Assessing ‘stage of change’ in current and former smokers

Jean-François Etter¹ & Stephen Sutton²

Institute of Social and Preventive Medicine, University of Geneva, Switzerland ¹ and Institute of Public Health, University of Cambridge, UK²

ABSTRACT

Aims The concept of ‘stage of change’ is widely used by researchers and clinicians in the field of smoking cessation. Our aim was to assess the validity of three staging questionnaires and of the concept of ‘stage of change’ itself.

Setting and participants Survey on the Internet in 1025 ever smokers, retest after 8 days in 318 people (31%), follow-up after 32 days in 451 people (44%).

Measurements Three measures of ‘stage of change’.

Findings Participants (83–93%) were classified in the same stage by all pairs of questionnaires, and 15% changed stage during an interval of 8 days. Including quit attempts in the ‘preparation’ stage had a large impact on stage distributions, because 18–24% of smokers who had decided to quit in the next 30 days were downgraded to the ‘contemplation’ stage as they had not made a quit attempt in the previous year. The ‘action’ stage included 5–7% of occasional smokers. Quit attempts during the past 7 days and 30 days were better predictors of smoking cessation than quit attempts during the past 12 months. Baseline stage and a continuous measure of intention predicted smoking abstinence at follow-up.

Conclusions These results reflect theoretical and methodological problems with the concept of stage of change. ‘Stage’ covers four different variables: current behaviour, quit attempts, intention to change and time since quitting. These variables are combined in a somewhat haphazard manner, none of them is measured comprehensively, and intention and time are continuous variables categorized by arbitrary cutpoints. Measuring each of these four variables independently may be preferable to using an incomplete mix of these elements.

KEYWORDS Epidemiological measurements, Internet, smoking, tobacco use disorder, validation studies.

INTRODUCTION

The concept of ‘stage of change’ is at the core of the transtheoretical model of behaviour change (TTM) (DiClemente et al. 1991; Prochaska, DiClemente & Norcross 1992). This model is used widely by researchers and clinicians in the area of health promotion in general and smoking cessation in particular. Stages of change are presented as a description of the natural history of the process of smoking cessation. They are also used to predict smoking cessation (Velicer et al. 1999), and as a basis for behavioural counselling (Velicer et al. 1993).

The definition of stages of change has been modified several times since the concept was first introduced, and several questionnaires are used currently to assess stages (Farkas et al. 1996a). This lack of standardization makes it difficult to compare different studies and limits the possibility of testing the TTM empirically. Few studies have compared staging questionnaires (Farkas et al. 1996a; Etter & Perneger 1999). These studies showed that different questionnaires produced large differences in stage distributions, and classified smokers with very different characteristics in the same stage. However, these studies compared questionnaires that were not based on the
same definition of stages. Thus it is not known whether various questionnaires, based on the same definition, classify ever smokers in the same stage. Establishing whether questionnaires based on the same definitions classify ever smokers similarly may indicate whether results from studies using different questionnaires are comparable. More importantly, such a comparison may provide a test of the validity of questionnaires and of the concept of 'stage of change' itself. This concept has been criticized, but most criticisms have been theoretical (Bandura 1997; Davidson 1992; Farkas et al. 1996a, 1996b; Sutton 1996a, 1997, 2001; Etter & Perneger 1997, 1999; Littell & Girvin 2002; Weinstein, Rothman & Sutton 1998). There have been few validation studies of questionnaires used to assess stages of change. In particular, the test–retest reliability of staging algorithms was assessed in only one study, which found that 9–33% of smokers changed stage during a 7-day interval (Hughes 2001). This is probably more than expected and could reflect measurement and theoretical problems. Given the current trend of matching interventions to a participant’s stage of change (Velicer et al. 1993), using valid stage measures is important, because if stage was measured unreliable, then stage-matched messages would be ineffective or unacceptable to participants.

The aim of this study was to compare and assess the validity of questionnaires that assess stages of change in ever smokers, and to discuss the validity of the concept of 'stage of change'.

METHODS

Data collection

We conducted a survey on the Internet, in English, between May and August 2001, on http://www.stop-tabac.ch/scales/. An invitation to fill the survey was sent by e-mail to 3500 smokers and ex-smokers who participated in the English-language version of the smoking cessation programme available on this site (Etter & Perneger 2001a, 2001b). The questionnaire was also available to visitors of the site who did not take part in the cessation programme.

Staging questionnaires

According to theory, smokers are assumed to progress through five stages before they become long-term ex-smokers (DiClemente et al. 1991; Prochaska et al. 1992). The ‘precontemplation’ stage includes smokers who do not seriously consider quitting within the next 6 months, the ‘contemplation’ stage includes smokers who seriously consider quitting smoking in the next 6 months, the ‘preparation’ stage includes smokers who ‘intend to quit’ or ‘seriously think about quitting’ in the next 30 days and have made a 24-hour quit attempt in the previous 12 months (DiClemente et al. 1991; Prochaska et al. 1992; Prochaska et al. 1994), the ‘action’ stage includes ex-smokers who have quit smoking within the last 6 months, and the ‘maintenance’ stage includes ex-smokers who have quit more than 6 months ago (DiClemente et al. 1991; Prochaska et al. 1992).

We compared the characteristics of three staging questionnaires based on this definition of stages of change. The first questionnaire (‘questionnaire A’) was published on the website of the authors of the concept of ‘stage of change’ (http://www.uri.edu/research/cprc/Measures/Smoking11.htm, accessed 18 October 2001) (Appendix 1). The second questionnaire (‘questionnaire B’) was used by the same researchers in their ‘expert system’ programme for smoking cessation (Velicer et al. 1993) (Appendix 2). We developed a third questionnaire (‘questionnaire C’) for several reasons. First, questionnaires A and B do not use a conventional definition of ever smokers. Thus, in questionnaire C we used the standard WHO definition of ever smokers (smoked ≥100 cigarettes in their life-time) (World Health Organization 1996). Secondly, the question used in questionnaires A and B to assess quit attempts (‘In the last year, how many times have you quit smoking for at least 24 h?’) was not well understood by participants in a pretest conducted in Geneva (Etter & Perneger 1999). Thus, we used the following question to assess quit attempts in questionnaire C: ‘In the past 12 months, did you try to quit smoking AND succeed in not smoking for at least 24 h? (Yes/No)’ (Appendix 3).

We assessed whether participants were classified in the same stage by all questionnaires, and whether the questionnaires had similar psychometric characteristics.

Additional questions

We also assessed whether participants smoked every day, occasionally (not daily) or never; how many cigarettes they smoked per day; whether they smoked any cigarettes during the past 6 months; whether they tried to quit smoking and succeeded in not smoking for at least 24 hours, in the past 12 months, 30 days and 7 days; and level of intention to quit smoking (0–10 scale with two anchors: ‘I have absolutely no intention of quitting smoking = 0’, ‘I have made a firm decision to quit in the next days = 10’). The questionnaire also covered age and sex. We recorded the date when the questionnaire was answered and the computer number of each participant, to identify duplicate records. Participants who agreed to take part in a follow-up indicated their first name and e-mail address.
Retest
Participants who agreed were invited by e-mail to answer the same questionnaire a second time, 7 days after baseline. To assess the reliability of staging questionnaires, we reported the proportion of participants who were classified in the same stage at baseline and retest, we computed test–retest intraclass correlation coefficients for each staging algorithm, and we used the kappa coefficient as a measure of agreement between baseline and retest (Nunnally & Bernstein 1994).

Follow-up
We conducted a follow-up survey to assess the ability of measures of stage of change to predict smoking cessation. Participants who agreed were invited by e-mail 31 days after baseline to answer the following question with ‘yes’ or ‘no’: ‘Did you smoke tobacco during the past 7 days (even one puff of cigarette, cigar, pipe, etc.)?’ We chose the criterion of 1 week of abstinence because it was used in a recent guideline as the main outcome measure in smoking cessation trials (Fiore, Bailey & Cohen 2000).

Intention to quit smoking
To assess whether intention was measured adequately as a continuous variable, we used ANOVA models to assess whether there were linear associations between the 0–10 score of intention to quit and smoking abstinence at follow-up, and between this score and past quit attempts. In addition, we computed intraclass correlation coefficients to assess the test–retest reliability of questions on intention to quit smoking, in current smokers. We compared a classification of intention in three categories (not in the next 6 months, in the next 6 months, in the next 30 days, from questionnaire C) to a 0–10 score of intention to quit.

Quit attempts
In current smokers, stage covers both intention to quit and previous quit attempts, but quit attempts are only used to define the preparation stage. We assessed whether excluding from the preparation stage smokers who had not made a quit attempt had an impact on the composition of this stage. We also tested whether, in the precontemplation and contemplation stages, smokers who had made a quit attempt in the previous year differed from those who had not.

We assessed the test–retest reliability of self-reports of 24-hour quit attempts in the previous year. This analysis was conducted in 116 people who were smokers at baseline and retest, and who said at retest that they had not made a quit attempt in the previous 7 days.

We tested whether questions on quit attempts used in questionnaires A and B produced similar results as the question used in questionnaire C.

Finally, we tested whether smoking abstinence at follow-up was best predicted by 24-hour quit attempts during the past 12 months, the past 30 days or the past 7 days.

Occasional smokers
According to theory, the action and maintenance stages should include only ex-smokers, and occasional smokers should be classified as smokers (Prochaska et al. 1992; Prochaska, Redding & Evers 1996). We reported the proportion of occasional smokers in each stage.

RESULTS
Participation
The raw baseline database included 1175 records. We deleted 31 empty records, 32 duplicate records and 87 records of never smokers (i.e. people who had smoked fewer than 100 cigarettes in their lifetime). The analysis was based on the remaining 1025 participants, and included 496 daily smokers (49%), 63 occasional smokers (6%) and 453 ex-smokers (45%). Participants were on average 42 years old (range 14–79) and 42% were men. All questionnaires classified 7–8% participants in the precontemplation stage, 25–31% in contemplation, 14–20% in preparation, 18–20% in action and 26–28% in maintenance.

Comparison of stage classifications
Questionnaires A and C produced fewer missing values (0.8%) than questionnaire B (2.8%) and classified more participants in the same stage (93% for A versus C, against 88% for A versus B and 83% for B versus C) (Tables 1–3). The main discrepancies between A and C concerned 40 people who were classified in preparation by questionnaire A, and in contemplation by questionnaire C. Thirty of them said they were seriously thinking of quitting within the next 30 days, but that they had not decided to quit in the next 30 days. The other 10 had decided to quit in the next 30 days but gave different responses on the two questions on quit attempts.

Another 66 people (33% of 202) were classified in the preparation stage by questionnaire B and in contemplation by questionnaire C. Fifty-three of them said that they were planning but had not decided to quit in the next 30
days, and the others said that they quit at least one time for 24 hours in the past year but had not made a quit attempt in that period.

Among ex-smokers who said that they had quit more than 6 months ago and were therefore classified in the maintenance stage by questionnaire A, 10% (29 of 289) said that they had smoked cigarettes during the past 6 months and were therefore classified in the action stage by questionnaire B.

Among smokers who said that they were ‘planning to

Table 1 Percentage of participants in each stage of change for questionnaires A and B.

<table>
<thead>
<tr>
<th>Questionnaire B</th>
<th>Precontemplation (%)</th>
<th>Contemplation (%)</th>
<th>Preparation (%)</th>
<th>Action (%)</th>
<th>Maintenance (%)</th>
<th>Missing (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questionnaire A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precontemplation</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7 (n = 76)</td>
</tr>
<tr>
<td>Contemplation</td>
<td>0</td>
<td>24</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>28 (n = 287)</td>
</tr>
<tr>
<td>Preparation</td>
<td>0</td>
<td>1</td>
<td>16</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>18 (n = 179)</td>
</tr>
<tr>
<td>Action</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16</td>
<td>1</td>
<td>1</td>
<td>18 (n = 186)</td>
</tr>
<tr>
<td>Maintenance</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>24</td>
<td>1</td>
<td>28 (n = 289)</td>
</tr>
<tr>
<td>Missing</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1 (n = 8)</td>
</tr>
<tr>
<td>Total</td>
<td>7</td>
<td>25</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>3</td>
<td>100 (n = 1025)</td>
</tr>
</tbody>
</table>

Total in the diagonal 88%.

Table 2 Percentage of participants in each stage of change for questionnaires A and C.

<table>
<thead>
<tr>
<th>Questionnaire C</th>
<th>Precontemplation (%)</th>
<th>Contemplation (%)</th>
<th>Preparation (%)</th>
<th>Action (%)</th>
<th>Maintenance (%)</th>
<th>Missing (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questionnaire A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precontemplation</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7 (n = 76)</td>
</tr>
<tr>
<td>Contemplation</td>
<td>1</td>
<td>27</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>28 (n = 287)</td>
</tr>
<tr>
<td>Preparation</td>
<td>0</td>
<td>4</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>18 (n = 179)</td>
</tr>
<tr>
<td>Action</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>18</td>
<td>0</td>
<td>0</td>
<td>18 (n = 186)</td>
</tr>
<tr>
<td>Maintenance</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>28</td>
<td>1 (n = 8)</td>
</tr>
<tr>
<td>Missing</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1 (n = 8)</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>31</td>
<td>14</td>
<td>18</td>
<td>28</td>
<td>1</td>
<td>100 (n = 1025)</td>
</tr>
</tbody>
</table>

Total in the diagonal 93%.

Table 3 Percentage of participants in each stage of change for questionnaires B and C.

<table>
<thead>
<tr>
<th>Questionnaire C</th>
<th>Precontemplation (%)</th>
<th>Contemplation (%)</th>
<th>Preparation (%)</th>
<th>Action (%)</th>
<th>Maintenance (%)</th>
<th>Missing (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questionnaire B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precontemplation</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7 (n = 75)</td>
</tr>
<tr>
<td>Contemplation</td>
<td>1</td>
<td>23</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>25 (n = 258)</td>
</tr>
<tr>
<td>Preparation</td>
<td>0</td>
<td>6</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20 (n = 202)</td>
</tr>
<tr>
<td>Action</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>16</td>
<td>3</td>
<td>0</td>
<td>20 (n = 200)</td>
</tr>
<tr>
<td>Maintenance</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>24</td>
<td>0 (n = 261)</td>
</tr>
<tr>
<td>Missing</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>3 (n = 29)</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>31</td>
<td>14</td>
<td>18</td>
<td>28</td>
<td>1</td>
<td>100 (n = 1025)</td>
</tr>
</tbody>
</table>

Total in the diagonal 83%.
quit’ in the next 30 days and had made a quit attempt, and were therefore classified in the preparation stage by the questionnaire B. 13% (27 of 202) said they were ‘seriously thinking of quitting’ in the next 6 months, but not in the next 30 days, and were therefore classified in the contemplation stage by questionnaire A.

Retest

The retest survey was answered by 318 people (31% of 1025), a median of 8 days after baseline (mean 9 days, quartiles 7, 8 and 9 days, 95th percentile 16 days, range 7–35 days). For questionnaires A and C, 85% of participants were classified in the same stage at baseline and retest, but only 76% for questionnaire B. Test–retest intra-class correlations coefficients were 0.95 for questionnaire A and 0.93 for questionnaires B and C. The kappa coefficients of agreement between baseline and retest were 0.82, 0.79 and 0.83 for questionnaires A, B and C, respectively. Most participants who changed stage between baseline and retest progressed or regressed by one stage.

Prediction of smoking cessation

The follow-up question was answered by 451 people (44% of 1025). The median interval between baseline and follow-up was 32 days (mean = 39 days, quartiles: 31, 32 and 37 days, 95th percentile 77 days, range 31–105 days). Eleven per cent of baseline daily smokers, 36% of baseline occasional smokers and 88% of baseline ex-smokers had not smoked tobacco during the 7 days before follow-up. With all three staging questionnaires, similar proportions (21–24%) of ‘preparators’ were abstinent at follow-up, and similar proportions of ex-smokers in the action stage (23–25%) and in the maintenance stage (3–4%) had smoked tobacco during the 7 days before follow-up. Interestingly, 4–6% of ‘precontemplators’ and 8–9% of ‘contemplators’ were abstinent at follow-up (Table 4).

Among smokers who were in the first three stages at baseline, each additional stage increased the odds of quitting by 2.9, 2.9 and 2.7 for questionnaires A, B and C, respectively \((P \leq 0.004\) for all odds ratios (OR)).

Among smokers who were in the first three stages at baseline, each additional stage increased the odds of quitting by 2.9, 2.9 and 2.7 for questionnaires A, B and C, respectively \((P \leq 0.004\) for all odds ratios (OR)).

Among smokers who were in the first three stages at baseline, each additional stage increased the odds of quitting by 2.9, 2.9 and 2.7 for questionnaires A, B and C, respectively \((P \leq 0.004\) for all odds ratios (OR)).

Among smokers who were in the first three stages at baseline, each additional stage increased the odds of quitting by 2.9, 2.9 and 2.7 for questionnaires A, B and C, respectively \((P \leq 0.004\) for all odds ratios (OR)).

Quit attempts

Among current smokers, more people were classified as having made a quit attempt in the previous year by questionnaires A and B (68%) than by questionnaire C (61%).
There were few missing answers to this question (1.8% for questionnaires A and B, and 0.4% for questionnaire C). Eighty-eight per cent of smokers were classified similarly by both questions on quit attempts.

The analysis of the test–retest reliability of self-reports of quit attempts showed that with both questions, 88% of participants in this analysis gave the same answer at both occasions.

With both questions, 32–40% of precontemplators and 53–57% of contemplators had made a 24-hour quit attempt in the previous year. Requiring participants to have made a quit attempt to be included in the preparation stage had a large impact on stage distributions. With questionnaire A, 18% (39 of 218) of smokers who were ‘seriously thinking of quitting smoking in the next 30 days’ were downgraded to the contemplation stage because they had not quit for 24 hours in the previous year. With questionnaire B, 19% (47 of 249) of smokers who were ‘planning to quit in the next 30 days’ had not quit for 24 hours in the previous year and were downgraded to contemplation. With questionnaire C, 24% (44 of 184) of smokers who had ‘decided to quit in the next 30 days’ had not made a quit attempt in the previous year and thus were downgraded to contemplation.

Among smokers who intended to quit in the next 30 days, those who had made a quit attempt in the previous year smoked five cigarettes per day fewer than those who had not (P < 0.001), but there was no difference in abstinence rates at follow-up between these two groups.

When the analysis was limited to the precontemplation and contemplation stages as defined by questionnaire A, smokers who had made a 24-hour quit attempt in the previous year smoked fewer cigarettes than those who had not (−3.0 cigarettes/day, P = 0.02), they were more motivated to quit smoking (+0.6 point on a 0–10 scale, P = 0.03), and were more likely to be occasional smokers (10% versus 5%, P = 0.052). In the first two stages, age, sex ratio and abstinence at follow-up were not statistically significantly different in those who had made a quit attempt in the previous year than in those who had not.

In all smokers, the prediction of smoking cessation was better for 24-hour quit attempts during the past 7 days (abstinence rate = 28% in those who made a quit attempt versus 10% in those who did not: OR = 3.4, P = 0.003) and for 24-hour quit attempts during the past 30 days (22% versus 9%, OR = 2.7, P = 0.010) than for 24-hour quit attempts during the past 12 months (16 versus 8%, OR = 2.1, P = 0.09).

**Classification of occasional smokers**

The whole sample included 6% of occasional smokers. Most of them were classified in the first three stages, but with all algorithms, the action stage included 5–7% of occasional smokers and the maintenance stage 1–2% (Table 4).

**Intention to quit smoking**

Among current smokers, the association between the 0–10 score of intention to quit and smoking abstinence at follow-up was linear (test for linearity from ANOVA model: F = 3.9, P = 0.048, deviation from linearity: F = 0.8, P = 0.592). An increase of one point on the 0–10 score of intention increased by 20% the odds of being abstinent at follow-up (OR = 1.20, P = 0.02). The associations between the 0–10 score of intention to quit and past quit attempts was also linear (test for linearity from ANOVA model: F = 53.3, P < 0.001, deviation from linearity: F = 0.7, P = 0.8).

Among current smokers, the test–retest reliability of the three-point question on motivation to quit and for the 0–10 score of intention to quit were r = 0.74 and r = 0.82, respectively.

With all questionnaires, 33–38% of precontemplators said that they had ‘absolutely no intention’ of quitting smoking, and 49–57% of contemplators said that they had made ‘a firm decision’ to quit smoking in the next days.

**DISCUSSION**

**Reliability of staging questionnaires**

In this study, we tested the validity of three questionnaires aimed at assessing stages of change in current and former smokers. Results showed that all pairs of questionnaires classified 83–93% of participants in the same stage. This is reassuring and suggests that studies using different staging questionnaires can be compared, as long as these questionnaires are based on the same definition of stages of change. Even though discrepancies had a limited impact on stage distributions, this result calls for a more precise definition of stages and for the use of a unique standardized questionnaire.

Questionnaire B had the lowest test–retest reliability, partly because there were more missing values on this questionnaire at retest. However, it is difficult to say whether assessments made at an interval of 8 days should classify more than 76–85% of participants in the same stage, because theory does not state how long smokers remain in the first three stages, nor when they progress to the next stage (Sutton 1996a). The 15–24% difference between baseline and retest may reflect true movements across the stages, or unreliability of the questionnaires. Most movements were one stage up or down.
which could reflect true change in stages, especially among people who visited a website on smoking cessation, and were therefore involved actively in modifying their behaviour (Etter & Perneger 2001b). Although movements between adjacent stages suggest a stage process, they are also consistent with pseudo-stages based on continuous variables (intention and time). Another study showed that during a 7-day interval, 16% of precontemplators and 6% of contemplators progressed to the next stage, and 33% of preparators regressed to contemplation (Hughes 2001). This is considerably more than in the present study and more than expected, and could reflect either measurement or theoretical problems (Etter & Perneger 2001a).

Validity of the concept of stage of change

This study confirms that measurement cannot be conducted independently from the theory, as the most important issues that arose from the data reflect unresolved theoretical problems. The concept of stage of change is a mix of four variables: intention to change, past quit attempts, current behaviour and duration of the current behaviour. None of these variables is assessed comprehensively, and they are mixed in a somewhat haphazard manner. Two of these variables (intention and time) are continuous variables categorized by arbitrary cutpoints. We will address each of these points in the light of our data.

Intention to change

In current smokers, the stage concept includes three levels of intention to quit smoking, but in this study a 0–10 score of intention to quit was linearly associated with past quit attempts and with cessation at follow-up. This and previous research suggest that intention is adequately measured as a continuous variable (Kraft et al. 1999). Furthermore, our data indicated that stages are heterogeneous categories of intention to quit smoking, as only one-third of precontemplators had absolutely no intention of quitting smoking, and only half the preparators had made a firm decision to quit in the next days. This situation led authors of the TTM to define subtypes within stages (Velicer et al. 1995; Norman et al. 1998, 2000), but this approach hardly takes into account that the first three stages are in fact pseudo-stages based on a continuum of intention. In addition, the cut-points of 6 months and 30 days are arbitrary, and they may not be the best possible (Kraft et al. 1999).

Furthermore, in the current stage definition, intention to quit smoking is assessed only in current smokers. However, the intention to remain abstinent in ex-smokers may also be relevant, as well as the intention to decrease cigarette consumption or to switch to occasional smoking. Thus intention is not assessed in a comprehensive manner in current staging questionnaires.

Current behaviour

By dichotomizing ever smokers in current and former smokers, the classic stage concept ignores occasional smoking, but in the present study, occasional (versus daily) smoking was associated with previous quit attempts and predicted smoking abstinence at follow-up, which indicates that occasional smoking is relevant to a theory of smoking cessation (Evans et al. 1992; Gilpin, Cavin & Pierce 1997).

With all questionnaires, the action stage included 5–7% of occasional smokers. In another sample, the action stage included 17% of occasional smokers (Etter & Perneger 1999). This is contrary to theory, which states that to be classified in the action stage ‘only total abstinence counts’ (Prochaska et al. 1996, p. 61), or that being in the action stage ‘means reaching a particular criterion, such as abstinence’ (Prochaska et al. 1992, p. 1104). This discrepancy between theory and measurement is seldom discussed in the literature. This suggests that the stage concept does not reflect reality well. It is based on a dichotomy of behaviour (smoker/ex-smoker), whereas people actually proceed through intermediary behaviour changes, such as switching from daily to occasional smoking or decreasing their cigarette consumption. Occasional smoking could be a stable pattern, a transitional state preceding the installation of tobacco dependence in adolescents, a transition before smoking cessation among daily smokers, or a transition between a period of abstinence and full-blown relapse (Evans et al. 1992; Gilpin et al. 1997). This complexity is not reflected in the stages of change concept, which is therefore an incomplete representation of behaviour change.

Finally, questionnaires A and B do not use the WHO conventional definition of ever smokers (≥100 cigarettes in a life-time) (World Health Organization 1996), which limits the comparability of studies based on these questionnaires with other studies of ever smokers.

Prediction of smoking cessation

Stage was a good predictor of smoking cessation and relapse. Preparators were more than twice as likely as contemplators to be abstinent at follow-up, who in turn were twice as likely to be abstinent as precontemplators. Ex-smokers in the action stage were six times as likely as ex-smokers in the maintenance stage to have smoked during the week before follow-up. This indicates that the staging algorithms used in this study had predictive valid-
An evident principle of correspondence requires that tests of the predictive value of the question ‘Do you plan to quit smoking in the next 30 days?’ should be conducted 30 days after this question is answered (Sutton 1996b). Research on the predictive power of stages of change has not always respected this principle (e.g. Farkas et al., 1996b). We used an interval of 32 days and showed that one in four preparators was abstinent at follow-up. A previous study showed that 27% of preparators progressed to the action stage after 30 days (Hughes 2001). However, the TTM neither states when preparators quit smoking nor how many of them are expected to quit after 30 days. Thus it is unclear whether the observed quit rates are higher or lower than expected.

In our data, 4–9% of precontemplators and contemplators were abstinent at follow-up. This suggests that these people remained very briefly in the intermediary stages, or that they skipped these stages. The latter possibility would be contrary to theory, as the TTM assumes that change is a rational process involving contemplating, preparing for, initiating and maintaining change. Our data do not support this approach. Previous research suggests that abrupt cessation in smokers who never transit through contemplation and preparation can be caused by sudden events such as a disease, a pregnancy or the death of a relative (Etter, Bergman & Perneger 2000). Alternatively, swift stage transitions in our data could result from unreliable assessments of stages and abstinence.

### Quit attempts

The inclusion of quit attempts in the preparation stage had a large impact on the distribution of smokers by stage, since 18–24% of smokers who had decided to quit in the next 30 days were downgraded to contemplation because they had not made a quit attempt in the previous year. As a result, the contemplation stage is an heterogeneous category which includes smokers who intend to quit in the next 6 months and may or may not have made a quit attempt, and smokers who intend to quit in the next 30 days but have not made a quit attempt. Because intention to quit and past quit attempts are conceptually distinct variables, the current definition of contemplation is not satisfactory.

Because smokers need to have made a quit attempt to be included in the preparation stage, those who never tried to quit can never be ‘prepared’ for their first quit attempt (Sutton 1997; Etter & Perneger 1999). Thus, smokers in the preparation stage must have visited the action stage in the previous year, even briefly. This is contrary to the concept of a linear progression through stages. Thus the current definition of the preparation stage is not satisfactory either.

In the present study, one-third of precontemplators and half the contemplators had made a quit attempt in the previous year. In the precontemplation and contemplation stages, those who had made a quit attempt were quite different from those who had not, which suggests that quit attempts is a relevant variable in all stages, not only in preparation.

Interestingly, 50 people (10% of smokers in this analysis) said that they quit smoking for 24 hours at least once in the previous year (questionnaires A and B), but had never tried to quit in the previous 12 months (questionnaire C). This suggests that the question in A and B captures people who were abstinent for 24 hours for other reasons than quit attempts, perhaps because they were ill, had no more cigarettes, etc. Because theory says that preparators have ‘made a 24-hour quit attempt in the past year’ (DiClemente et al. 1991), the words ‘try to quit’ or ‘quit attempt’ should appear in the question used to assess quit attempts. This is not the case with questionnaires A and B.

We know of no other empirical study on test–retest reliability of retrospective self-assessments of quit attempts. A disturbing result was that self-reports of 24-hour quit attempts in the previous 12 months were unreliable in 12% of participants. This may reflect another theoretical problem with the stage concept: the delay of 12 months and the duration of 24 hours are arbitrary and not necessarily the most relevant. Our study brings new insight by showing that quit attempts in the previous 7 days or 30 days are better predictors of smoking cessation than quit attempts in the past 12 months. There could be two explanations for this result. First, reports of more recent quit attempts may reflect motivation to quit, which may increase the likelihood of a subsequent quit attempt. Secondly, recent research showed that when smokers reported quit attempts during each of the 12 previous months, there was a trend towards reporting fewer quit attempts the further back (West et al. 2001). This suggests a memory bias, which would result in an underestimation of self-reports of quit attempts during the past 6–12 months. In addition, quit attempts lasting only 24 hours can be relatively insignificant events that some smokers may not remember for as long as 1 year. Previous research showed that smokers are more likely to forget short quit attempts than longer ones (Gilpin & Pierce 1990). Quit attempt durations of 1 week or 1 month may be more easily remembered.

The current question captures short, unsuccessful quit attempts. This approach may be most relevant to predicting whether smokers will try again to quit. Once a quit attempt is made, its success will be predicted by variables that are not in the TTM, including the number and...
duration of previous quit attempts (Ockene et al. 1982; Cohen et al. 1989; Farkas et al. 1996b), the level of tobacco dependence, the strength of withdrawal symptoms and the ability to cope with withdrawal, the availability of social support (Shiffman 1996), and the use of pharmacotherapy. Longer quit attempts may reflect these variables better. be more predictive of future success and more relevant to therapy.

Thus a comprehensive assessment of quitting experience should take into account not only the occurrence of quit attempts, but also the number and duration of previous quit attempts, and when cessation and relapse occurred.

**Duration of current behaviour**

Time since quitting smoking is the only criterion that distinguishes ex-smokers in the action and maintenance stages. Ex-smokers enter into the maintenance stage simply by the passage of time, even when they experience no change in other predictors of relapse. Thus the action and maintenance stages are in fact pseudo-stages based on the continuum of time.

In addition, the 6 months delay is arbitrary and may not be the best possible. Previous research showed that about half (48%) of ex-smokers who had reached 6 months of abstinence eventually relapsed 5 years later (Blondal et al. 1999). The risk of relapse was smaller among those who reached 1 year of continuous abstinence. Most people who relapse do so during the first days and weeks of abstinence (Blondal et al. 1999). Withdrawal symptoms are strongest during the first days and weeks after cessation (Ward, Swan & Jack 2001), pharmacological treatments are usually prescribed during 2–3 months after cessation (Silagy et al. 2000; Jorenby et al. 1999) and the US Food and Drugs Administration requires 4 weeks of continuous abstinence to assess outcome in smoking cessation trials (US Food and Drug Administration 1995). Such intervals may be more relevant to therapists than 6 months, because usually no critical qualitative change occurs 6 months after cessation.

In the current stage definition, duration of the current behaviour is assessed only in ex-smokers, but duration may also be relevant in current smokers, because smokers who began to smoke at a younger age have more difficulty quitting (Fernandez et al. 1999; Lando et al. 1999).

More importantly, the definition of stages says nothing about how long smokers stay in each of the first three stages, and when they progress to the next stage. Thus stages are not ‘periods of time’ (Prochaska et al. 1994) and they are not a representation of when people change, contrary to what is often believed.

**Limitations of this study**

Participants visited a website dedicated to smoking cessation, and most of them took part in an on-line smoking cessation programme (Etter & Perneger 2001a). Smokers who volunteer for cessation studies may differ from smokers in the general population (Etter & Perneger 2001b; Hughes et al. 1997). Previous research showed that smokers recruited on this website were in more advanced stages of change than smokers in a representative sample of the Geneva population, that they smoked more cigarettes and were more likely to have made a quit attempt in the previous year (Etter, Perneger & Ronchi 1997; Etter & Perneger 2001b). This may limit the generalizability of our results. However, we showed previously that recruiting smokers on the Internet rather than by mail had little impact on associations between smoking-related variables (Etter & Perneger 2001b). Thus bias in the distribution of variables does not imply bias in associations between variables (Etter & Perneger 2001b). Because the present study focused on associations between variables, its results may be generalizable, even though the sample was not representative of the general population. In addition, sufficient numbers of participants were present in all stages. Thus the sample did not suffer from range restriction, which would have affected the associations between variables, and the observed associations were unlikely to be due to a few extreme outliers, which would also have been a cause of bias.

**CONCLUSION**

The concept of stage of change was adopted with enthusiasm by researchers and clinicians. Dozens of scientific papers include some measure of stage of change, but this concept has been used uncritically too often. Measuring independently and comprehensively each of the four variables included in the stage concept may provide a more thorough understanding of the process of smoking cessation than using an incomplete mix of these variables.

**ACKNOWLEDGEMENTS**

Vincent Baujard, from the HON Foundation (http://www.hon.ch), developed the software for data collection. This study was supported by grants from the Swiss National Science Foundation to J.-F. Etter (3233–054994.98 and 3200–055141.98).

**REFERENCES**


Appendix 1 Questionnaire A.

Are you currently a smoker?

Yes, I currently smoke
No, I quit within the last 6 months (action stage)
No, I quit more than 6 months ago (maintenance stage)
No, I have never smoked (non-smoker)

For smokers only

In the last year, how many times have you quit smoking for at least 24 hours?
Are you seriously thinking of quitting smoking?
Yes, within the next 30 days (preparation stage if they have one 24-hour quit attempt in the past year—refer to previous question… if no quit attempt then contemplation stage)
Yes, within the next 6 months (contemplation stage)
No, not thinking of quitting (precontemplation stage)

Appendix 2 Questionnaire B.

1 Are you currently a cigarette smoker? (no/yes)
2 Have you smoked ANY cigarettes during the past 6 months? (no/yes)
3 Are you seriously considering quitting smoking within the next 6 months?
   (no/yes/I don’t smoke)
4 Are you planning to quit in the next 30 days? (no/yes/I don’t smoke)
5 In the last year, how many times have you quit smoking for at least 24 hours?
   (0/1 or more times)

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precontemplation</td>
<td>Yes</td>
<td>–</td>
<td>No</td>
<td>No</td>
<td>–</td>
</tr>
<tr>
<td>Contemplation</td>
<td>Yes</td>
<td>–</td>
<td>Yes</td>
<td>No</td>
<td>–</td>
</tr>
<tr>
<td>Contemplation</td>
<td>Yes</td>
<td>–</td>
<td>Yes</td>
<td>Yes</td>
<td>0 or missing</td>
</tr>
<tr>
<td>Preparation</td>
<td>Yes</td>
<td>–</td>
<td>Yes</td>
<td>Yes</td>
<td>1 or more times</td>
</tr>
<tr>
<td>Action</td>
<td>No</td>
<td>Yes</td>
<td>I don’t smoke</td>
<td>I don’t smoke</td>
<td>–</td>
</tr>
<tr>
<td>Maintenance</td>
<td>No</td>
<td>No</td>
<td>I don’t smoke</td>
<td>I don’t smoke</td>
<td>–</td>
</tr>
</tbody>
</table>
1. Have you smoked AT LEAST 100 cigarettes in your life-time? (yes/no)

2. Which of the following statements describes the best your current situation?
   (a) I smoke and I have NO intention to quit smoking in the next 6 months
   (b) I smoke, but I seriously consider quitting smoking in the next 6 months
   (c) I smoke, but I have decided to quit smoking in the next 30 days
   (d) I am an ex-smoker; I quit smoking LESS than 6 months ago
   (e) I am an ex-smoker; I quit smoking MORE than 6 months ago

3. In the past 12 months, did you try to quit smoking AND succeed in not smoking for at least 24 hours? (yes/no).

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precontemplation</td>
<td>Yes</td>
<td>(a)</td>
<td>–</td>
</tr>
<tr>
<td>Contemplation</td>
<td>Yes</td>
<td>(b)</td>
<td>–</td>
</tr>
<tr>
<td>Contemplation</td>
<td>Yes</td>
<td>(c)</td>
<td>No or missing</td>
</tr>
<tr>
<td>Preparation</td>
<td>Yes</td>
<td>(c)</td>
<td>Yes</td>
</tr>
<tr>
<td>Action</td>
<td>Yes</td>
<td>(d)</td>
<td>–</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Yes</td>
<td>(e)</td>
<td>–</td>
</tr>
</tbody>
</table>