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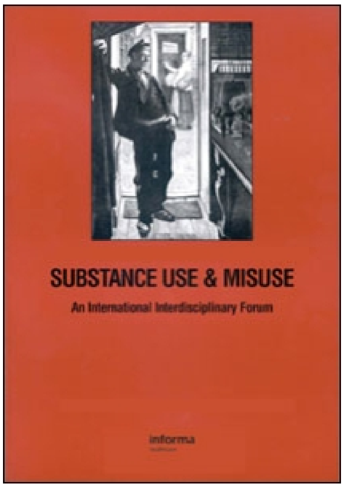

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Using Latent Class and Latent Transition Analysis to Examine the Transtheoretical Model Staging Algorithm and Sequential Stage Transition in Adolescent Smoking

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Data on stage of change was collected between 1997–1999 on 4125 adolescent non-smokers and smokers from central England who completed two versions of the stage of change algorithm for smoking acquisition and cessation. The fit of the latent variable defined by the spiral of change to adolescents' responses to the staging questions was examined using latent class analysis. Whether a model of sequential transition across stages fitted the observed transitions was tested with latent transition analysis (LTA). There was reasonable support for the staging algorithm but no evidence of sequential stage transition. The research was funded by Cancer Research UK.

Keywords transtheoretical model; stage of change; smoking; adolescence; latent class analysis; latent transition analysis

Introduction

The Transtheoretical Model (TTM) postulates that individuals change their behavior incrementally by stages (Prochaska and Velicer, 1997). Stage is assumed to be a latent unobservable construct and has been measured either with a staging questionnaire or, more commonly, with a staging algorithm (Pallonen, Prochaska, Velicer, Prokhorov, and

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Smith, 1998). The algorithm asks individuals about their current smoking, past quit attempts, and current intentions to stage them (Figure 1) (Pallonen et al., 1998). Small changes to the wording can have marked effects on stage distribution (Etter and Sutton, 2002). As can be seen from Figure 1, the TTM is hypothesized to explain smoking uptake as well as cessation.

Latent class analysis (LCA) is the most theoretically appropriate technique to examine the validity of the staging algorithm (Collins, Lanza, Schafer, and Flaherty, 2002; Magidson and Vermunt, 2001). The TTM postulates that individuals' responses to the staging algorithm questions are determined by their stage, the latent variable. LCA can be used to test this assumption by examining the extent to which a categorical latent stage variable can explain the pattern of responses to the staging questions in Figure 1. Velicer, Martin, and Collins (1996) called for studies using LCA to examine the validity of the stages, but to date, no such study has been published. The first aim of this study is to use LCA to examine the validity of the staging algorithm in adolescent smokers.

An important axiom in the TTM is that individuals move from one stage to the next in order. As Prochaska, Diclemente, Velicer, and Rossi (1992) note, "individuals who successfully leap over stages, such as from precontemplation to maintenance, may exist but we have not yet found any." Littell and Girvin (2002) reviewed studies purporting to test this assumption and found little evidence for or against. Herzog et al. (1999) recorded stage in smokers three times, one year apart. Given that many smokers make quit attempts during a year (Raw et al., 1999) and must have moved several stages to do so, the assessment periods are too far apart to examine this. Two studies confirmed the stability of stage but did not report on whether stage transition was orderly or not (Martin et al., 1996; Morera et al., 1998). Norman et al. (1998) reported on stage measured five times over two years, clustering together types depending upon starting and ending stage, so that it is impossible to show whether stage transition was orderly.

The hypothesis of orderly transition is best tested with latent transition analysis (LTA). Using the same underlying approach, LTA extends LCA by allowing that individuals can move stage from one timepoint to the next. Movement between latent classes is expressed by transition probabilities; the probability of being in a particular latent class on one occasion is conditional on latent class membership on a previous occasion. The Markov assumption is the simplest characterization of these transitions, i.e., the state at the current observation depends upon the stage immediately previously, and not any other states prior to the immediate past observation.

Velicer et al.'s (1996) is the only study to have used LTA to examine sequential stage movement. They found that a model that allowed two steps forward and one step backward between observations best fitted the observed stage distributions. This model is compatible with a model allowing stage skipping. However, in six months many people might have moved two or more stages. Moreover, the preparation stage implies action within the next month and cannot really be stable over six months without being self-contradictory. Thus, studies with shorter periods between observations are needed to properly test the orderly transition hypothesis. Furthermore, the authors used stage itself to indicate the latent variable stage, meaning that they used a manifest not a latent variable in the analysis, though as (Velicer et al.) note, multiple indicators for latent stage measurement would provide a better test of sequential stage movement. In this paper, we apply LTA with observed responses to the staging algorithm as indicators of the latent variable stage to examine whether stage transition is orderly. We use a three-month interval between observations in a population of adolescent nonsmokers at the risk of becoming a smoker and adolescent smokers, some of whom stopped smoking over the course of a school year.

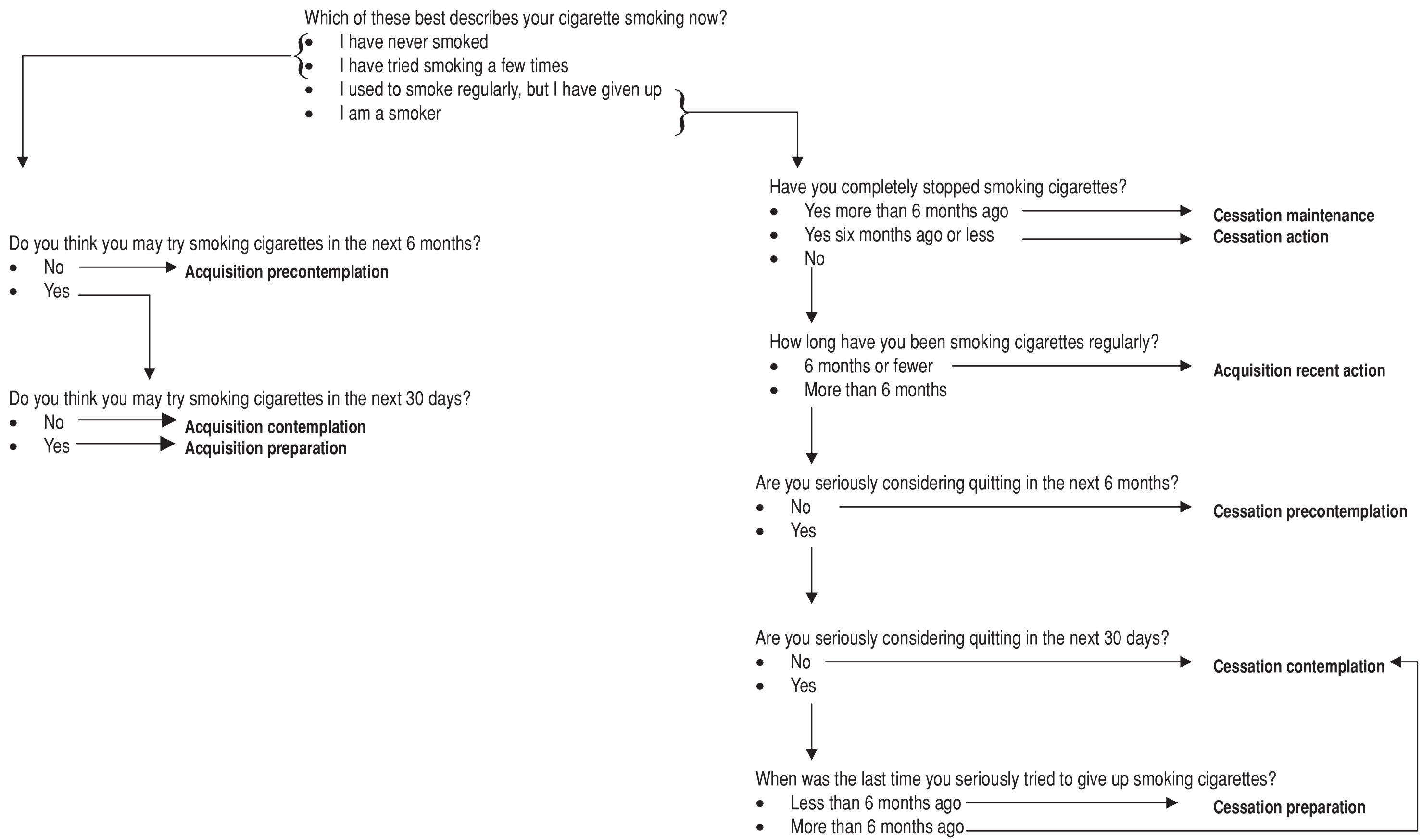

Figure 1. The staging algorithm for adolescent smoking acquisition and cessation.

Method

Participants and Measures

The data for both LCA and LTA were taken from the same trial on the same participants but from different sources (Aveyard et al., 1999; Aveyard et al., 2001). Participants were told by their teachers and by the research team that they were taking part in research to examine the effects of two different types of education about smoking in their personal health and social education lessons. They were allowed to opt out, but no consent forms were signed. The educational authorities in the West Midlands approved the study.

In the trial, 4125 Year 9 students from 26 intervention schools completed a baseline paper questionnaire in autumn 1997, which contained the staging questions in Figure 1. These participants also completed an identical computerized staging questionnaire three times, once in each of the academic terms of 1997–1998. All participants were readministered the baseline questionnaire in autumn 1998 and autumn 1999. We used the data from the paper questionnaire for LCA because participants answered all staging questions, regardless of their answers to other questions other than being guided to the smoker or nonsmoker questions. However, in the computerized questionnaire, a person who smoked who answered that they were not seriously considering quitting in the next six months answered no further staging questions, making LCA problematic without indicator variables theoretically determined by the latent variable stage. However, LTA requires stage to be assessed with only short intervals and therefore we used the computerized questionnaire data as the paper data were assessed with 12 month intervals. We therefore used the computerized questionnaire data, where stage was assessed three months apart.

The participants had a similar socio-demographic and smoking profile to that of England as a whole, and full details are shown in Table 1. At baseline, in Year 9, 13% were regular (at least weekly) smokers, 8% former smokers, 25% had tried smoking, and the remainder had never smoked. By the final follow-up, two years later, 23% were regular smokers. The median consumption of regular weekly smokers at baseline, one year, and two years was 2.6, 2.9, and 7.6 cigarettes per day respectively. Eighty-nine percent of the adolescents were present at one year and 86.0% were present at two-year follow-up.

LCA

LCA was conducted separately for smoking acquisition and smoking cessation using Latent Gold 4.0 (Vermunt and Magidson, 2005). Smoking acquisition terminates in the acquisition recent action stage, when a young person has become a regular smoker. However, in that stage, participants have formed intentions with regard to stopping smoking so that they can also be classified in the cessation stages (Velicer et al., 1996). Consequently, there were five stages for smokers: cessation precontemplation (PC), cessation contemplation (C), cessation preparation (P), cessation action (A), and cessation maintenance (M). There were three acquisition stages: acquisition precontemplation (aPC), acquisition contemplation (aC), and acquisition preparation (aP).

In LCA, the fit of the theoretical model to the observed data is judged analogously to the fit of a structural equation model (Collins, Fidler, Wugalter, and Long, 1993; Collins, Hyatt, and Graham, 2000; Collins and Wugalter, 1992; Muthen and Muthen, 2006; Vermunt and Magidson, 2003). Likelihood χ^2 and entropy are the commonest indicators for model fit (Muthen et al., 2002; Muthen and Muthen, 2006). Nonsignificant likelihood χ^2 indicates

Table 1
Baseline characteristics of participants

	Intervention
Total subjects	4125 (49.4)
Sex	
Boys/girls	1995 (48.4)/2130 (51.6)
Ethnicity	
White	3566 (86.4)
Indian	16 (0.4)
African/Caribbean	160 (3.9)
Pakistani	133 (3.2)
Bangladeshi	48 (1.2)
Chinese	104 (2.5)
Mixed Race	68 (1.6)
Other	13 (0.3)
Unspecified ethnicity	17 (0.4)
Family's smoking habits	
Mother smokes	1227 (29.7)
Father smokes	1446 (35.1)
Sibling smokes	947 (23.0)
Best friend smokes	831 (20.1)
Smoking habits of students at baseline	
Ex-smoker	312 (7.6)
Smoker	547 (13.3)
Tried smoking	1094 (26.5)
Never smoked	2135 (51.8)
Smoking status unknown	37 (0.9)
Stage of smoking at baseline	
Acquisition/precontemplation	2478 (60.1)
Acquisition/contemplation	192 (4.7)
Acquisition/preparation	120 (2.9)
Acquisition/recent action	104 (2.5)
Cessation/precontemplation	156 (3.8)
Cessation/contemplation	97 (2.4)
Cessation/preparation	153 (3.7)
Cessation/action	126 (3.1)
Cessation/maintenance	90 (2.2)
Stage unknown	609 (14.8)
Deprivation	
Mean Townsend score[a] (SD)	1.65 (3.65)

[a]Standardized to a mean of zero and an SD of 4 across the region, with positive values indicating increasing levels of socio-economic deprivation.

good fit. However, with many sparsely populated cells, more variables in a model, or large sample sizes the likelihood χ^2 deviates from the χ^2 distribution, making the statistic unreliable (McCutcheon, 2002). We therefore did not strictly bind ourselves by likelihood χ^2 in view of the sample size. The entropy value, which indicates how well the model can predict class membership based on the observed variables, was also used to judge model fit (Vermunt and Magidson, 2005). The closer this value is to one the better the prediction.

LTA

Smoking acquisition and cessation stage transitions were analyzed separately. LTA was conducted by WinLTA (Collins and Flaherty et al., 2002). A free transition model, two step forward one step backward model, one step forward one step backward model, and one step forward only model were tested against the observed pattern of stage transitions and compared. Once a model has been deemed satisfactory, data augmentation was used to obtain final parameter estimates and their standard errors (Collins, Lanza, and Schafer, 2002).

Default G^2 (likelihood χ^2) is an indicator of model fit in LCA and LTA. In WinLTA, however, with large sample sizes, it is difficult to reject a null hypothesis when testing a more complex pattern of stage transition against a simpler one (Collins and Wugalter, 1992). Thus, the Akaike Information Criterion (AIC), penalizing the likelihood for complexity, was also used to assess model fit, with smaller AIC values being preferred (Collins and Wugalter, 1992; Kaplan, 2000; McCutcheon, 2002). AIC was computed with the formula $G^2 + 2p$, where p is the number of parameters estimated in the model (Graham, Collins, Wugalter, Chung, and Hansen, 1991).

Results

Latent Class Analysis

LCA for Cessation Stages. The model likelihood χ^2 for the year 1 data was 40.5 with 36 degrees of freedom ($p = .28$) with a model entropy of 0.80. In year 2, model χ^2 was 36.5 ($p = .45$) with entropy of 0.82. In year 3, model χ^2 was 53.6 ($p = .030$) with entropy of 0.88. These results show a good fit of the model to the data. Generally speaking, those in the various stages responded as theoretically appropriate to most questions (Table 2). The patterns for years 2 and 3 were similar and tables displaying these results are available on our website (to be confirmed).

LCA for Acquisition Stages. For the data from year 1, the model likelihood χ^2 was 212.3 with 1 degree of freedom ($p < .001$) but the model entropy was 0.98. For the year 2 data, the model likelihood χ^2 was 386.4 with 1 degree of freedom ($p < .001$), with model entropy of 1.00. For the year 3 data, the model χ^2 was 277.4 with 1 degree of freedom ($p < .001$) and model entropy was 1.00. The χ^2 values may indicate departure from theoretical expectations, but the very high entropy values show this is trivial, as confirmed by inspection of Table 3. The data for years 2 and 3 are available at http://www.pcpoh.bham.ac.uk/primarycare/research/ttm/index.htm.

Conditional Independence Check. An essential assumption of LCA is that of local independence, meaning that the responses individuals make in one stage to one of the staging questions are unrelated to the responses they may make to other questions. Given some logical flaws in the staging algorithm (Sutton, 2000a), and given the related nature of the questions in the algorithm, we checked the conditional independence assumption by checking whether all bivariate residuals in above models were less than one

Table 2

Probability of endorsing particular responses to the cessation staging algorithm conditional upon stage membership (year 1 data)

Stem and responses	Precontemplation	Contemplation	Preparation	Action	Maintenance
Stage distribution	0.2309	0.0827	0.2706	0.1752	0.2406
Intend to quit in next 6 months					
No	0.8592	0.3418	0.0150	0.0004	0.0002
Yes	0.1404	0.6570	0.9799	0.0219	0.0004
Given up	0.0004	0.0012	0.0051	0.9776	0.9994
Intend to quit in next 30 days					
No	0.9564	0.7056	0.2952	0.0005	0.0003
Yes	0.0386	0.2850	0.7042	0.0004	0.0041
Given up	0.0050	0.0094	0.0006	0.9992	0.9955
When was the last time you tried to give up smoking?					
Within 6 months	0.3155	0.9208	0.8205	0.5533	0.0675
More than 6 months ago	0.6842	0.0117	0.1789	0.0074	0.1907
Given up	0.0003	0.0675	0.0006	0.4393	0.7418
Have you completely stopped smoking?					
Within 6 months	0.0932	0.8965	0.3359	0.8444	0.2245
More than 6 months ago	0.1197	0.0729	0.1638	0.0151	0.7460
Never stopped	0.7872	0.0306	0.5003	0.1405	0.0295

Table 3
Probability of endorsing particular responses to the acquisition staging algorithm conditional upon stage membership (year 1 data)

Stem and response	Precontemplation	Contemplation	Preparation
Stage distribution	0.8418	0.0681	0.0900
May try smoking in next 6 months			
No	0.9997	0.2708	0.2894
Yes	0.0025	0.9639	0.3644
May try smoking in next 30 days			
No	1.0000	0.9998	0.0020
Yes	0.0000	0.0001	0.5261

(Vermunt and Magidson, 2005). Results showed that for the cessation latent class models, the questions "Have you ever completely stopped smoking cigarettes?" and "When was the last time you seriously tried to give up smoking cigarettes?" have bivariate residuals larger than one for the data from years 1 and 3. For the acquisition latent class model, bivariate residuals for "May try smoking cigarettes in the next 30 days?" and "May try smoking cigarettes in the next six months?" are larger than one on all three occasions. These models do not meet the assumption of local independence for Latent class model.

Latent Transition Analysis

LTA for Cessation Stages. A minority of individuals stayed in the same stage (on the diagonal) between the first and second assessments, three months apart (Table 4). The same pattern was observed for change in stage between the second and third assessments, available at (http://www.haps.bham.ac.uk/primarycare/cv/smoking/ttm.shtml). Results show that people were generally more likely to move to an adjacent stage than a distal one. Students in cessation preparation stage were the most unstable group with only about a quarter remaining in the same stage three months later. Forty-five percent in the first three months and 42% in second three months regressed to a former stage. Twenty-six percent in first three months and 33% in second three months stopped smoking. Among those adolescents who had stopped smoking for more than six months, fewer than 10% relapsed and were still smoking when reassessed on both subsequent occasions. However, a quarter of this group relapsed between assessments but was not smoking again by reassessment.

Table 4
Free transition probabilities (standard errors) for cessation stages from time 1 to time 2

	PC2	C2	P2	A2	M2
PC1	**0.529** (0.040)	0.202 (0.032)	0.074 (0.021)	0.196 (0.032)	—
C1	0.260 (0.039)	**0.340** (0.042)	0.148 (0.032)	0.252 (0.039)	—
P1	0.188 (0.041)	0.274 (0.046)	**0.274** (0.046)	0.263 (0.046)	—
A1	0.112 (0.021)	0.084 (0.019)	0.030 (0.011)	**0.540** (0.034)	0.235 (0.029)
M1	0.032 (0.013)	0.026 (0.012)	0.026 (0.012)	0.280 (0.034)	**0.637** (0.037)

Note: In all cases, the lower limit of the 95% CI are larger than 0.
PC, precontemplation; C, contemplation; P, preparation; A, action; M, maintenance.

Table 5
LTA model fit indices for cessation stage transitions

Model	AIC	G^2	df	$\Delta G^2/\Delta df$
Free transition model	195.8	87.8	32713	—
2 step forward 1 step backward model	1805.7	1725.7	32727	1637.8/14**
1 step forward 1 step backward model	2104.6	2032.6	32731	1944.7/18**
1 step forward model	2851.4	2795.4	32739	2707.5/26**

$^{**}p < .01$.

The impression of great variability in stage between assessments is confirmed by model testing (Table 5). The free-transition model was preferred because its AIC was smallest and the G^2 changes relative to the other models were statistically highly significant.

LTA Result for Acquisition Stages. The pattern for the acquisition stage transitions is different from that for the cessation stages (Table 6). Acquisition precontemplation was very stable, with only a minority of participants moving between assessments, but those that did were almost as likely to end up as smokers at the next assessment as be in acquisition contemplation. However, both contemplation and preparation were very unstable with a minority remaining in the same stage and distribution to other stages being fairly equal at the subsequent assessment. The acquisition preparation stage was the most unstable; only 29% in first three month interval and 23% in second three month interval stayed in the same stage. However, a minority started smoking, with 25% in the first three months and 37% in the second three months acting on their intention to start smoking. Even for adolescents in the acquisition precontemplation stage, about 5% became regular smokers in the three months between assessments, while more than 10% in acquisition contemplation became regular smokers within three months.

The model fit indices indicate the free transition model provided the best fit to the data; its AIC was much smaller than the alternative models and the G^2 changes relative to other models were significant (Table 7).

Discussion

We used LCA to examine how well the responses to the adolescent staging algorithm described by Pallonen et al. (1998) classifies individuals into the stages of change. Our results show that the theoretical model of stage distribution fitted the observed pattern or responses well, but problems with conditional independence of the indicators temper this

Table 6
Free transition probabilities (standard errors) for acquisition stages from time 1 to time 2

	aPC2	aC2	aP2	Smoker 2
aPC1	**0.861** (0.008)	0.077 (0.006)	0.020 (0.003)	0.042 (0.004)
aC1	0.380 (0.028)	**0.363** (0.028)	0.117 (0.018)	0.140 (0.020)
aP1	0.201 (0.044)	0.262 (0.049)	**0.287** (0.050)	0.250 (0.048)
Smoker 1	—	—	—	**—**

Note: In all cases, the lower limit of the 95% CI are larger than 0.
aPC, acquisition precontemplation; aC, acquisition contemplation; aP, acquisition preparation.

Table 7
LTA model fit indices for acquisition stage transitions

Model	AIC	G^2	df	$\Delta G^2/\Delta df$
Free transition model	120.6	52.6	4061	—
2 step forward 1 step backward model	2563.6	2503.6	4065	2451.0/4**
1 step forward 1 step backward model	3476.6	3424.6	4069	3372.0/8**
1 step forward model	4986.7	4942.7	4073	4890.1/12**

$^{**}p < .01$.

conclusion; that there are associations between the responses to the staging algorithm is to be expected. It would be reasonable to assume that a person responding to an indicator question such as "Are you seriously considering stopping smoking in the next six months" would show a response that correlates with their answer to the same question but with a 30 day time period. This makes checking the staging algorithm with LCA problematic.

One issue that merits attention in this and all research is the ethical issues. We enrolled young people in their schools. As part of the national curriculum, these pupils covered smoking related issues as part of the personal health and social education curriculum. We supplied teachers in the control schools with teaching materials and in the intervention school with materials based on the TTM. These materials might have been expected to reduce the take-up of smoking or at least educate young people on the choice about whether to take up smoking and thus we regard our trial as ethical. In exchange for this, however, we asked young people to complete fairly short questionnaires, for which we offered only our thanks.

The validity of questionnaires for stage measuring and the stage definition itself have been questioned (Etter and Sutton, 2002; Sutton, 2000b; Weinstein, Rothman, and Sutton, 1998; West, 2005; West, 2006). The staging algorithm has been argued to have theoretical and methodological problems. The algorithm questions concern four different variables: current behavior, quit attempts, intention to change, and time since quitting (Etter and Sutton). However, none of these behaviors and intentions is measured comprehensively. Intention to quit is only assessed for current smokers, time periods for the duration of behavior are arbitrary, and past quit attempts are only considered for defining cessation preparation. Although smoking acquisition and cessation are integrated, acquisition preparation and cessation preparation are assessed with different indicators. These problems weaken the construct validity of algorithm.

Previous research found poor test-retest reliability of the staging algorithm for staging adolescent smoking acquisition (Aveyard, Lancashire, Almond, and Cheng, 2002). The results presented here for LCA identify further problems with the TTM algorithm for cessation. The conditional probabilities of each indicator, which are analogous to factor loadings (Eaton, Mccutcheon, Dryman, and Sorenson, 1989), show that the conditional probabilities of past quit attempts are higher in the precontemplation and contemplation stages than in preparation. Cessation precontemplation and contemplation are defined solely on the intention to change (DiClemente et al., 1991; Pallonen et al., 1998). Etter and Sutton (2002) reported that one third of precontemplators and half of all the contemplators had made a quit attempt in the previous year. This could suggest that the algorithm might be improved by considering past quit attempts in all cessation stage definitions.

Although LCA showed a good fit of the theoretical model of stages, LTA showed no evidence that stage movement is sequential and orderly. Stage movement was the norm over three months and frequently to stages several places distant on the spiral of change. However, it is not possible to invalidate the sequential movement hypothesis for two reasons. First, stage skipping, which contradicts the TTM hypotheses, or frequent stage movement, which does not contradict it, could explain our results. Second, the nature of the staging algorithm prevents some stage movements. In the quote above, Prochaska et al. (1992) describe the example of skipping stages from cessation precontemplation to maintenance. However, even if an individual does skip stages and is psychologically in maintenance using the appropriate process of change for maintenance, this person could only be coded as in action until they have stopped for at least six months.

The finding that free stage transition and not sequential transition was preferred could be explained in several ways. First, the time interval of assessment could be too long to catch sequential movement. Individuals might have made sequential moves but they might have made several between assessments and the pattern appears free, when in truth it was sequential. Some have argued that the description of the stages is flawed in that it has implied slow and steady movements, but other have suggested rather that intentions change more frequently than that and quit attempts can be halted, revised, or even abandoned at any point (Weinstein et al., 1998). Some evidence that suggests that intentions to quit change rapidly without prior planning has been produced (West and Sohal, 2006).

The second explanation is that there is some error in the stage assessment method, i.e., the algorithm led to spurious volatility. The original staging algorithm has been questioned, as discussed above. Taking our results on the LCA analysis, together with others on the reliability of the algorithm, and the theoretical and practical concerns on construct validity (Etter and Sutton, 2002; Sutton, 2000b; Sutton, 2005), we conclude that the algorithm has only fair validity. Clearly, if the staging instrument is wrong in part, this may lead to apparent stage volatility that would not be present if a more valid instrument had been used.

A third explanation is that stage transition is not sequential, contradicting (Prochaska et al., 1992) assertion that it is. A variant on this explanation is that meaningful stages do not exist. Rather, people change their intention depending on rapid, unpredictable events resulting in a "chaotic" pattern of behavior and intention shift. There is increasing evidence to support this notion (Hughes, Keely, Fagerstrom, and Callas, 2005; West, 2005; West, 2006).

In summary, although we found reasonable support for the staging algorithm, other concerns and the lack of statistical independence of the staging indicators mean that the algorithm could be improved. Stage transition did not appear sequential, casting doubt on one of the central tenets of the TTM.

RÉSUMÉ

En utilisant des classes latentes et des analyses de transitions latentes pour examiner l'algorithme de transition du modèle Transthéorique et les étapes de transitions séquentielles chez les adolescents fumeurs

Des données sur des changements de stade collectées entre 1997 et 1999 sur 4125 adolescents non-fumeurs et fumeurs du centre de l'Angleterre ayant accomplis deux types d'algorithme de changement d'état pour un début et un arrêt de la cigarette. La place de l'état latent variable définit par une spirale de changement des adolescents réactifs aux questions de stade a été examinée en utilisant des analyses par classe. Selon qu'un modèle de transition séquentiel à travers les stades correspondait aux transitions observées était testé par des analyses de transitions latentes. Il y avait un soutien correct pour l'algorithme de transition mais pas d'évidence de stade de transition séquentielle. Cette recherche a été financée par le centre de recherche contre le cancer du Royaume-Uni.

RESUMEN

Utilización del análisis de clase latente y de transición latente para examinar el Modelo Transteorético (Prochaska) con los estadios de cambio de algoritmo y transición secuencial en el consumo de tabaco en adolescentes

Los datos de los "estados de cambio" de Prochaska fueron recopilados entre 1997–1999 a través de 4.125 adolescentes fumadores y no fumadores del centro de Inglaterra, los cuales completaron dos versiones para el proceso de cambio utilizando el método algorítmico para el inicio y el cese de la práctica de fumar. La aproximación de la variable latente, definida por la espiral de diferentes respuestas a preguntas realizadas a los adolescentes, fue examinada utilizando una clase de análisis de transición latente. Si hubo un modelo de transición secuencial a través de los estados de las transiciones observadas, éste se examinó con el análisis de transición latente. Hubo un apoyo razonable para el algoritmo de cada estado de cambio pero no existió ninguna evidencia de transición secuencial en el proceso. Esta investigación fue financiada por "Investigación del Cáncer

THE AUTHORS

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Glossary

Latent class analysis (LCA): Latent classes are discrete unobserved groupings that explain the observed set of responses. Latent class analysis examines the probability of an individual in a given latent class making the observed responses.

Latent transition analysis (LTA): Latent transition analysis is a technique for examining how movement occurs between classes. It expresses the probability of being in one latent class at the second point, given the starting class.

Transtheoretical model (TTM): This is a theory expressing how behavior changes incorporating various concepts drawn from other theories in health psychology.

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