



UvA-DARE (Digital Academic Repository)

Does a typical contemplator exist? Three clusters of smokers in contemplation

Smit, E.S.; Hoving, C.; de Vries, H.

DOI

[10.1093/her/cyp059](https://doi.org/10.1093/her/cyp059)

Publication date

2010

Document Version

Author accepted manuscript

Published in

Health Education Research

[Link to publication](#)

Citation for published version (APA):

Smit, E. S., Hoving, C., & de Vries, H. (2010). Does a typical contemplator exist? Three clusters of smokers in contemplation. *Health Education Research*, 25(1), 61-73.
<https://doi.org/10.1093/her/cyp059>

General rights

It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations

If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: <https://uba.uva.nl/en/contact>, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.

This is a pre-copyedited, author-produced PDF of an article accepted for publication in Health Education Research following peer review.

The definitive publisher-authenticated version

Smit, E.S., Hoving, C., de Vries, H. (2010). Does a Typical Contemplator Exist? Three clusters of smokers in contemplation, *Health Education Research*, 25(1), 61-73. DOI: 10.1093/her/cyp059

is available online at: <http://her.oxfordjournals.org/content/25/1/61.long>

Does a Typical Contemplator Exist? Three clusters of smokers in contemplation.

E.S. Smit, C. Hoving, H. de Vries

School for Public Health and Primary Care (CAPHRI); Faculty of Health Medicine and Life Sciences, Department of Health Promotion, Maastricht University, P.O. Box 616, 6200 MD, Maastricht, the Netherlands.

Please direct all correspondence to:

E.S. Smit, Department of Health Promotion, Maastricht University, P.O. Box 616, 6200 MD Maastricht, the Netherlands

Telephone: +31433882397

Fax: +31433671032

E-mail: es.smit@gvo.unimaas.nl

Running Title: Does a Typical Contemplator Exist?

Keywords: Smoking, cluster analysis, stages of change, contemplation

Word Count Main Text: 3974

Abstract

Objective To test whether subtypes exist among smokers in contemplation.

Method Data from 194 adult smokers that participated in an RCT testing the effectiveness of a computer tailored smoking cessation program in Dutch general practices were used for secondary analysis. Cluster analysis was conducted based on baseline scores on pros and cons of quitting and self-efficacy to quit. Clusters were cross-sectionally compared for demographic variables and smoking characteristics with ANOVA and Chi-square tests. Logistic and multinomial regression analyses were used for longitudinal comparison for smoking behaviour and stage of change at six months follow-up.

Results Three clusters were identified: Early, Progressing and Disengaged Contemplators. Clusters differed significantly on all clustering variables ($p < 0.001$). Disengaged smokers were significantly less addicted than Early Contemplators. Cluster membership was not predictive of outcome measures.

Discussion Subtypes exist within our sample. No subtype was identified representing the Classic Contemplator, scoring high on both pros and cons of quitting and low on self-efficacy, as found in previous studies among US samples [1-3]. The predictive validity of the clusters found was limited.

INTRODUCTION

Several concepts have been developed to describe the process of behavioural change [4-7], of which the stages of change concept proposed by Prochaska and colleagues as part of the Transtheoretical Model (TTM) [5, 8, 9] is the most widely known and used. For the present study, the I-Change model was used as a theoretical framework. This model states that the intention to change behaviour is determined by predisposing factors (behavioural, psychological, biological, social cultural factors), awareness factors (knowledge, cues to action, risk perception) and motivational factors (attitude, social influence, self-efficacy). The intention to change in combination with an individual's abilities and experienced barriers, subsequently influences the likelihood of accomplishing the desired behaviour change. In line with the TTM, the I-Change model [4] argues that behavioural change is a process that unfolds over time through a sequence of five stages [4]. The first three stages are defined by the time an individual expects to elapse between the present moment and the intended behaviour change. These pre-action stages are precontemplation (not intending to quit within six months), contemplation (intending to quit within six months) and preparation (intending to quit within one month). After moving through the action stage (has quit for less than six months), the ex-smoker can progress to maintenance (has quit for more than six months) or relapse to smoking [4]. As we used the operationalizations proposed by the I-Change model [4] and as it has recently received multiple critiques [10, 11], the criterion that smokers in preparation should have attempted to quit in the last year was abandoned in the present study. Contemplators were considered those smokers intending to quit within the next six months, regardless of previous quit attempts. The

stages of change concept assumes that people within the same stage face common barriers to change, while people in different stages face different barriers [12].

Therefore, if progress through the stages is to occur, health educators should adapt their messages to those determinants of behaviour change relevant to the stage an individual is in [2, 12].

Stage-based tailoring has been used as a basis for several smoking cessation programs [13, 14], as well as for interventions targeting other health behaviours [15, 16]. Over time, doubts have arisen regarding the viability of the stages of change as the underlying conceptualization of health promotion interventions [10, 17-19]. Stage-based interventions are based on the assumption that smokers in the same stage benefit from targeting the same psychological constructs [20, 21]. However, a recent review by Herzog suggest that contemplation consists of a mixture of smokers who are moderate to high in motivation to quit, causing within-stage heterogeneity [22]. This can be a possible indication of the stages not being mutually exclusive, but also of the contemplation stage of change being too comprehensive. A closer look should be taken at this stage to investigate whether it encompasses potential subtypes.

The idea that subtypes exist within stages has received considerable attention in recent studies [1-3, 23-26]. However, only three of these studies have focused on the contemplation stage [1-3]. In all three studies, four subtypes within contemplation were identified: the Classic contemplator (with above average scores on both the pros and cons of smoking, resulting in a cognitive conflict, and high scores on the perceived temptations to smoke), the Early contemplator (with a profile corresponding to precontemplation; scoring higher on the pros than on the cons of smoking and

perceiving average temptations to smoke), the Progressing contemplator (with a profile corresponding to preparation; with the cons outweighing the pros of smoking, and still perceiving average temptations to smoke) and a subtype demonstrating a lack of concern regarding both pros and cons and situational temptations, labelled Disengaged (scoring slightly below or above average on all scales). However, all studies clustered respondents based on the pros and cons of smoking and perceived temptations to smoke.

The current study is the first that addresses the replication of clusters within contemplation in a non-American sample. In addition, it is the first that uses cluster analysis based on the scores on three cognitive clustering variables directly related to cessation. On the basis of theoretical and empirical considerations [27-29] and on studies finding an inverse relationship between self-efficacy and temptation [30, 31], the pros of quitting, the cons of quitting, and self-efficacy to quit are treated as being complementary to the cons of smoking, pros of smoking, and temptation, respectively.. This assumption of complementarities between clustering variables used in this and in previous studies [1-3] makes it possible to compare the present study with earlier ones. However, according to the compatibility principle of Ajzen [32], predictors of a target behaviour should be measured in a similar manner as the target behaviour itself. As smoking cessation interventions aim at moving people towards quitting smoking, determinants of behaviour such as attitude and self-efficacy should also be measured with respect to quitting, not smoking. In correspondence with this principle, we expect that the use of clustering variables directly related to quitting will provide a more accurate cluster solution.

METHODS

Participants

Smokers were recruited to take part in a randomized controlled trial (RCT) investigating the effectiveness of a computer tailored smoking cessation program in Dutch general practices. Seventy-five general practices applied a passive recruitment method (posters were displayed in the waiting area and questionnaires were provided in a separate folder stand, leaving uptake to the smoker's initiative) during eight months and recruited 665 adult smokers (aged 18 years or older). Of these respondents, 84 (12.5%) were in precontemplation, 218 (32.4%) in contemplation, 265 (39.4%) in preparation and 102 (15.2%) were so called immotives [33]. Twenty-four respondents had missing values on any of the cluster variables and were therefore excluded from analyses, leaving a sample of 194 contemplators eligible for the present study. One hundred and forty-nine (76.8%) completed the six-month follow-up questionnaire. As no main effect of the intervention was found neither on 7-day point prevalence abstinence nor on continuous abstinence (having refrained from smoking since the previous measurement point), between conditions in the RCT [33], both respondents in the experimental group and in the control group were included in the present study. Full details about the recruitment and sampling procedure can be found in Hoving et al. [34].

Baseline measurement

Baseline characteristics were collected using a written questionnaire consisting of 54 questions based on the I-Change model [4]. This questionnaire has been tested

experimentally among Dutch smoking adults in previous studies [27, 34, 35]. Variables relevant to the present study included demographics, addiction level, the occurrence of cardiovascular and respiratory diseases, attitude, self-efficacy and the number of previous quit attempts, along with stage of change as a measure of the smoker's intention to quit.

Education was measured with one item, recoded into three categories: 'low' (1) = primary school/basic vocational school; 'medium' (2) = secondary vocational school/high school degree; and 'high' (3) = higher vocational school/college degree/university degree.

Addiction level was measured with three items: the tobacco product smoked, the amount of tobacco smoked daily (in number of cigarettes) and the time that elapses between getting out of bed and smoking (less than 5 minutes, between 6 and 30 minutes, 31 to 60 minutes and more than 60 minutes). Based on these three items, an addiction score was calculated and respondents were classified based on the abbreviated Fagerström scale [36], varying from 0=not addicted to 7=highly addicted.

The occurrence of cardiovascular and respiratory diseases was measured by one dichotomous item each, asking whether the respondent suffered from this disease (0=no; 1=yes).

The number of previous quit attempts was assessed with one item, asking the respondents how often they had tried to quit smoking in the past.

Pros of quitting were measured by 11 items. Statements were given with which a respondent could agree or disagree, measured on a 4-point Likert scale (0=disagree/do

not know; 1=somewhat agree; 2=agree; 3=fully agree) (e.g. 'When I quit smoking, my health will improve'; $\alpha=.84$).

Cons of quitting were measured by 5 items. Statements were given with which a respondent could agree or disagree, measured on a 4-point Likert scale (0=disagree/do not know; 1=somewhat agree; 2=agree; 3=fully agree) (e.g. 'When I quit smoking, I will gain weight'; $\alpha=.53$). This is comparable to the internal consistency of the cons-of-quitting subscale found in previous studies ($\alpha=.57$) [27, 35].

Self-efficacy was measured by 15 items (-2=disagree; 2=agree) asking respondents to indicate whether they would be able to refrain from smoking in various situations (e.g. when being angry, when being offered a cigarette; $\alpha=.90$).

Stage of change was measured with one item, asking respondents to state within what time span they intended to quit smoking on a 7-point scale (within 1 month, within 6 months, within 1 year, within 5 years, at some point but not within 5 years, never quit but smoke less or use tobacco products with lower nicotine and tar levels, or never quit nor smoke less nor use tobacco products with lower nicotine and tar levels). With regard to preparation, a slightly different definition was used than originally defined by the TTM [37]. In the TTM, preparation is defined as intending to quit within 1 month while having attempted to quit in the last year. However, according to this definition, contemplators who have never quit smoking cannot move to preparation, but will have to progress to action directly. Additionally, by including the criterion of having made a quit attempt in the last year, the stages of change paradigm does not solely measure intention to change behaviour, but also assesses actual behaviour change. Using the operationalizations proposed by the I-Change model [4], this criterion was abandoned in

the present study. As only smokers motivated to quit within 6 months, but not within 1 month were included, smokers in preparation were excluded.

Follow-up measurement

Six months after baseline, respondents were contacted by telephone and asked about their smoking status and their smoking activity since baseline.

Four outcome measures were assessed: *7-day point prevalence abstinence* (having refrained from smoking during the last 7 days; 0=no; 1=yes), *continued abstinence* (having refrained from smoking since the previous measurement point; 0=no; 1=yes), and *having made one or more serious quit attempts* (at least 24 hours of abstinence) *since the previous measurement point* (0=no; 1=yes).

Stage of change was measured again to determine whether the respondent had moved through the stages since baseline. *Stage transition* was defined as negative (-1), neutral (0) or positive (+1) [38].

Analysis

Cluster analysis is a statistical method used to group individuals into clusters in such a manner that individuals within one class are similar to each other with regard to specific variables, but unlike individuals in other classes [39, 40]. Clustering variables (pros and cons of quitting and self-efficacy) were measured at baseline and were standardized to z-scores. The squared Euclidian distance metric and Ward's minimum variance clustering algorithm were used as distance metric and clustering algorithm, respectively. Ward's method has been shown to be one of the more reliable methods within cluster

analysis and has been especially widely used in the behavioural sciences [41]. The squared Euclidian distance is the proximity measure it is most often applied with and reflects the level, profile shape and scatter of the cluster solution (compared with correlation measures, which only reflect the shape and scatter) [41].

Multiple methods were used to determine the number of clusters [2, 39]. First, inverse scree tests were conducted to provide an indication of the optimal number of clusters. Second, cluster profiles were visually inspected to determine their interpretability. Attention was paid to the shape, level and scatter of the separate cluster profiles [42]. Third, the stability of the cluster solutions was examined with non-hierarchical cluster analyses within random subsamples, each independently drawn from the total sample and consisting of approximately 50% of respondents.

To cross-sectionally compare the cluster solutions found, one-way ANOVA's with Tukey's HSD ad hoc comparisons were conducted to compare clusters for age, addiction level and the number of previous quit attempts. Chi-square tests were used to compare clusters regarding gender, educational level and suffering from a cardiovascular and/or respiratory disease. Furthermore, logistic regression analysis was used to test whether 7-day point prevalence abstinence, continued abstinence, and having made one or more serious quit attempts since the previous measurement point could be predicted by cluster membership at baseline. Comparisons were made, first with the cluster of Early Contemplators and second with the cluster of Progressing Contemplators as a reference category. In addition, multinomial logistic regression analysis was used to determine whether cluster membership had any predictive value with regard to stage transition (reference category=neutral). For longitudinal validation

of the clusters, missing values were replaced to avoid misleading artefacts because of drop-out. A sensitivity analysis was conducted, consisting of three different analyses. Both a negative scenario (respondents with missing values at six months follow-up were considered as smokers) and a positive scenario (respondents with missing values at six months follow-up were considered as non-smokers) were investigated and a complete-case analysis was conducted. Data was analyzed using SPSS 15.0.

RESULTS

Sample characteristics

The age of respondents included in the analyses varied from 18 to 79 years (Mean = 40.4; SD = 12.1). Women were slightly overrepresented (61.1%) and most respondents reported a medium level of education (secondary vocational school or high school; 55.6%). A description of the overall sample and respondents' scores on the cognitive variables on which cluster analysis was based, are presented in Table 1.

Cluster analysis

Inverse scree tests and examining the stability of different cluster solutions indicated that a three-cluster solution best represented the data. However, as a four cluster solution was consistently found in previous studies [1-3], we investigated both cluster solutions with regard to their interpretability.

For both cluster solutions, clusters differed significantly from each other with regard to pros and cons of quitting, and self-efficacy to quit ($p < 0.001$). The three cluster solution, though, replicated better across subsamples than the four cluster solution.

Cluster means and standard deviations are presented in Table 2 and 3 for the three cluster solution and the four cluster solution respectively. Figures 1 and 2 display the cluster profiles for the three and four clusters identified.

The investigation of the cluster solutions' interpretability indicated a three cluster solution over and above four clusters. Therefore, the following section only elaborates on the three clusters found.

Cluster 1 (N=46; 23.7%). The first cluster was labelled Progressing Contemplation. Smokers in this cluster scored a standard deviation above average on the pros of quitting, average on the cons of quitting and scored half a standard deviation above average on self-efficacy. For the Progressing Contemplator, pros of quitting outweighed the cons, while self-efficacy scores were relatively high.

Cluster 2 (N=53; 27.3%). The second cluster was labelled Early Contemplation. Smokers in this cluster scored slightly above the overall sample's average on the pros of quitting, more than a standard deviation above average on the cons of quitting and more than a standard deviation below average on self-efficacy. For Early Contemplators, the cons of quitting outweighed the pros and self-efficacy perceptions were low.

Cluster 3 (N=95; 49%). Smokers in the third cluster were labelled Disengaged Contemplators. The profile of the disengaged smoker was characterized by about half a standard deviation below average scores for both the pros and cons of quitting and average scores on self-efficacy.

Validation

Table 4 displays the results from the cross-sectional comparison of the clusters. A significant difference between the Early Contemplation cluster and the Disengaged cluster was found for addiction level ($F=9.338$; $df=2$; $p<0.001$). Disengaged smokers scored significantly lower on addiction level compared with Early Contemplating smokers. Therefore, regarding these two clusters, addiction level was taken into account as a confounder in regression analyses determining the predictive validity of the clusters on behavioural outcomes.

As is shown in Tables 5 and 6, cluster membership was not predictive of 7-day point prevalence abstinence, continued abstinence, having made one or more serious quit attempts since the previous measurement, or stage transition. Moreover, conducting effect analyses for each subtype separately using condition*subtype interaction terms did not yield any significant differences between the experimental and control group for any of the clusters separately. Results reported are based on a negative scenario, in which respondents lost to follow-up were considered as smokers. When repeating the analyses with a positive scenario or with complete cases only, results did not change (results not reported).

DISCUSSION

Main conclusions

The present study suggests that subtypes exist within the contemplation stage of change, which are comparable to those found in previous studies [1-3]. Three of four clusters could be replicated: Early, Progressing and Disengaged Contemplators. The Classic Contemplator as found previously [1-3] was not found within the present

sample. As this cluster could not be identified, doubts may arise whether the typical contemplator as suggested [9, 43] truly exists. One possible explanation for not finding the Classic Contemplator might be that the variables used for cluster analysis were directly related to smoking cessation (i.e. the desired behaviour), while previous studies used the pros and cons of smoking (i.e. the undesired behaviour). However, as longitudinal validation of the clusters was limited, support for the cluster solution found is not extremely strong yet.

Additional support for our three-cluster solution was obtained by cross-sectionally comparing the clusters. Disengaged smokers were significantly less dependent on nicotine than Early Contemplators. This finding corresponds with previous findings indicating that the Disengaged smoker seems to be a light smoker [1, 2]. Furthermore, the high degree of dependence among Early Contemplators in comparison with Disengaged smokers potentially explains why the former reported a lower score on self-efficacy. A previous study showed that the more dependent on nicotine a smoker is, the lower self-efficacy to quit and consequently the higher the risk of relapsing [44].

For the three clusters found, traditional interventions for contemplators might be inappropriate. Interventions targeting smokers in contemplation typically attempt to solve the cognitive conflict contemplators are said to experience [1, 9, 43, 45] by aiming at decreasing the perceived cons of quitting [20]. However, in our sample no contemplators were in such a cognitive conflict about their smoking behaviour. Only the Disengaged cluster showed a similar score on both pros and cons of quitting, though both scores were below average. Also a significant lack of self-efficacy, characteristic for the Classic Contemplator, was not observed within this group of smokers. The

Disengaged smoker thus might be able to change, but is not interested in changing. These smokers might benefit most from an intervention aimed at raising the pros of quitting, typically designed for precontemplators [20]. As interventions aimed at contemplators typically focus on lowering the cons, the appropriateness of stage based interventions may need to be re evaluated.

Recommendations

Based on the present study, several recommendations can be made for future research. First, no study to date has been able to fully understand the cluster of Disengaged Contemplators [1-3]. Within our study, almost half of the respondents could be considered Disengaged. As this is probably the cluster of smokers most difficult to change, this highlights the complex nature of smokers said to be in contemplation [43, 46]. Further research might need to start focusing more on Disengaged smokers. Perhaps these smokers would benefit from interventions focused on precontemplators, as these usually aim at increasing the perceived pros of quitting [20]. As they already perceive few cons of quitting and perceive a high self-efficacy to quit, they might then directly move to preparation. However, as no previous, quantitative studies have yet succeeded in explaining this cluster of smokers, qualitative research is vital to identify the variables that need to be addressed in smoking cessation interventions aimed at Disengaged smokers.

Second, there is a need for more research to investigate whether the typical contemplator as suggested in previous studies does truly exist, and consequently

whether the strategy usually used in stage-based interventions targeting smokers contemplating to quit is still tenable.

Third, together with prior studies focusing on subtypes within contemplation [1-3], this study can be considered the necessary first step in evaluating the viability of subtypes within contemplation. However, more work is required to evaluate the validity of this (sub)stage theory [12].

Fourth, it has been suggested previously that pre-action stages (precontemplation, contemplation and preparation) might not be qualitatively different [22] and that a continuous measure of intention is perhaps a better predictor of behavioural change than the stages of change [19]. Future studies could investigate the relative predictive power of the subtypes found in this and other studies, and compare these with continuous measures of motivation and readiness to change.

Limitations

This study is subject to certain limitations. First, the sample size was limited. This may have resulted in some non-significant results in the validation of the cluster solution. Moreover, the small sample size made sampling without replacement to examine the cluster solution's stability impossible. Therefore we have used sampling with replacement, potentially somewhat subsiding our findings. Also due to the relatively small sample, missing values had to be replaced for longitudinal validation of clusters. Yet, conducting the same analyses replacing missing values with a negative and a positive outcome and conducting complete-case analyses revealed similar results. This

indicates a certain robustness of our findings. However, repetition of the study with a larger sample is recommended.

Second, as is inherent to every research, it is possible that a selection bias has occurred. However, we do not expect that such a bias had a large influence on our results, as the original study was presented as a study about smoking, not about quitting. We therefore do not expect that certain smoker types were not willing to participate. Indeed, as described earlier, precontemplators, contemplators, preparers as well as immotives took part in the study.

Third, the reliability of the factor representing the cons of quitting was relatively low ($\alpha = .53$). As this factor has been critical for the formation of subtypes, it may have somewhat influenced the results, thus these have to be interpreted with caution. However, reliability was comparable in previous studies [33-35].

Fourth, we used a three-item measure of addiction level, derived from the abbreviated Fagerström scale [36]. Even though this abbreviated version has been well studied [36], the specific psychometric properties of the three-item measure are unknown.

Fifth, based on previous work [27, 47] and in line with many recent studies that have dropped the second criterion [10, 18, 48], we used a slightly different definition of the preparation stage of change than originally defined by the TTM [9]. Smokers who reported to be willing to quit smoking within a month, whether or not they had attempted to quit in the last year, were defined as preparers and thus excluded in the present study. This decision might have somewhat limited the comparative value of this study,

but as this criterion lately has received a lot of critique [10, 11] future studies within this field might consider using the same definition as has been used here.

Sixth, cluster analysis is a heuristic procedure; the interpretation of the results may have depended on the researcher's perspective. Though, using multiple methods to determine the number of clusters has limited its influence [2, 39].

Conclusion

Our study supports the idea that subtypes exist within the contemplation stage of change, though the Classic Contemplator as identified previously could not be replicated within the present sample. However, as the population studied consisted of smokers contemplating to quit, clustering variables used here were compatible with the behaviour change aimed at [32]. Therefore, it can be expected that the cluster solution presented in this paper was more accurate than those found in previous studies, using clustering variables related to smoking. Further research is necessary to confirm the subtypes found, which might provide an opportunity to further tailor smoking cessation interventions to the needs of groups of individuals with similar characteristics [1-3, 23, 24, 26].

FUNDING

This study was supported by the Dutch Organization for Health Research and Development [Grant number UM 2007-3834].

ACKNOWLEDGEMENTS

The authors would like to acknowledge the efforts made by the participating general practices and their participating patients. The study was conducted at the University of Maastricht in cooperation with STIVORO for a smoke-free future.

REFERENCES

1. Anatchkova MD, Velicer WF, Prochaska JO. Replication of subtypes for smoking cessation within the contemplation stage of change. *Addict Behav.* 2005;**30(5)**:915-927.
2. Norman GJ, Velicer WF, Fava JL, Prochaska JO. Cluster subtypes within stage of change in a representative sample of smokers. *Addict Behav.* 2000;**25(2)**:183-204.
3. Velicer WF, Hughes SL, Fava JL, Prochaska JO, DiClemente CC. An empirical typology of subjects within stage of change. *Addict Behav.* 1995;**20(3)**:299-320.
4. De Vries H, Mudde A, Leijts I, Charlton A, Vartiainen E, Buijs G, et al. The European Smoking prevention Framework Approach (EFSA): an example of integral prevention. *Health Educ Res.* 2003;**18(5)**:611-626.
5. Prochaska JO, DiClemente CC. Stages and processes of self-change of smoking: Toward an integrative model of change. *J Consult Clin Psych.* 1983;**51(3)**:390-395.
6. Schwarzer R. Modeling health behavior change: The Health Action Process Approach (HAPA). 2004 [cited 2008 23-04-2008]; Available from: <http://userpage.fu-berlin.de/~health/hapa.htm>
7. Weinstein ND, Sandman PM. The Precaution Adoption Process Model. In: Glanz K, editor. *Health Behavior and Health Education: Theory, Research and Practice*. San Francisco: Jossey-Bass; 2002. p. 121-143.
8. Fava JL, Velicer WF, Prochaska JO. Applying the transtheoretical model to a representative sample of smokers. *Addict Behav.* 1995;**20(2)**:189-203.

9. Prochaska JO, Redding CA, Evers KE. The Transtheoretical Model and Stages of Change. In: Glanz K, editor. *Health Behavior and Health Education: Theory, Research, and Practice*. San Francisco: Jossey-Bass; 1997. p. 99-120.
10. Sutton S. Back to the drawing board? A review of applications of the transtheoretical model to substance use. *Addiction*. 2001;**96(1)**:175-186.
11. West R. Time for a change: putting the Transtheoretical (Stages of Change) Model to rest. *Addiction*. 2005;**100(8)**:1036-1039.
12. Weinstein ND, Rothman AJ, Sutton SR. Stage theories of health behavior: conceptual and methodological issues. *Health Psychol*. 1998;**17(3)**:290-299.
13. Erol S, Erdogan S. Application of a stage based motivational interviewing approach to adolescent smoking cessation: the Transtheoretical Model-based study. *Patient Educ Couns*. 2008;**72(1)**:42-48.
14. Meyer C, Ulbricht S, Baumeister SE, Schumann A, Ruge J, Bischof G, et al. Proactive interventions for smoking cessation in general medical practice: a quasi-randomized controlled trial to examine the efficacy of computer-tailored letters and physician-delivered brief advice. *Addiction*. 2008;**103(2)**:294-304.
15. Johnson SS, Paiva AL, Cummins CO, Johnson JL, Dymant SJ, Wright JA, et al. Transtheoretical model-based multiple behavior intervention for weight management: effectiveness on a population basis. *Prev Med*. 2008;**46(3)**:238-246.
16. Johnson SS, Driskell MM, Johnson JL, Prochaska JM, Zwick W, Prochaska JO. Efficacy of a transtheoretical model-based expert system for antihypertensive adherence. *Dis Manag*. 2006;**9(5)**:291-301.

17. Heather N. Foreword. In: Davidson R, Rollnick S, MacEwan I, editors. *Counseling problem drinkers*. New York: Routledge; 1991. p. X-XI.
18. Littel JH, Girvin H. Stages of change: A Critique. *Behav Modif*. 2002;**26(2)**:223-273.
19. de Vet E, de Nooijer J, de Vries NK, Brug J. Comparing stage of change and behavioral intention to understand fruit intake. *Health Educ Res*. 2007;**22(4)**:599-608.
20. Dijkstra A, Conijn B, De Vries H. A match-mismatch test of a stage model of behaviour change in tobacco smoking. *Addiction*. 2006;**101(7)**:1035-1043.
21. Prochaska JO, Butterworth S, Redding CA, Burden V, Perrin N, Leo M, et al. Initial efficacy of MI, TTM tailoring and HRI's with multiple behaviors for employee health promotion. *Prev Med*. 2008;**46(3)**:226-231.
22. Herzog TA. Analyzing the transtheoretical model using the framework of Weinstein, Rothman, and Sutton (1998): the example of smoking cessation. *Health Psychol*. 2008;**27(5)**:548-556.
23. Anatchkova MD, Velicer WF, Prochaska JO. Replication of subtypes for smoking cessation within the precontemplation stage of change. *Addict Behav*. 2006;**31(7)**:1101-1115.
24. Anatchkova MD, Velicer WF, Prochaska JO. Replication of subtypes for smoking cessation within the Preparation stage of change. *Addict Behav*. 2006;**31(2)**:359-366.
25. de Vries H, van 't Riet J, Spigt M, Metsemakers J, van den Akker M, Vermunt JK, et al. Clusters of lifestyle behaviors: Results from the Dutch SMILE study. *Preventive Medicine*. 2007.

26. Dijkstra A, De Vries H. Clusters of precontemplating smokers defined by the perception of the pros, cons, and self-efficacy. *Addict Behav.* 2000;**25(3)**:373-385.
27. Dijkstra A, de Vries H, Bakker M. Pros and cons of quitting, self-efficacy, and the stages of change in smoking cessation. *J Consult Clin Psychol.* 1996;**64(4)**:758-763.
28. Prochaska JO, Velicer WF, Guadagnoli E, Rossi JS, Diclemente CC. Patterns of Change: Dynamic Typology Applied to Smoking Cessation *Multivariate Behavioral Research.* 1991;**26(1)**:83 - 107.
29. Prochaska JO, Velicer WF, Rossi JS, Goldstein MG, Marcus BH, Rakowski W, et al. Stages of change and decisional balance for 12 problem behaviors. *Health Psychol.* 1994;**13(1)**:39-46.
30. Diclemente CC, Prochaska JO, Gibertini M. Self-Efficacy and the Stages of Self-Change of Smoking. *Cognitive Therapy and Research.* 1985;**9(2)**:181-200.
31. Rabois D, Haaga DA. The influence of cognitive coping and mood on smokers' self-efficacy and temptation. *Addict Behav.* 2003;**28(3)**:561-573.
32. Ajzen I. *Attitudes, personality and behavior.* Milton Keynes: Open University Press; 1988.
33. Hoving C. The feasibility of a smoking cessation computer tailored expert system in Dutch general practice and community pharmacy setting. Maastricht: Maastricht University; 2007.
34. Hoving C, Mudde AN, de Vries H. Effect of recruitment method and setting on the composition of samples consisting of adult smokers. *Patient Educ Couns.* 2007;**65(1)**:79-86.

35. Dijkstra A, De Vries H, Roijackers J. Long-term effectiveness of computer-generated tailored feedback in smoking cessation. *Health Educ Res.* 1998;**13(2)**:207-214.
36. Heatherton TF, Kozlowski LT, Frecker RC, Fagerstrom KO. The Fagerstrom Test for Nicotine Dependence: a revision of the Fagerstrom Tolerance Questionnaire. *Br J Addict.* 1991;**86(9)**:1119-1127.
37. DiClemente CC, Prochaska JO, Fairhurst SK, Velicer WF, Velasquez MM, Rossi JS. The process of smoking cessation: an analysis of precontemplation, contemplation, and preparation stages of change. *J Consult Clin Psychol.* 1991;**59(2)**:295-304.
38. Dijkstra A, De Vries H, Roijackers J, van Breukelen G. Tailored interventions to communicate stage-matched information to smokers in different motivational stages. *J Consult Clin Psychol.* 1998;**66(3)**:549-557.
39. Everitt B. *Cluster Analysis*. London: Heinemann Educational Books; 1980.
40. Field A. *Postgraduate Statistics: Cluster Analysis*. Postgraduate Statistics; 2000.
41. Borgen FH, Barnett DC. Applying Cluster Analysis in Counseling Psychology Research. *J Couns Psych.* 1987;**34(4)**:456-468.
42. Cronbach LJ, Gleser GC. Assessing similarity between profiles. *Psychol Bull.* 1953;**50(6)**:456-473.
43. Velicer WF, Norman GJ, Fava JL, Prochaska JO. Testing 40 predictions from the transtheoretical model. *Addict Behav.* 1999;**24(4)**:455-469.
44. Ockene JK, Mermelstein RJ, Bonollo DS, Emmons KM, Perkins KA, Voorhees CC, et al. Relapse and maintenance issues for smoking cessation. *Health Psychol.* 2002;**19(1)**:17-31.

45. Prochaska JO, Velicer WF, Redding C, Rossi JS, Goldstein M, DePue J, et al. Stage-based expert systems to guide a population of primary care patients to quit smoking, eat healthier, prevent skin cancer, and receive regular mammograms. *Prev Med.* 2005;**41(2)**:406-416.
46. Hoving EF, Mudde AN, de Vries H. Smoking and the O pattern; predictors of transitions through the stages of change. *Health Educ Res.* 2006;**21(3)**:305-314.
47. De Vries H, Mudde AN, Dijkstra A, Willemsen MC. Differential beliefs, perceived social influences, and self-efficacy expectations among smokers in various motivational phases. *Prev Med.* 1998;**27(5 Pt 1)**:681-689.
48. Dijkstra A, Roijackers J, De Vries H. Smokers in four stages of readiness to change. *Addict Behav.* 1998;**23(3)**:339-350.

TABLES

Table 1
A description of the overall sample at baseline (N=194)

Variables	
Demographics	
Gender	
Male (%)	38.9
Age (Mean; S.D.)	40.4; 12.1
Educational level	
Low (%)	20.4
Medium (%)	55.6
High (%)	24.1
Addiction level (Mean; S.D.)#	3.3; 1.5
Cardiovascular disease	
Yes (%)	4.2
Respiratory disease	
Yes (%)	20.8
Cognitive variables	
Pros of quitting (Mean; S.D.)~	1.96; .60
Cons of quitting (Mean; S.D.)~	1.24; .61
Self-efficacy to quit (Mean; S.D.)^	-.25; .78
Smoking related behaviour	
Number of previous quit attempts (Mean; S.D.)	2.5; 2.9

Note: # addiction level varied from 0=not addicted to 7=highly addicted; ~ pros of quitting (11 items) and cons of quitting (5 items) were measured on a 4-point Likert scale (0=disagree/do not know; 1=somewhat agree; 2=agree; 3=fully agree); ^ self-efficacy to quit (15 items) was measured on a 5-point Likert scale (-2=disagree; 2=agree).

Table 2
Cognitive clustering variables in standardized z-scores (mean = 0; standard deviation (S.D.) = 1) for the three clusters found

	Total sample (N=53)			Tukey HSD Pattern
	1. Early (N=53)	2. Progressing (N=46)	3. Disengaged (N=95)	
Pros of quitting	.34; .83	.94; .42	-.40; .86	3<1<2***
Cons of quitting	1.10; .64	.18; .72	-.41; .72	3<2<1***
Self-efficacy to quit	-1.05; .47	.65; .81	.05; .780	1<3<2***
Random subsample 1 (N=34)	1. Early (N=34)	2. Progressing (N=41)	3. Disengaged (N=29)	Tukey HSD Pattern
Mean; S.D.	Mean; S.D.	Mean; S.D.	Mean; S.D.	
Pros of quitting	.70; .60	.49; .72	-.87; .63	3<1, 2*
Cons of quitting	1.13; .62	-.11; .69	-.40; .68	3<2<1*
Self-efficacy to quit	-.58; .58	.53; 1.01	-.40; .83	1<3<2***
Random subsample 2 (N=24)	1. Early (N=24)	2. Progressing (N=25)	3. Disengaged (N=59)	Tukey HSD Pattern
Mean; S.D.	Mean; S.D.	Mean; S.D.	Mean; S.D.	
Pros of quitting	1.03; .52	.96; .32	-.44; .77	3<2***, 3<1***
Cons of quitting	1.28; .67	-.52; .62	-.00; .81	2<1***, 3<1***
Self-efficacy to quit	-1.10; .57	.66; .95	-.00; .80	3<2***, 1<2***
Random subsample 3 (N=25)	1. Early (N=25)	2. Progressing (N=29)	3. Disengaged (N=52)	Tukey HSD Pattern
Mean; S.D.	Mean; S.D.	Mean; S.D.	Mean; S.D.	
Pros of quitting	.16; .91	.92; .40	-.45; .79	3<1<2**
Cons of quitting	1.13; .51	.18; .71	-.46; .73	3<2<1***
Self-efficacy to quit	-1.07; .53	.65; .68	-.02; .83	1<3<2***

Note * p < 0.05; ** p < 0.01; *** p < 0.001.

Table 3
Cognitive clustering variables in standardized z-scores (mean = 0; standard deviation (S.D.) = 1) for a four cluster solution

	1. Early (N=53)	2. Progressing (N=46)	3. Disengaged I (N=39)	4. Disengaged II (N=56)	
Total sample	Mean; S.D.	Mean; S.D.	Mean; S.D.	Mean; S.D.	Tukey HSD Pattern
Pros of quitting	.34; .83	.94; .42	.20; .75	-.82; .67	4<1,3<2***
Cons of quitting	1.10; .64	.18; .72	-.74; .56	-.18; .73	3<4<2<1**
Self-efficacy to quit	-1.05; .47	.65; .81	-.49; .56	-.42; .69	1<3<2,4***
Random subsample 1	1. Early (N=28)	2. Progressing (N=27)	3. Disengaged I (N=16)	4. Disengaged II (N=28)	Tukey HSD Pattern
Mean; S.D.	Mean; S.D.	Mean; S.D.	Mean; S.D.	Mean; S.D.	
Pros of quitting	.41; .74	.60; .62	-.75; .52	-1.01; .62	4<3,1,2***
Cons of quitting	.90; .59	.09; .59	-.43; .42	-.48; .66	4,3,2<1*
Self-efficacy to quit	-.90; .49	.72; .46	-.52; .40	-.09; .89	1,3,4<2***, 1<4***
Random subsample 2	1. Early (N=19)	2. Progressing (N=36)	3. Disengaged I (N=30)	4. Disengaged II (N=20)	Tukey HSD Pattern
Mean; S.D.	Mean; S.D.	Mean; S.D.	Mean; S.D.	Mean; S.D.	
Pros of quitting	.79; .81	.40; .60	-.14; .81	-1.11; .82	4<3<2***, 3<1*
Cons of quitting	1.28; .76	.33; .51	-.67; .67	-.44; .68	3,4<2<1***
Self-efficacy to quit	-1.04; .41	-.18; .52	.86; .52	-.75; .66	4,1<3<2***
Random subsample 3	1. Early (N=10)	2. Progressing (N=21)	3. Disengaged I (N=28)	4. Disengaged II (N=25)	Tukey HSD Pattern
Mean; S.D.	Mean; S.D.	Mean; S.D.	Mean; S.D.	Mean; S.D.	
Pros of quitting	.29; .82	.74; .60	.72; .68	-1.15; .49	4<3,1,2**
Cons of quitting	1.66; .43	-.49; .60	.36; .53	-.34; .73	4,2<3<1***
Self-efficacy to quit	-1.05; .48	1.00; .84	-.32; .52	.05; .77	1<3*, 1<4<2***

Note * p < 0.05; ** p < 0.01; *** p < 0.001.

Table 4.
Cross-sectional comparison of the cluster solution: comparing clusters in terms of items concerning demographics, addiction level, the occurrence of cardiovascular and respiratory diseases and the number of previous quit attempts

Variables	1. Early (N=53)			2. Progressing (N=46)			3. Disengaged (N=95)			Chi- square (df)	F (df)	Tukey/HSD pattern
	Mean	S.D.	Range	Mean	S.D.	Range	Mean	S.D.	Range			
Gender (% male)	32.1			41.3			41.5			1.42 (2)	1.50 (2)	ns
Age (Mean; S.D.)	38.81; 10.43			39.15; 11.48			41.96; 13.09			4.90 (4)		
Educational level												
Low (%)	29.2			11.8			18.8				.	.
Medium (%)	54.2			58.8			55.0				.	.
High (%)	16.7			29.4			26.3				.	.
Addiction level (Mean; S.D.) #	3.96; 1.55			3.44; 1.21			2.93; 1.56			.	8.34 (2)	1->3*
Cardiovascular disease (% yes)	5.7			-			5.3			2.50 (2)		
Respiratory disease (% yes)	26.4			15.9			20.0			1.69 (2)		
Number of previous quit attempts (Mean; S.D.)	3.21; 3.88			2.26; 1.72			2.18; 2.66			.	2.34 (2)	ns

Note: . = not applicable; ns = non-significant; * p < 0.05; ** p < 0.01; *** p < 0.001.

Table 5.
 Predictive validity of contemplation subtypes with regard to three measures of smoking behaviour change

	7-day point prevalence abstinence			continued abstinence			24-hour quit attempt		
	OR	R ²	95% CI	OR	R ²	95% CI	OR	R ²	95% CI
Reference category: Early Contemplators									
Step 1		.022			.025			.005	
Progressing	2.15		.59 7.90	3.05		.56 16.54	.69		.27 1.72
Disengaged	2.31		.72 7.36	2.35		.48 11.52	.86		.40 1.83
Step 2									
Progressing	2.06		.56 7.58	3.66		.65 20.48	.63		.25 1.61
Disengaged	2.09		.63 6.90	3.15		.61 16.34	.73		.33 1.62
Addiction level	.91		.68 1.20	1.32		.89 1.96	.86		.69 1.07
Reference category: Progressing Contemplators									
Step 1		.022			.025			.005	
Disengaged	1.07		.40 2.84	.77		.24 2.51	1.25		.54 2.90
Early	.46		.13 1.70	.33		.06 1.78	1.46		.58 3.67
Step 2									
Disengaged	1.02		.38 2.73	.86		.26 2.83	1.16		.49 2.71
Early	.49		.13 1.80	.27		.05 1.53	1.58		.62 4.00
Addiction level	.91		.68 1.20	1.32		.89 1.96	.86		.69 1.07

Note: * p < 0.05; ** p < 0.01; *** p < 0.001.

Table 6.
 Predictive validity of contemplation subtypes with regard to transition through the stages of change

	Positive stage transition (N=55)				Negative stage transition (N=28)			
	OR	R ²	Lower 95% CI	Upper 95% CI	OR	R ²	Lower 95% CI	Upper 95% CI
Early vs. Disengaged	1.28	.008	.59	2.77	1.60	.008	.62	4.10
Early vs. Disengaged Addiction level	1.57		.68	3.59	1.83		.67	5.00
Early vs. Progressing Addiction level	.83		.65	1.06	.88		.65	1.19
Early vs. Progressing	1.28	.018	.52	3.15	2.07	.018	.63	6.86
Early vs. Progressing Addiction level	1.39		.55	3.51	2.14		.63	7.26
Disengaged vs. Progressing	.91		.65	1.25	1.01		.67	1.53
Disengaged vs. Progressing Addiction level	1.00	.002	.45	2.24	.77	.002	.25	2.37
Disengaged vs. Progressing Addiction level	1.02		.45	2.33	.74		.24	2.30
Disengaged vs. Progressing Addiction level	.90		.69	1.17	1.02		.72	1.45

Note reference category is neutral (no transition) (N=111); * p < 0.05; ** p < 0.01; *** p < 0.001.

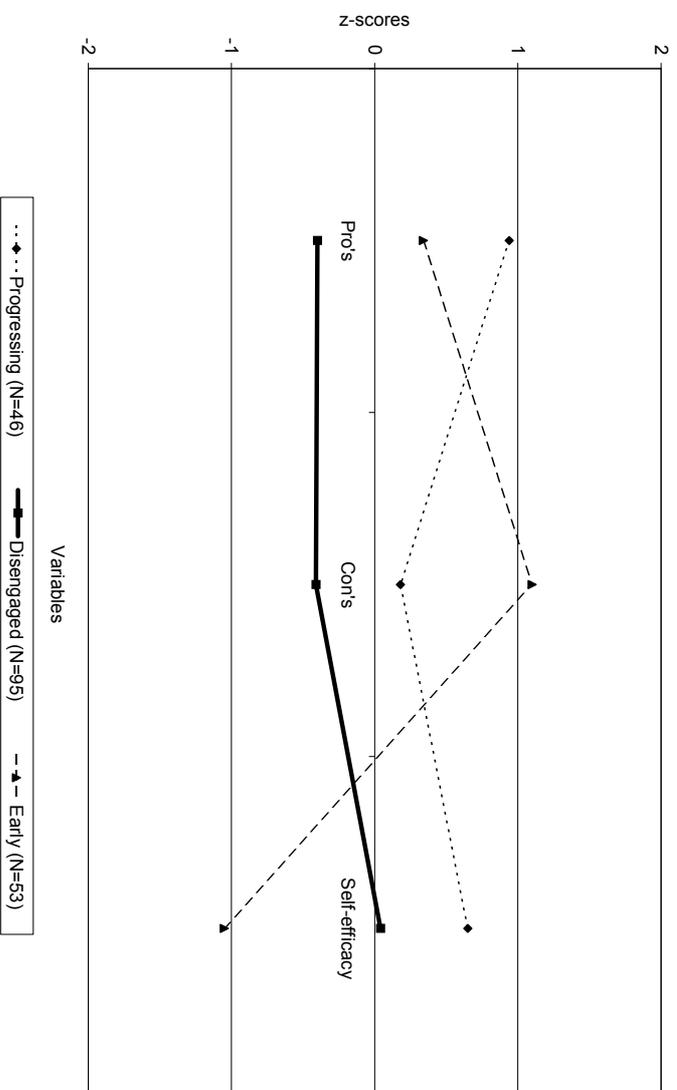


Figure 1. Cluster profiles for the three clusters identified within the three cluster solution

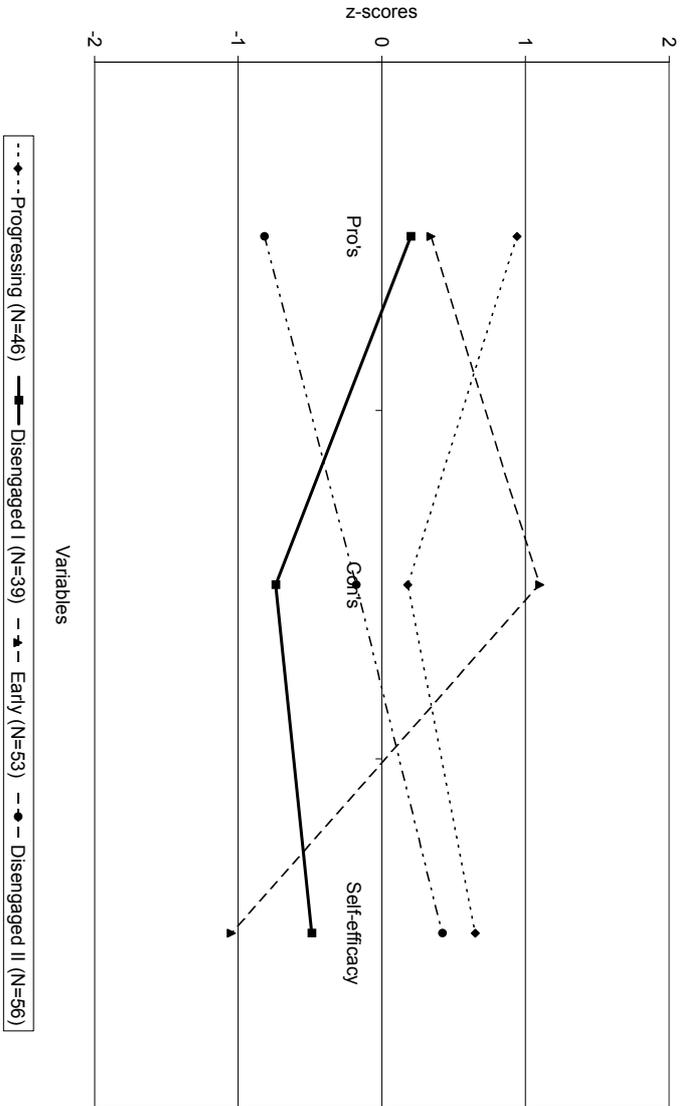


Figure 2. Cluster profiles for the four clusters identified within the four cluster solution