



Short communication

## Replication of subtypes for smoking cessation within the Preparation stage of change<sup>☆</sup>

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### Abstract

*Objective:* Recent cluster analyses based on the Pros and Cons and the Situational Temptations measures performed within the stages of change defined by the Transtheoretical Model have suggested the existence of distinct cluster subtypes. The goal of this study is to replicate cluster subtypes within the Preparation stage of change in a secondary analysis of data from a sample of current smokers ( $N=3967$ ). Identification of stable cluster subtypes would permit the development of tailored interventions focusing on these subtypes.

*Method:* Two random samples of approximately 340 subjects were selected from the 686 participants in the Preparation stage. The cluster analyses were performed using the Pros, Cons and Situational Temptations. Interpretability of the pattern, pseudo  $F$  test, and dendrograms were used to determine the number of clusters.

*Results:* Four distinct cluster subtypes (Classic, Progressing, Early Preparation, and Disengaged) were found and replicated across samples. The clusters were externally validated using the ten processes of change and two smoking behavior variables. Statistically significant ( $p<0.05$ ) multivariate effects were found for the ten processes of change and the smoking behavior variables ( $p<0.001$ ) in the two samples.

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<sup>☆</sup> This study was supported by NCI Grants 71356, Grants CA 50087 and CA 27821. Requests for reprints should be sent to Wayne F. Velicer, Cancer Prevention Research Center, 2 Chafee Road, University of Rhode Island, Kingston, RI, 02881-0808. E-mail: [velicer@uri.edu](mailto:velicer@uri.edu). Website: [www.uri.edu/research/cprc](http://www.uri.edu/research/cprc).

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

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*Keywords:* Stages of change; Cluster analysis; Transtheoretical Model; Tailored interventions

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## 1. Introduction

According to the Transtheoretical Model (TTM) of behavior change (Prochaska & Velicer, 1997), readiness of people to change behavior follows five consecutive stages of change (Precontemplation, Contemplation, Preparation, Action and Maintenance). Based on this paradigm, interventions should be tailored to the individual's stage of change. Originally, the stages were considered to be homogeneous in their motivational profiles, but in recent years, studies have focused on exploring the idea of existing subgroup profiles within each stage of change (Norman, Velicer, Fava, & Prochaska, 2000; Velicer, Hughes, Fava, Prochaska, & DiClemente, 1995). The existence of such subgroups has important theoretical and practical implications, providing a complementary typology system for the development of tailored interventions. Stage subgroups can successfully be explored within the TTM framework. 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 behavior, and the independent variables dimension, which includes the Processes of change (Prochaska, Velicer, DiClemente, & Fava, 1988). To identify the subgroups, the profiles on the Pros, Cons and Situational Temptations are explored in cluster analyses and the resulting clusters are externally validated using the Processes of change.

In the first empirical investigation of the stage subtypes theory, Velicer et al. (1995) identified four distinct profiles within each of the first four stages of change in a 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 was called Disengaged.

Five years later, Norman et al. (2000) published a replication of these findings within the first three stages, using a larger representative sample of adult smokers. The study produced similar cluster profiles. 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. Overview of the current study

This report describes replication of cluster subtypes within the Preparation stage of change reported by Norman et al. (2000). Both the original study and the replications in the preceding stages (Anatchkova, Velicer, & Prochaska, 2005; Anatchkova, Velicer, & Prochaska, submitted for publication) used cluster analyses following the same analytic steps (Everitt, Landau, & Leese, 2001). The Preparation stage is characterized by readiness to change behavior in the next 30 days and at least one 24-h quit attempt. People in the Preparation stage are expected to have high Cons scores indicating their

motivation for change. This study can provide additional evidence for the existence of theoretically interpretable, internally consistent and externally valid cluster subtypes within the Preparation stage as the last step of cross-replication required in cluster analytical studies.

## 2. Method

### 2.1. Participants

The present study is a secondary data analysis. The initial sample was recruited after a screening method was completed on 19,236 adults in four offices of a managed care system via mail and telephone surveys. Out of these, a total of 4653 were identified as smokers and 85.3% of the eligible subjects ( $N=3967$ ) were recruited at baseline. The primary results of the two studies based on this sample can be found elsewhere (Velicer, Prochaska, Fava, Laforge, & Rossi, 1999). Only the data of participants in the Preparation stage of change were used for the current analysis.

### 2.2. Measures

The battery of measures administered at baseline included the Pros 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). Also administered at baseline were the ten Processes of Change (Prochaska et al., 1988). Two smoking items measured the number of cigarettes smoked per day and the time elapsed before the first cigarette of the day (Fagerstrom, 1978).

### 2.3. Procedure

*Sample selection.* Participants in the Preparation stage with missing data on any of the key variables were excluded. The remaining 686 subjects were randomly divided into two samples of about 340 subjects each and a cluster analysis was performed within each sample. This permitted assessment of the extent to which the results replicated and were stable across samples.

*Cluster analysis.* The procedure for the cluster analyses has been described in detail in the original study (Norman et al., 2000) and in a recent replication within the contemplation stage (Anatchkova et al., 2005). The variables employed in the cluster analysis were the Pros and Cons of Smoking from the Decisional Balance Inventory and the total score from the Situational Temptations Scale. All variables were standardized to  $T$ -scores ( $M=50$ ;  $SD=10$ ). All analyses used the squared Euclidean distance metric and Ward's minimum variance algorithm. An inverse scree test (Lathrop & Williams, 1987, 1989) and the pseudo  $F$  test (Calinski & Harabasz, 1974) narrowed the range of cluster solutions that would be interpreted and visual inspection of the cluster profiles was performed, focusing on shape, level and scatter to determine the final solution.

*External validation.* The relationship of cluster membership to variables not included in the development of the clusters provides external validation. Cluster membership served as the independent variable and two different variable sets were employed as the dependant variables: (1) the two variables assessing smoking behavior and (2) ten Processes of Change scales.

### 3. Results

#### 3.1. Cluster analysis

Four clusters were found to describe the data best in each sample (see Table 1). All the profiles replicated well across samples. The cluster profiles (Fig. 1) were similar to the findings of Norman et al. (2000) and the same cluster labels were used for clarity in the retained clusters.

The first cluster was labeled *Classic Preparation*. The profile has shape with low scatter and medium to high level. The scores on all scales are between half and a full standard deviation above the mean. The elevated Cons suggested readiness of participants to quit smoking, but action is still delayed by elevated temptation to smoke. The second cluster was labeled *Progressing*. It had a distinct inverted “V” shape with average level and moderate scatter. The values for Pros of Smoking and Temptations are around the average and the Cons scores are slightly more than a standard deviation above the mean. The cluster demonstrates the cross-over effect in which the Cons become more important than the Pros of smoking indicating the smokers’ readiness to quit. The third cluster was labeled *Early Preparation*. The profile has an inverted “V” shape, at a low level and with moderate scatter. The Pros are between half and one standard deviation below average, the Cons were about average and the Temptations were a standard deviation below average. The fourth cluster was labeled *Disengaged*. The profile is an inverted “V” shape, with moderate scatter and below average level. The scores for Pros and Temptations are about average, while the Cons are about a standard deviation below average.

Table 1  
Means and standard deviations for the four clusters in the two samples for the Pros, Cons, and Temptations scales

	Sample 1 (N=344)		Sample 2 (N=342)	
	Mean	SD	Mean	SD
<i>Pros</i>				
1. Classic	59.91	5.19	59.45	4.84
2. Progressing	48.98	6.12	47.86	5.61
3. Early	50.52	6.12	47.18	5.04
4. Disengaged	44.45	4.75	42.45	3.78
<i>Cons</i>				
1. Classic	56.66	5.81	55.32	6.56
2. Progressing	56.68	4.42	56.63	5.30
3. Early	43.19	4.88	44.74	5.14
4. Disengaged	46.64	5.39	51.13	6.82
<i>Temptations</i>				
1. Classic	59.13	3.54	55.90	4.09
2. Progressing	48.24	5.94	47.96	4.80
3. Early	55.34	4.28	51.09	4.98
4. Disengaged	41.27	6.05	37.24	5.12

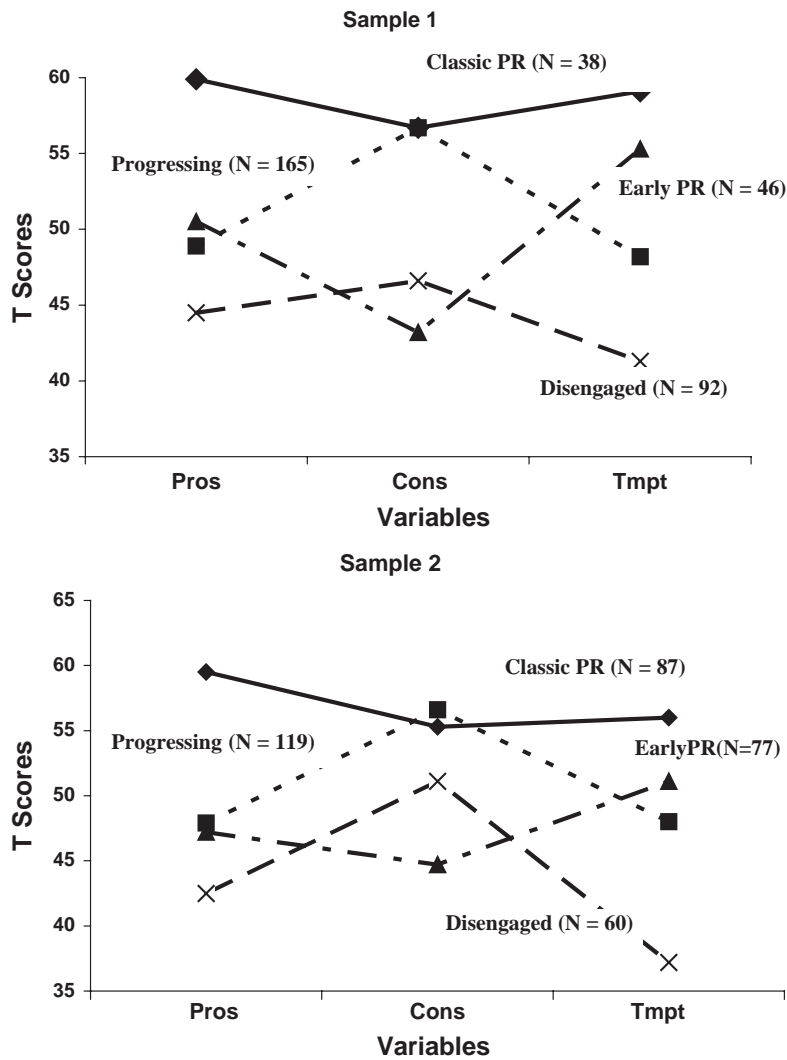


Fig. 1. Cluster profiles across the two preparation samples.

### 3.2. External validation

Significant multivariate effects were found by a MANOVA on the two smoking variables in the two samples (Sample 1, Wilk's  $\Lambda=0.796$ ,  $p<0.001$ ; Sample 2, Wilk's  $\Lambda=0.827$ ,  $p<0.001$ ). Cluster subtypes differed significantly on the Number of Cigarettes per Day and Minutes to First Cigarette (see Table 2). Medium to large effect sizes (Cohen, 1988) were found across the samples. Participants in the Disengaged cluster smoked the lowest number of cigarettes, while the Classic Contemplators smoked the most. People in the Disengaged cluster waited the longest before smoking. The results are consistent with previous findings.

A multivariate analysis of variance indicated significant multivariate effects for the 10 processes of change in the samples (Sample 1, Wilk's  $\Lambda=0.679$ ,  $p<0.001$ ; Sample 2, Wilk's  $\Lambda=0.756$ ,

Table 2  
ANOVA results and cluster differences for the smoking behavior and process of change

	Sample 1		Sample 2	
	Univariate $F(3,325)$	Tukey HSD pattern	Univariate $F(3,323)$	Tukey HSD pattern
<i>Smoking behavior by cluster</i>				
Cigarettes per day	( $F=12.54^*$ , $\eta^2=0.103$ )	$C>P, E, D; P>E$	( $F=9.61^*$ , $\eta^2=0.080$ )	$C, P, E>D$
Minutes to first cigarette	( $F=19.68^*$ , $\eta^2=0.153$ )	$D>E, P, C$	( $F=19.17^*$ , $\eta^2=0.148$ )	$D>E, P, C$
<i>Processes of change by cluster</i>				
Consciousness raising	( $F=13.69^*$ , $\eta^2=0.172$ )	$P>C>E, D$	( $F=7.17^*$ , $\eta^2=0.062$ )	$P, C>E, D$
Self reevaluation	( $F=22.85^*$ , $\eta^2=0.097$ )	$P, C>E, D$	( $F=12.13^*$ , $\eta^2=0.101$ )	$P, C>E, D$
Environmental reevaluation	( $F=5.72^*$ , $\eta^2=0.049$ )	$P, C>E; C>D$	( $F=4.03^*$ , $\eta^2=0.030$ )	$P, C>E$
Dramatic relief	( $F=14.98^*$ , $\eta^2=0.120$ )	$P, C>E, D$	( $F=6.93^*$ , $\eta^2=0.060$ )	$P, C>E$
Social liberation	( $F=20.27^*$ , $\eta^2=0.156$ )	$P, C>E, D$	( $F=7.72^*$ , $\eta^2=0.066$ )	$P, C>E$
Helping relationship	( $F=2.11$ , $\eta^2=0.018$ )	–	( $F=1.71$ , $\eta^2=0.015$ )	–
Counter conditioning	( $F=2.36$ , $\eta^2=0.021$ )	–	( $F=6.85^*$ , $\eta^2=0.060$ )	$D>E, P, C$
Stimulus control	( $F=5.38^*$ , $\eta^2=0.046$ )	$P, C>D$	( $F=3.36^*$ , $\eta^2=0.030$ )	$P>E$
Self liberation	( $F=2.45$ , $\eta^2=0.021$ )	$P>E$	( $F=0.24$ , $\eta^2=0.002$ )	–
Reinforcement management	( $F=5.24^*$ , $\eta^2=0.045$ )	$C>E, D$	( $F=4.68^*$ , $\eta^2=0.041$ )	$C>E, D$

$E$ —Early PR;  $C$ —Classic PR;  $P$ —Progressing PR;  $D$ —Disengaged.

\*  $p < 0.05$ .

$p < 0.001$ ). In Sample 1, there were significant differences among the clusters in the use of seven of the ten processes (Table 2). Medium to large effect sizes were found for Consciousness Raising, Self-reevaluation, Dramatic Relief and Social Liberation. Small to medium effect sizes were found for Stimulus Control, Reinforcement Management and Environmental Reevaluation. People in the Classic and Progressing clusters used the processes more than people in the Early and the Disengaged cluster. In Sample 2, there were significant differences among clusters on eight of the processes. The effect sizes in this sample were somewhat lower, but the pattern observed in the first sample was replicated.

#### 4. Discussion

The major result of this study is the successful replication of previously reported cluster subtypes within the Preparation stage. The clusters in the current sample match closer the original four clusters reported by Velicer et al. (1995) with only one Disengaged cluster in the final solution. The current study failed to identify a second Disengaged cluster as reported by Norman et al. (2000). Regardless of this departure in the solution, the overall line of findings have been replicated in this study as well, confirming the existence of stable subgroups within stages of change, corresponding to different patterns on the three scales (Pros, Cons and Temptations).

The profiles of the clusters suggest heterogeneity within the Preparation stage in terms of readiness to alter the behavior, which can be used in developing targeted interventions. For example, for people in the Progressing Preparation group, the best strategy would be to promote change of behavior as their profile with low Pros and Temptations and high Cons indicates they are ready to quit smoking immediately. On the other hand, people in the Early Preparation group may benefit from an intervention that helps them

first to reduce temptations and increase the cons of smoking instead of pushing them hard to make a change that they are unlikely to maintain.

The Processes of Change also served as external validation variables and a clear pattern of differences was found between the clusters with respect to process use. People in the Progressing and Classic subtypes were using the processes more actively than people on the Early and the Disengaged subtypes. Preparation is the last of the pre-action early stages of change in which it is expected that experiential processes would be used more than behavioral ones. This was confirmed by the larger effect sizes (medium to large) associated with experiential processes and the smaller (small to medium) effect sizes demonstrated by behavioral processes. Reinforcement Management had a medium effect size in both samples, indicating that rewards for achieved progress differentiate between the clusters in Preparation.

#### 4.1. Limitations and conclusions

The inherent limitations of the method used impact on the findings. Since cluster analysis is an exploratory procedure, the final solution depends on the interpretation of the researcher and is to some degree subjective. Since this study replicates previous findings, uses a large sample, and multiple methods to determine the cluster solution, the problem is somewhat alleviated.

This study provides additional evidence for the presence of distinct subgroups within the Preparation stage for smoking cessation. This complementary classification of smokers provides an additional level for tailoring of more specific interventions. Prospective studies demonstrating the relationship between clusters' changes in behavior at later time points would provide the additional evidence for the practical significance of cluster subtypes.

## References

- Anatchkova, M. D., Velicer, W. F., & Prochaska, J. O. (2005). Replication of subtypes for smoking cessation within the contemplation stage of change. *Addictive Behaviors*, *30*, 915–927.
- Anatchkova, M. D., Velicer, W. F., Prochaska, J. O. (under review). Replication of subtypes for smoking cessation within the precontemplation stage of change. *Addictive Behaviors*.
- Calinski, R. B., & Harabasz, J. (1974). A dendrite method for cluster analysis. *Communications in Statistics*, *3*, 1–27.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.
- Everitt, B. S., Landau, S., & Leese, M. (2001). *Cluster analysis* (4th ed.). New York: Oxford University Press.
- Fagerstrom, K. (1978). Measuring degree of physical dependence to tobacco smoking with reference to individualization of treatment. *Addictive Behaviors*, *3*, 235–241.
- Lathrop, R. G., & Williams, J. E. (1987). The reliability of the inverse scree tests for cluster analysis. *Educational and Psychological Measurement*, *47*, 953–959.
- Lathrop, R. G., & Williams, J. E. (1989). The shape of the inverse scree tests for cluster analysis. *Educational and Psychological Measurement*, *49*, 827–837.
- Norman, G. J., Velicer, W. F., Fava, J. L., & Prochaska, J. O. (2000). Cluster subtypes within stage of change in a representative sample of smokers. *Addictive Behaviors*, *25*, 183–204.
- Prochaska, J. O., & Velicer, W. F. (1997). The Transtheoretical Model of health behavior change. *American Journal of Health Promotion*, *12*, 38–48.
- Prochaska, J. O., Velicer, W. F., DiClemente, C. C., & Fava, J. L. (1988). Measuring the processes of change: Applications to the cessation of smoking. *Journal of Consulting and Clinical Psychology*, *56*, 520–528.
- Velicer, W. F., DiClemente, C. C., Prochaska, J. O., & Brandenburg, N. (1985). A decisional balance measure for assessing and predicting smoking status. *Journal of Personality and Social Psychology*, *48*, 1279–1289.

- Velicer, W. F., DiClemente, C., Rossi, J. S., & Prochaska, J. O. (1990). Relapse situations and self-efficacy: An integrative model. *Addictive Behaviors*, *15*, 271–283.
- Velicer, W. F., Hughes, S. L., Fava, J. L., Prochaska, J. O., & DiClemente, C. C. (1995). An empirical typology of subjects within stage of change. *Addictive Behaviors*, *20*, 299–320.
- Velicer, W. F., Prochaska, J. O., Fava, J. L., Laforge, R. G., & Rossi, J. S. (1999). Interactive versus non-interactive interventions and dose–response relationships for stage matched smoking cessation programs in a managed care setting. *Health Psychology*, *18*, 21–28.