



## Replication of subtypes for smoking cessation within the contemplation stage of change

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### Abstract

*Objective:* Tailored interventions based on stage of change and other Transtheoretical Model constructs have been effective for promoting smoking cessation. Recent cluster analyses based on the Pros and Cons from the Decisional Balance and the Situational Temptations measures performed within the stages have suggested the existence of distinct cluster subtypes. Cluster subtypes would permit the development of tailored interventions focusing on these subtypes. This study attempts to replicate cluster subtypes within the Contemplation stage of change in a secondary analysis of data from a sample of current smokers ( $N=3967$ ).

*Method:* Four random samples of 400 were selected from the 1734 Contemplators. The cluster analyses were performed using the Pros, Cons, and Situational Temptations. Interpretability of the pattern, pseudo- $F$ -test, and dendograms were used to determine the number of clusters.

*Results:* Four distinct cluster subtypes (Classic Contemplators, Progressing, Early Contemplators, and Disengaged) were found and replicated across samples. The clusters were externally validated using the 10 Processes of change and 2 smoking behavior variables (cigarettes per day and time before first morning cigarette). Statistically significant ( $p<0.05$ ) multivariate effects were found for the 10 Processes of change in all four samples. The cluster groups differed on 7 or more of the processes in each sample. Significant multivariate effects were also found for the smoking behavior variables in all samples ( $p<0.001$ ).

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*Conclusions:* The cluster patterns closely replicate earlier findings and provide evidence for the existence of clusters subtypes within the Contemplation stage of change.

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## 1. Introduction

The Transtheoretical Model of behavior change (Prochaska & DiClemente, 1983; Prochaska & Velicer, 1997; Velicer et al., 2000) is one of the influential frameworks of behavior change within which a large number of population-based interventions for smoking cessation have been successfully developed. The model has been conceptualized as involving three key dimensions: the temporal, represented by the Stages of change; the dependant variable dimension, which includes the constructs of Decisional Balance, Situational Temptations, and behavioral measures; and the independent variables dimension, which includes the Processes of change (Velicer, Prochaska, Fava, Norman, & Redding, 1998).

The best known of these is the temporal organizing construct of the Stages of Change. It represents the intention and readiness to change a target behavior. The model defines five distinct stages in the smoking cessation process (precontemplation (PC), contemplation (C), preparation (PR), action, and maintenance). Based on the stages of change construct, TTM-based programs provide interventions that are tailored to participants' readiness to change, instead of the general "one fits all" approach often employed in population-based programs (Norman, Velicer, Fava, & Prochaska, 2000). Although tailored interventions based on stage of change are a step away from the low efficacy of the one group approach, the number of interventions that can be designed is still rather limited. In recent years, the idea of designing interventions for subgroups within each stage has been explored by a number of studies (Norman et al., 2000; Velicer, Hughes, Prochaska, & DiClemente, 1995). The subtypes within each stage are determined through cluster analysis based on three constructs: Pros, Cons, and Situational Temptations. This approach increases the number of potential interventions by a factor of 4 or 5 (Norman et al., 2000).

In the first empirical investigation of the stage subtypes idea, Velicer et al. (1995) identified four distinct profiles within each of the first four stages of change in convenience sample of smokers. The subgroup with a profile most closely corresponding to the stage was labeled Classic, a profile corresponding to the previous stage was labeled Early and a profile corresponding to the next stage was designated as Progressing. A subgroup demonstrating lack of interest and detachment in the cognitive and physiological aspects of smoking and situational temptations were called Disengaged.

Five years later, Norman et al. (2000) published a replication of these finding within the first three stages, using a large representative sample of adult smokers. The study produced cluster profiles similar to the first study. In general, the two papers provided evidence for the existence of stage subtypes that can be used as a complementary typology system in the design of new tailored interventions.

### *1.1. Cluster analysis*

The studies described above, as well as the current study, use cluster analysis to determine the number of subgroups within each stage. Cluster analysis is used to discover groups or subtypes of homogeneous observations in a multivariate data set (Everitt, Landau, & Leese, 2001). This analysis can be described as an empirical method of classification, which leads to more objective and stable results than narrative taxonomy procedures. Such classifications provide a useful summary of the data and within the field of medicine can be used to separate disease with different etiology, which require differential treatment (Everitt et al., 2001). Cluster analysis can be viewed as a method of exploratory data analysis (Behrens & Yu, 2003).

Cluster analysis is particularly appropriate for identifying subgroups that could benefit from tailored interventions. In the studies discussed above, hierarchical clustering was employed. The classification goes through a series of fusions, running from a single individual through a small number of clusters and ending with a single cluster containing all the individuals so that cluster analysis proceeds from the individual level to the group level with data determining the patterns. The intermediate level is appropriate for tailored interventions. Clusters retain the full configurational information; that is, the pattern of high scores and low scores that is unique to each cluster.

Several steps with corresponding requirements have been described as generally constituting cluster analysis (Everitt et al., 2001; Milligan, 1996). These steps from careful variable selection to the choice of a stopping rule were followed in the current study and the details are described below.

### *1.2. Overview of the current study*

The goal of the current study is to try to replicate the findings of cluster subtypes within the Contemplation stage of change for smoking cessation reported by Norman et al. (2000). The Contemplation stage is characterized by an intention to change behavior in the next 6 months. People in this stage are usually aware both of the pros and cons of changing and due to this balance between the benefits and barriers many people stay in this stage for long time, becoming “chronic contemplators” (Velicer et al., 1998). The study follows the steps and procedures described in Norman et al. (2000), but uses a bigger sample that allows for a larger number of replications. The internal validity was established on four random samples of Contemplators. The study can provide additional evidence for the existence of theoretically interpretable, internally consistent and externally valid cluster subtypes within the Contemplation stage.

## **2. Method**

### *2.1. Participants*

The present study is a secondary data analysis. The initial sample was recruited after a screening was completed on 19,236 adults in four offices of a managed care system via mail and

telephone surveys. Out of these, 4653 were identified as smokers with no serious illness, between the ages of 18 and 75, and were competent in English. Total of 85.3% of the eligible subjects ( $N=3967$ ) were recruited at baseline. The stage distribution of the sample was Precontemplation (PC), 1480 (37.3%), Contemplation (C) 1775 (44.7%), and Preparation (PR), 712 (17.9%). The primary results of the two studies based on this sample can be found elsewhere (Prochaska et al., 2001; Velicer, Prochaska, Fava, Laforge, & Rossi, 1999). Only the data of participants in the Contemplation stage of change were used for the current analysis. The average age of the Contemplation subgroup was 38.4 years and 56.1% of the samples were female.

## 2.2. Measures

The battery of measures administered at baseline included the Pros of Smoking and Cons of Smoking from the Decisional Balance Inventory (Velicer, DiClemente, Prochaska, & Brandenburg, 1985) and the total score from the Situational Temptations Inventory (Velicer, DiClemente, Rossi & Prochaska, 1990). These three variables were the basis for the cluster analysis. Also administered at baseline were the 10 Processes of Change (Prochaska, Velicer, DiClemente, & Fava, 1988). Two smoking behavior items measured the number of cigarettes smoked per day during the last week and the time elapsed before the first cigarette of the day (Fagerstrom, 1978). These were used in the external validation of the clusters.

## 2.3. Procedure

### 2.3.1. Sample selection

Participants in the Contemplation stage with missing data on any of the key variables were excluded from the study. The remaining 1734 subjects were randomly divided into four samples of approximately 400 subjects each and a cluster analysis was performed with each sample independently to assess the stability and replicability of the clusters.

### 2.3.2. Variable selection

The variables employed in the cluster analysis were the same used in the Norman et al. (2000) and Velicer et al. (1985) studies, the Pros of Smoking and Cons of Smoking from the Decisional Balance Inventory, and the total score from the Situational Temptations Scale.

### 2.3.3. Standardization of variables

The three variables used in each cluster analysis were standardized to  $T$ -scores (Mean ( $M$ )=50; standard deviation (S.D.)=10). Standardization was performed across the entire sample of 1734 subjects and served both to equalize the contribution of each variable and to put the variables on a comparable metric.

### 2.3.4. Distance metric and clustering algorithm

All analyses were performed using the squared Euclidean distance metric and Ward's (1963) minimum variance algorithm. Euclidean distance metric was chosen because of its sensitivity to the cluster profile characteristics of shape, level, and scatter (Cronbach & Gleser, 1953;

Edelbrock, 1979). Ward's algorithm is a hierarchical agglomerative procedure that has performed well in simulation studies (Blashfield, 1976; Milligan, 1980; Milligan & Cooper, 1987; Milligan & Hirtle, 2003).

#### 2.3.5. Determining the number of clusters

Inverse scree test (Lathrop & Williams, 1987, 1989) and the pseudo-*F*-test (Calinski & Harabasz, 1974) were used to narrow the range of cluster solutions that would be interpreted. As a next step, visual inspection of the cluster profiles was performed with a focus on the shape (configuration of scores), level (the mean score of the variables), and scatter (the standard deviation) of the profiles.

#### 2.3.6. External validation

Cluster analysis interpretation and replication establishes the internal validity of the cluster. The relation between cluster membership and variables not included in the development of the clusters provides external validation. Cluster membership served as the independent variable in series of multivariate analyses of variances (MANOVAs). Significant multivariate results were followed by univariate analysis of variance (ANOVA) and post hoc Tukey's tests. For this study, two different variable sets were employed as the dependant variables: (1) two variables assessing smoking behavior and (2) 10 Processes of Change scales. The smoking behavior items measured the number of cigarettes smoked per day during the last week and the time elapsed before the first cigarette of the day (Fagerstrom, 1978). The Processes of change are the activities that people employ to change their behavior. There are two distinct groups of processes: behavioral and experiential (Prochaska et al., 1988). These variables were appropriate for establishing external validation of the cluster solution because they have theoretical relevance to the clustering variables.

### 3. Results

#### 3.1. Cluster analysis

The same procedure was used to determine the number of clusters in each of the four Contemplation samples. The decision rules indicated that three to five clusters were the optimum solution. The three, four, and five cluster solutions were evaluated in each of the four samples. Four clusters were found to describe the data best in each of the four samples and the solution replicated well across the samples. The cluster means and standard deviations are presented in Table 1. The cluster profiles generally replicated the findings of Norman et al. (2000) and the same cluster labels were retained for clarity. The cluster profiles for the four samples are illustrated in Fig. 1.

##### 3.1.1. Cluster 1

The first cluster was labeled *Classic Contemplators*. The profile was generally flat with low scatter and high level. The scores are about one standard deviation above the mean on all

Table 1

Means and standard deviations (S.D.) for the four clusters in the four samples for the pros, cons, and temptation scales

	Sample 1 (N=400)		Sample 2 (N=400)		Sample 3 (N=400)		Sample 4 (N=400)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
<i>Pros</i>								
1. Classic	57.92	6.0	58.69	5.0	62.45	3.7	63.52	3.8
2. Early	50.83	5.9	50.22	5.0	48.05	4.7	48.75	5.6
3. Progressing	48.19	4.9	46.15	5.0	50.64	5.6	41.39	3.2
4. Disengaged	42.06	3.6	43.08	4.3	42.60	4.6	53.02	5.5
<i>Cons</i>								
1. Classic	54.43	6.3	56.55	5.3	51.93	7.0	55.43	4.4
2. Early	43.34	4.5	48.93	5.5	44.8	4.8	55.72	4.8
3. Progressing	55.99	4.2	59.42	4.0	56.56	4.6	47.77	6.2
4. Disengaged	46.48	6.0	44.44	6.4	48.37	8.9	44.47	5.3
<i>Temptation</i>								
1. Classic	58.36	4.6	56.31	5.1	57.87	6.2	58.74	4.9
2. Early	50.87	4.6	51.25	5.2	49.23	5.4	51.09	5.8
3. Progressing	49.02	4.5	51.24	6.7	53.5	4.8	41.44	6.3
4. Disengaged	41.59	4.3	42.76	6.6	40.18	5.3	52.19	5.9

scales, illustrating the ambivalence of the person in Contemplation. People in this cluster are highly tempted to smoke and the high score on Pros and Cons create a cognitive conflict. This subgroup most closely corresponds to the profile of a person in the Contemplation stage of change. The classic profile for this cluster replicated very well across three of the samples. In Sample 3, there was more scatter and the Cons were lower than expected.

### 3.1.2. Cluster 2

The second cluster was labeled *Early Contemplators*. It resembles the profile of a Precontemplator more than that of a Contemplator. It has a “V” shape, with average scores for Pros of Smoking and Temptations and below average scores for Cons. The profile is at a medium overall level and demonstrates only a medium degree of scatter. Smokers in this cluster still value the Pros of smoking higher than the Cons of Smoking. The pattern replicated well across the samples, but with a somewhat lower scatter than expected in Samples 2 and 3.

### 3.1.3. Cluster 3

The third cluster was labeled *Progressing*. The shape is more similar to smokers in the Preparation rather than the Contemplation stage. The profile is an inverted “V” shape, with moderate scatter and medium to high overall level. The scores for Pros and Temptations are about average, while the Cons are about half a standard deviation above average. An important difference for people in this cluster is that the Cons outweigh the Pros of smoking, indicating the readiness of people in this cluster to make more changes. The decrease in the

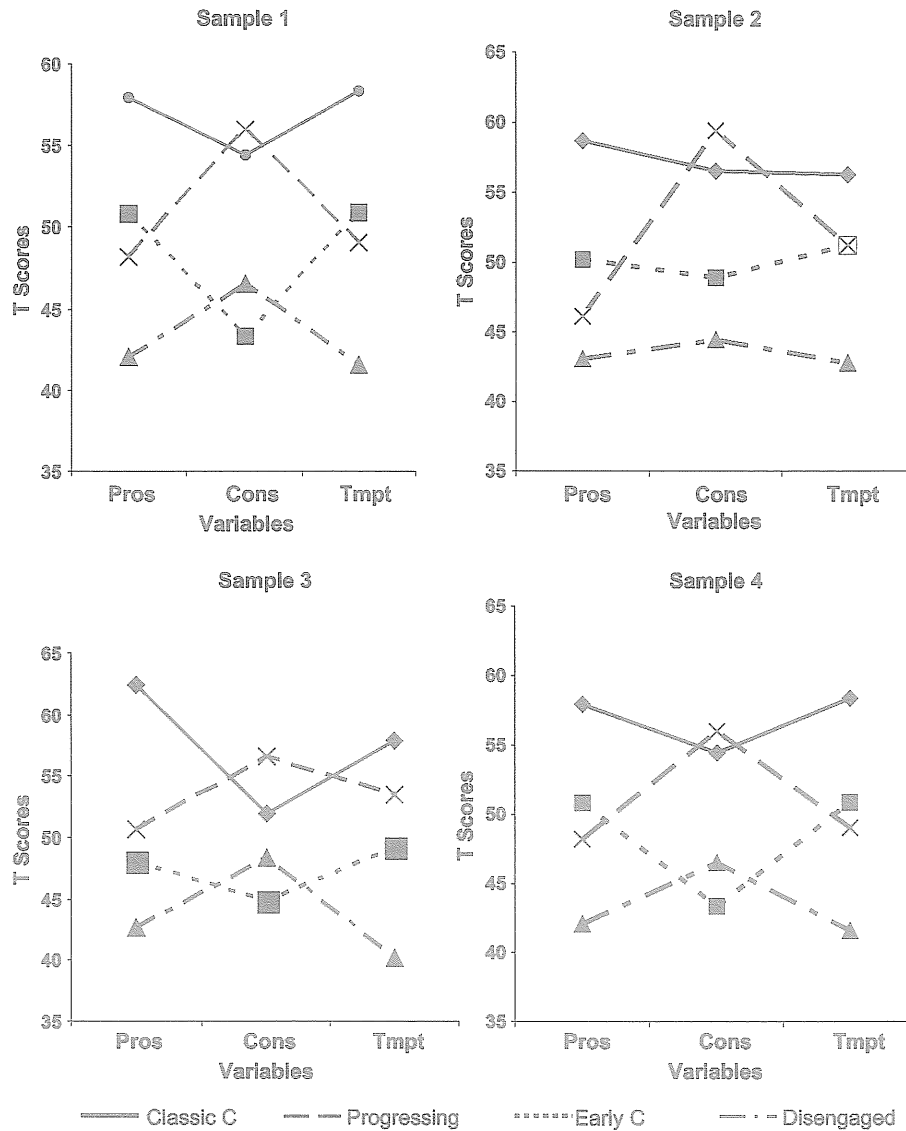


Fig. 1. Cluster profiles across the four samples.

Temptations indicates an increased ability to make a successful quit attempt. The cluster replicated well across all four samples.

### 3.1.4. Cluster 4

The fourth cluster was labeled *Disengaged*. The profile is a shallow inverted “V” shape, at a low level and with low scatter. The Cons were about half a standard deviation below average and the Pros and Temptations were a standard deviation below average. This profile replicated well across all samples.

### 3.2. *External validation: smoking behavior variables*

Significant multivariate effects were found by a MANOVA on the smoking behavior variables in all samples (Sample 1, Wilk's  $\Lambda=0.860$ ,  $p<0.001$ ; Sample 2, Wilk's  $\Lambda=0.906$ ,  $p<0.001$ ; Sample 3, Wilk's  $\Lambda=0.948$ ,  $p<0.05$ ; and Sample 4, Wilk's  $\Lambda=0.927$ ,  $p<0.001$ ).

These significant results were followed by two separate ANOVAs. Cluster subtypes differed significantly in all four samples on the first indicator of smoking behavior, number of cigarettes smoked (see Table 2). Small to medium effect sizes (Cohen, 1988) were found across the four samples. A post hoc Tukey's test confirmed previous findings. Participants in the Disengaged cluster reported smoking the lowest number of cigarettes, while the Classic contemplators reported smoking the most in all four samples. The mean values of participants in the other two clusters positioned them between the Classic contemplators and the Disengaged, although significant differences were present only between the Early Contemplators and the Disengaged in Sample 1 and between the Early Contemplators and the Progressing and Disengaged in Sample 2.

The ANOVA also found significant differences for the number of minutes waited before the first cigarette was smoked (see Table 2). The effect sizes were in the medium range. Follow-up Tukey's tests revealed that people in the Disengaged cluster were waiting the longest before they smoked in all samples. In Sample 2, even finer differences were detected, where people in the Disengaged cluster waited an average of about an hour and a half, followed by the Early and Progressing clusters with averages of about 50 min. People in the Classic cluster were most impatient with an average of 22.8 min before their first cigarette in the morning. These results are consistent with previous findings, confirming the interpretation that the people in the Disengaged cluster are lighter smokers.

### 3.3. *External validation: processes of change*

A multivariate analysis of variance indicated significant multivariate effects for the 10 Processes of change in all four samples (Sample 1, Wilk's  $\Lambda=0.608$ ,  $p<0.001$ ; Sample 2, Wilk's  $\Lambda=0.676$ ,  $p<0.001$ ; Sample 3, Wilk's  $\Lambda=0.730$ ,  $p<0.001$ ; and Sample 4, Wilk's  $\Lambda=0.753$ ,  $p<0.001$ ).

In Sample 1, the 10 separate ANOVAs revealed significant differences among clusters in the use of eight of the 10 processes (Table 2). No differences among clusters were discovered in the use of Helping Relationship and Self-Liberation. The effect sizes for the significant processes ranged from medium to high. For half of these processes, follow-up Tukey's tests demonstrated equivalent pattern of mean differences in which people in the Classic and the Progressing clusters had higher mean process use than people in the Early and Disengaged clusters. People in the Progressing cluster consistently had significantly higher means across all processes that had significant ANOVA results and the same tendency was present in the processes where no significant differences were detected.

In Sample 2, the 10 separate ANOVAs revealed significant differences among clusters in the use of seven of the processes. The Tukey's pattern described in Sample 1 was replicated

Table 2  
ANOVA results and cluster differences for the smoking behavior items and process of change across four samples

	Sample 1		Sample 2		Sample 3		Sample 4	
	Univariate F	Tukey's HSD pattern	Univariate F	Tukey's HSD pattern	Univariate F	Tukey's HSD pattern	Univariate F	Tukey's HSD pattern
<i>Smoking behavior by cluster</i>								
Cigarettes per day	( $F=13.83^*$ , $\eta^2=0.097$ )	1>4, 3, 2>4	( $F=5.55^*$ , $\eta^2=0.041$ )	1, 3>2, 4	( $F=2.73^*$ , $\eta^2=0.021$ )	1>4	( $F=5.93^*$ , $\eta^2=0.043$ )	1>2, 3, 4
Minutes to first cigarette	( $F=9.92^*$ , $\eta^2=0.071$ )	4>3, 1	( $F=10.46^*$ , $\eta^2=0.074$ )	4>3=2>1	( $F=6.10^*$ , $\eta^2=0.045$ )	4>1, 2,3	( $F=5.47^*$ , $\eta^2=0.040$ )	4>1, 2, 3
<i>Processes of change by cluster</i>								
Consciousness raising	$F=19.63^*$ , $\eta^2=0.133$	1, 3>4, 2	$F=14.16^*$ , $\eta^2=0.099$	1=3>2>4	$F=13.72^*$ , $\eta^2=0.097$	3>2, 4, 1>2	$F=6.86^*$ , $\eta^2=0.051$	2>1, 3
Self-reevaluation	$F=37.13^*$ , $\eta^2=0.225$	3, 1>4, 2	$F=41.26^*$ , $\eta^2=0.244$	1, 3>2>4	$F=23.17^*$ , $\eta^2=0.154$	3>1, 2, 4	$F=26.14^*$ , $\eta^2=0.170$	1, 3>2, 4
Environmental reevaluation	$F=14.49^*$ , $\eta^2=0.101$	3>2, 4, 1>2	$F=3.41^*$ , $\eta^2=0.026$	1>4	$F=5.03^*$ , $\eta^2=0.038$	3>2	$F=7.77^*$ , $\eta^2=0.057$	3>2
Dramatic relief	$F=26.39^*$ , $\eta^2=0.171$	3, 1>4, 2	$F=13.47^*$ , $\eta^2=0.095$	3=1>2=4	$F=15.18^*$ , $\eta^2=0.106$	3>1, 2, 4	$F=18.37^*$ , $\eta^2=0.126$	3>4
Social liberation	$F=12.578^*$ , $\eta^2=0.089$	3>2, 4, 1>4	$F=7.04^*$ , $\eta^2=0.052$	1>2, 4, 3>4	$F=16.57^*$ , $\eta^2=0.115$	3, 1>4, 2	$F=3.40^*$ , $\eta^2=0.026$	3>2
Helping relationship	$F=2.14$ , $\eta^2=0.016$	3=1=4=2	$F=2.23$ , $\eta^2=0.017$	2=1=3=4	$F=1.36$ , $\eta^2=0.010$	1=3=4=2	$F=1.40$ , $\eta^2=0.010$	1=2=3=4
Counter conditioning	$F=10.09^*$ , $\eta^2=0.007$	3>1, 2, 4>1	$F=1.35$ , $\eta^2=0.010$	4=2=1=3	$F=3.06^*$ , $\eta^2=0.023$	4>1	$F=2.61$ , $\eta^2=0.020$	2=3=4=1
Stimulus control	$F=6.10^*$ , $\eta^2=0.045$	3>1, 2,4	$F=3.49^*$ , $\eta^2=0.026$	1>4	$F=0.88$ , $\eta^2=0.006$	4=3=1=2	$F=3.74^*$ , $\eta^2=0.028$	3>2
Self-liberation	$F=2.86$ , $\eta^2=0.021$	3=1=2=4	$F=1.38$ , $\eta^2=0.011$	1=2=4=3	$F=1.99$ , $\eta^2=0.015$	1=3=4=2	$F=3.62$ , $\eta^2=0.027$	3>2
Reinforcement management	$F=10.87^*$ , $\eta^2=0.078$	3, 1>4, 2	$F=4.61^*$ , $\eta^2=0.034$	1>4	$F=1.00$ , $\eta^2=0.007$	1=3=4=2	$F=3.48^*$ , $\eta^2=0.026$	3>4

1=Classic, 2=Early, 3=Progressive, 4=Disengaged.

\*  $p<.05$ .

in Sample 2 for Consciousness Raising, Self-Reevaluation, and Dramatic Relief. For Reinforcement Management, only the difference between the Classic and Disengaged cluster reached significance. People in the Progressing or the Classic contemplators cluster used the remaining processes the most. No significant univariate effects were found for Helping Relationship and Self-Liberation and Counter Conditioning.

In Sample 3, the 10 separate ANOVAs revealed significant differences among clusters in the use of 6 of the processes. Post hoc comparisons indicated that people in the Progressing cluster were using these processes the most, with the exception of Counter Conditioning, which was used the most by people in the Disengaged cluster. No significant differences among clusters were discovered in the use of Helping Relationships, Self-Liberation, Stimulus Control, and Reinforcement Management.

In Sample 4, the 10 separate ANOVAs revealed significant differences among clusters in the use of eight of the processes. As in the other samples participants in the Progressing cluster were using the processes the most, and had means significantly higher than the Early Contemplators and the Disengaged. Once again, no significant differences among the clusters were discovered for Helping Relationships and Counter Conditioning.

Overall, the cluster subtypes differed on 6 or more of the processes in each sample. Participants in the Progressing and Classic clusters used processes more than people in the other two clusters. The effect sizes for the experiential processes were from medium to large, while effect sizes for the behavioral processes were from low to medium. These findings are consistent with previous results.

#### **4. Discussion**

The major result of this study is that it successfully replicated the cluster subtypes within the Contemplation stage previously reported by Norman et al. (2000) and Velicer et al. (1995). This study was performed in a large representative sample and the results replicated across four randomly drawn subsamples. Consistent with previous findings, four readily interpretable cluster subtypes were identified, corresponding to different patterns on the three scales.

The profiles indicate that interventions could be targeted to different subgroups within the Contemplation stage. For people in the Classic Contemplation cluster, the conflict between the Pros and Cons of smoking is strong and the Temptations are high. This indicates that people in this profile need to learn ways to cope with temptations and need to successfully resolve the cognitive conflict. This is the approach usually used with people in the Contemplation stage of change. However, people in the Early Contemplation cluster would need a different intervention, because they do not experience cognitive conflict between the Pros and Cons (because the Cons of smoking are rather low). Because the Cons must be increased before they will be motivated to try to change, the intervention should focus most on the cons of smoking.

The Progressing cluster will require another approach. Here the profile resembles the one for people in the Preparation stage of change. For these individuals, support to make a

behavioral change would be the best strategy. However, people in the Disengaged cluster present the biggest challenge. The low level and low scatter indicate that neither the positive nor the negative side of smoking is very important for these people and that the temptation to smoke is not relevant either. They seem to be light smokers (Norman et al., 2000) and are not interested in quitting. This is the most challenging group for intervention because they do not recognize their behavior as a problem.

Additional support for the cluster solutions was achieved through the external validation of the clusters in the four samples. Across all four samples, the Disengaged subtypes were smoking the lowest number of cigarettes and waiting the longest before their first cigarette in the morning. This finding is consistent with Norman et al. (2000). The Classic Contemplators were smoking the highest number of cigarettes and waiting the shortest amount of time before their first cigarette. Norman et al. (2000) reported similar tendency, but, in their study, the result was not significant. The finding indicates that people with a Classic Contemplation profile actually engage in higher level of the risky behavior than people in the same stage with a profile corresponding to the Precontemplation stage (Early Contemplators). A potential explanation is the higher levels of temptation the Classic Contemplators experience, combined with acute feeling of cognitive conflict.

The Processes of Change also served as an external validation variable indicating differences among the clusters. As predicted by theory and consistent with previous findings, people in the Progressing and Classic subtypes were using the processes more actively than people on the Early and the Disengaged subtypes. Because Contemplation is an early stage, it would be expected that experiential processes would be used more than behavioral ones. This was confirmed by the larger effect sizes (from medium to large) associated with experiential processes and the smaller (from small to medium) effect sizes demonstrated by behavioral processes. In addition, the experiential processes produced consistently significant differences across samples, while results for the behavioral processes were less consistent across samples and failed to reach significance in some samples.

Two of the experiential processes, Self-Reevaluation and Dramatic Relief, seemed to differentiate most strongly the subtypes, generating large effect sizes across all four samples. The processes refer to the image of the self as a smoker and the emotional reaction towards hazards of smoking, respectively. Two other processes, Consciousness Raising and Social Liberation, also demonstrated a consistent pattern of findings with medium to large effect sizes. These processes describe the influence of external stimuli on the change of behavior. These findings are, in general, consistent with the results of Norman et al. (2000), but the effects produced are larger.

On the other hand, the only behavioral process that produced a consistent pattern of findings was Helping Relationship, which did not differentiate among clusters in any of the four samples. The rest of the behavioral processes demonstrated inconsistent patterns, and failed to reach the level of significance in at least one of the samples. Given the small to medium effect sizes, this can be interpreted as representing sampling fluctuations.

The results provide strong demonstration of the conclusion of Norman et al. (2000) that experiential processes (personal, emotional, information from the surroundings, and concerns of consequences) are the variables allowing differentiation of smokers at the early stages of

change. The behavioral processes are less effective at these early stages as predicted by the model and confirmed by these findings.

## 5. Limitations

This study has the inherent limitation of the method used. As cluster analysis is an exploratory procedure and the final solution depends on the interpretation of the researcher, the final results are, to some extent, subjective. However, the replication across four samples and the replication of previous findings help alleviate this limitation. Another limitation of the study is that it focuses on a single stage. Analyses for the Precontemplation and Preparation stages of change will be presented in separate research reports. Finally, no data was collected on the ethnicity of participants in the study, which limits the degree of generalizability of the findings.

## 6. Conclusions

This study provides additional evidence for the presence of large within-stage differences for the Contemplation stages of change. The presence of these subtypes is considered a complementary rather than competing classification of smokers that can provide the basis for an additional level for tailoring of interventions. Compared to individual tailoring, interventions based on the cluster subtypes will be more cost-effective, while at the same time providing more specific information than programs tailored only on the stages of change variable.

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