dividing the sample at a hypothesized discontinuity point and removing the cases on one side will truncate the range of responses, thereby reducing the predictive power of the model. However, if there is underlying non-linearity or discontinuity, removing cases that cross this discontinuity point (thereby removing the source of the discontinuity) can actually increase the predictive power of the model. Evidence of discontinuity in prediction is found when greater predictive power is achieved within either or both subgroups separately than in the predictive model applied to the entire sample. Testing alternatives and determining where the difference in predictive power is maximized can subsequently refine conclusions regarding the optimal boundary. The precision attainable depends on how the discontinuity point has been defined and what variations are possible given the questions asked.

First, predictors of making a quit attempt were first identified for inclusion in the multivariate predictive model using univariate analyses. An alpha level of 0.05 was used for all statistical tests. Second, individually for each predictor, we tested whether each hypothesized discontinuity point moderated prediction, following the recommendations of Baron and Kenny [21] for testing moderator effects. Variables that displayed a significant interaction across any discontinuity point were added to the multivariate model, if not already included. To test for discontinuity in prediction, the resultant multivariate model was first run on the overall sample, which was then partitioned into two groups across each hypothesized discontinuity point and
the model run on the two subsamples separately. The $R^2$ measure for logistic regression proposed by Menard [22] was used to estimate the strength of prediction (percentage of variance explained) for each model.

**Results**

Smokers with a quit date were higher in self-efficacy [$t(281) = 2.67, P \leq 0.01$], were using the processes of change consciousness raising [$t(281) = 2.23, P = 0.03$] and self-liberation [$t(281) = 3.71, P < 0.01$] more frequently and were higher in nicotine dependence [$t(281) = 2.60, P = 0.01$] than smokers without a quit date.

Two-thirds (67%, $n = 189$) of participants made a quit attempt within a month of the baseline assessment. Table I displays the relationship between each of the three hypothesized discontinuity points and outcome. Setting a quit date was associated with a greater likelihood of making a quit attempt.

**Predictors of making a quit attempt**

Choice of the 15 measured predictor variables to include in the discontinuity analyses included those with associations and those with any evidence of interaction around any of the three potential discontinuity points. In univariate analyses, higher self-efficacy, higher self-liberation, higher non-smoking preference and lower nicotine dependence were significant predictors of making a quit attempt and trends for lower doubting ability and lower habit/addictive temptations, as measured by the item, 'How tempted are you to smoke when you first get up in the morning?' The only interaction was for pros of smoking, which were more predictive of making a quit attempt among those with a quit date than among those without, this being significant across the ‘set a quit date’ potential discontinuity point ($P = 0.04$).

**Analysis of discontinuity in prediction**

The variables identified in the univariate and/or interactive analyses were entered into a multivariate logistic regression model, which was used to test for discontinuity in prediction. The model was first applied to the full sample of smokers in the preparation stage, explaining 9.3% of the variance in outcome. Significant independent predictors in the overall model were more frequent use of the self-liberation process of change, greater non-smoking preference and higher pros of smoking. A trend ($P < 0.10$) was found for lower nicotine dependence.

Next, the model was applied to the subgroups defined by each of the three potential points of discontinuity in prediction. A summary of these findings is displayed in Fig. 1, which shows that the definition of setting any quit date resulted in the strongest evidence of discontinuity, with both alternatives marginally less predictive.

Table II shows the results of the test of the ‘set a quit date’ discontinuity point in more detail.

**Table I.** Relationship between making a quit attempt by 1-month follow-up and each potential discontinuity point

<table>
<thead>
<tr>
<th>Boundary</th>
<th>$n$</th>
<th>Made a quit attempt</th>
<th>$\chi^2$</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set a quit date within the next 2 weeks</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>80</td>
<td>62 (78%)</td>
<td>5.77</td>
<td>0.02</td>
</tr>
<tr>
<td>No</td>
<td>203</td>
<td>127 (63%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set a quit date (any)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>90</td>
<td>70 (78%)</td>
<td>7.19</td>
<td>0.01</td>
</tr>
<tr>
<td>No</td>
<td>193</td>
<td>119 (62%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set a quit date (any) or cutting down to quit within the next 2 weeks</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>115</td>
<td>87 (76%)</td>
<td>6.87</td>
<td>0.01</td>
</tr>
<tr>
<td>No</td>
<td>168</td>
<td>102 (61%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>283</td>
<td>189 (67%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Among those with a quit date, 21.6% of the variance in prediction of making a quit attempt was explained, considerably more than in the overall (all cases) analysis. Higher pros of smoking was the only significant independent predictor of making a quit attempt in this subgroup. Among those without a quit date, only 7.3% of the variance was explained, with no significant predictors found.

Because of the relatively low reliability of the pros of smoking scale, the items in this scale were also explored separately. The effect was found to be attributable to the item ‘smoking helps you feel better when things are bad’. No evidence of discontinuity in prediction was found for the other two pros items.

Moderation of the effect by recent prior quitting experience

Finally, the potential moderating effect of recent prior quitting experience was explored. As few participants (9%, n = 26) had a previous quit attempt in the last month, there were insufficient numbers to explore the full interaction. As an alternative, these participants were excluded, and the test for discontinuity was redone only among participants without a quit attempt in the previous month. Of the 257 participants included in this analysis, 172 (67%) had set a quit date. The predictive power of the model increased in the overall sample (to 11.2% from 9.3%) and in both subgroups (to 26.2% among those with a quit date and to 8.1% among those without). The pattern of results was similar for all the individual predictors in the model, with the exception that a significant predictive relationship emerged for non-smoking preference among those without a quit date.

Discussion

We found that setting a quit date resulted in more quit attempts in the following month than for those without a set date, which is as would be expected. The proximity of the quit date did not appear to be important. Cutting down (but without a final quit date) was less clearly related to outcome. This finding adds to the growing research showing that the making of specific plans and commitments, be it for...
the overall behaviour pattern in this case or for more specific events (i.e. implementation intentions), are an important tool to facilitate successful behaviour change. Central to this paper, we found some evidence that the capacity to predict making a quit attempt differed for those with and without a quit date. The finding of an interaction with pros of smoking as a function of having a quit date, and the overall evidence of discontinuity in prediction as demonstrated by differential variance explained in the predictive model, suggests that smokers in the TTM preparation stage are not homogeneous in terms of factors that predict making a quit attempt.

Those who reported a stronger belief that ‘smoking helps you feel better when things are bad’ were more likely to make a quit attempt among those with a quit date, but not among those without. This seemingly counter-intuitive finding is similar to that of Segan et al. [11], who showed that among smokers with a quit date, more frequently questioning whether quitting was worthwhile was associated with a better short-term cessation outcome. This is consistent with our argument that, once a firm decision has been made to quit, consideration of the value of smoking (focusing on what needs to be done to minimize and/or compensate for feelings of loss that one may experience after quitting) might better prepare a person to carry out a planned quit attempt. However, doing so before a firm decision has been made could increase ambivalence about quitting and thus inhibit progression. That is, setting a quit date may actually change the dynamics of the process of quitting. The consistency of findings makes it less likely that the small effect we found was due to chance alone.

A number of possible limitations need to be considered. The intervention may have changed the predictive effects of some of the variables in the model, as it was designed to strengthen forces promoting and weaken forces inhibiting behaviour change. If so, it would reduce the strength of relationships between the predictors (assessed before the intervention) and the outcome. Thus, we may have missed other important determinants of quit attempts. However, it is less clear how the intervention could have affected the interaction we found and thus the differential prediction. Those with a set date typically had less follow-up calls before they quit or the month expired (partly due to quitting more) so any effects would be to reduce effect sizes among the no-date group. Given that pros of smoking are typically predictive of not progressing among smokers, it seems unlikely that any extra intervention would have masked an underlying positive relationship. That said, there is a need for replication on a sample not subjected to an intervention and to include smokers in the contemplation stage, where negative effects for pros of smoking would be more likely to occur. We also acknowledge limitations with the approach used to test for possible discontinuity in prediction, including the inability to assess the probability of the differences being chance effects. There is a need to develop methods for determining the significance of estimated differences in predictive power when applied to differently constituted samples.

The findings suggest that smokers who set a quit date (at least within a month, which was the upper limit assessed in this study) might benefit from different strategic approaches to quitting to those without such a date. Could such approaches improve the quit rates in such individuals? Recent research [23–26] indicates that up to half of all quit attempts in some populations might be spontaneous, with no delay between deciding and implementing. Thus, it is clear that setting a date is not a necessary ‘stage’ of change. These retrospective studies have also reported that those who quit spontaneously were more likely to stay quit for at least 6 months. Clearly, more work is needed to clarify whether a period of planning after a commitment to quit can be used to increase quit success, because if it cannot, such pre-planning should be discouraged.

We believe that testing the validity of specific discontinuity points is a critical aspect of testing any stage-based theory. It is the only form of evidence that is not equally consistent with an underlying continuity model [5]. While cluster analysis techniques may have some utility in identifying potentially interesting subtypes for further study, they need to be supplemented by testing whether predictors of progression vary by cluster subtype.
Our data complement other recent research we have conducted [7, 27], indicating that there are points in the process of quitting smoking across which determinants of quitting are differentially related to outcome. However, evidence for discontinuity appears strongest around points other than those postulated by the TTM, apart from the boundary defined by making a quit attempt (preparation to action). Moreover, the low predictive power of processes of change, decisional balance and situational temptations to smoke is consistent with a growing body of research that has failed to find that TTM predictors influence stage transitions longitudinally [e.g. 6, 28]. Overall, while the results of this research programme do not support the TTM stages, they are consistent with the core insight that determinants of change vary as a function of where the individual is with regard to change. That many appear to quit without a lead-in period after deciding suggests that there are different pathways to change. If these pathways have different determinants of action, then they need to be treated as discontinuity points. Discontinuity can exist between different pathways to change as well as between different stages in progression towards change.

In conclusion, the results of this study confirm that making a commitment to quit in the form of setting a quit date leads to increased rates of quitting (and thus strengthens the case for encouraging those attempting to quit to make specific commitments) and is associated with modest indication of discontinuity in prediction of making a quit attempt. The findings raise the possibility that the factors predicting stage progression are not uniform within the preparation stage of the TTM. More research is needed to understand how predictive relationships change as a function of having set a quit date and whether this has any implications for helping smokers quit successfully.

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None declared.

**References**


