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Outcomes of Cluster Profiles within Stages of Change for Sun Protection Behavior

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Abstract

Objective—Predictive and external validity was studied among cluster profiles for sun protection behavior within stages from Transtheoretical Model of behavior change using follow-up data.

Method—Data from participants in a home-based expert system were analyzed. Longitudinal patterns of clusters on the Precontemplation, Contemplation, and Preparation stages of change were assessed. Differences between clusters on membership in Action/Maintenance stages, scores on the Sun Protection Behavior Scale (SPBS) were measured at 12 and 24 months after intervention.

Results—Differences between clusters on stage progression and on scores from the SPBS were found at 12 and 24 months after intervention at all stages.

Discussion—Predictive and external validity of sun protection subtypes was established using sun protection variables after a stage-matched intervention. Results provide information to improve interventions for sun protection.

The Transtheoretical Model of Behavior Change (TTM) has been widely applied to the study and modification of a range of health-related behaviors (Burbank, Reibe, Padula, & Nigg, 2002; Fava, Velicer, & Prochaska, 1995; Prochaska et al., 1994, 2001, 2004, 2005; Weinstock, Rossi, Redding, Maddock, & Cottrill, 2000). Stage of change is the central organizing construct of the model. Stage of change represents the temporal dimension integrating current behavior and intention to engage in the new health behavior (Prochaska et al., 2005; Velicer et al., 2000). These five stages (in order of progression) are Precontemplation, Contemplation, Preparation, Action, and Maintenance. TTM tailored interventions that recommend different change strategies for each stage of change have been demonstrated effective for a range of single and multiple health risk behaviors including sun protection (Norman et al., 2007; Prochaska et al., 2004, 2005; Redding et al., 1999; Weinstock, Rossi, Redding, & Maddock, 2002). Nevertheless, heterogeneity within stages of change may provide an opportunity for further tailoring that could enhance intervention outcomes.

Studies have explored the existence of distinctive subgroups within stages of change from the TTM. Clusters with profiles that resembled early stages (e. g., precontemplation) reported more risk behaviors than clusters with profiles that resembled more advance stages (Anatchkova, Velicer & Prochaska, 2005, 2006a, 2006b; Gorely & Bruce, 2000; Johnson et al., 2006; Norman, Velicer, Fava, & Prochaska, 2000; Santiago-Rivas et al., under review;

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Santiago-Rivas, Velicer, Redding, Paiva, & Prochaska, 2010; Santiago-Rivas, Velicer, Redding, Paiva, & Prochaska, 2012; Velicer, Hughes, Fava, & Prochaska, 1995; Velicer, Redding, Anatchkova, Fava, & Prochaska, 2007).

The current study was conceptualized as a follow-up to three previous cluster analyses that explored whether meaningful typologies existed within stages of change for sun protection habits (Santiago-Rivas et al., 2010, 2012, under review). The predictive validity of sun protection profiles identified at baseline was assessed over a two-year period. Outcome was measured by identifying stage transition to action or maintenance stages at 12 and 24 months after a multiple risk expert system intervention. Sun protection behavior at 12 and 24 months was also assessed.

Method

Participants

The sample used in this secondary data analysis is a portion of a sample collected from a larger, multiple behavior (smoking, diet, sun protection, and mammography screening) intervention study of primary care patients (Prochaska et al., 2005).

The number of participants for the study was 1042 subjects: 68.7% were female, 38.4% were between ages 34–49, 65.4% were married, 94.7% were white, and 73.9% reported a good or very good health status. The stage distribution at baseline was precontemplation, N = 570; contemplation, N = 213; and preparation, N = 259.

Treatment group—Participants were mailed three computer-generated reports at baseline. In addition, they were mailed reports at 6 months and 12 months. The three-to five-page reports provided feedback about each participant's stage of change, the pros and cons of changing, change processes pertinent to their stage, how to increase self-efficacy, and techniques to progress to the next stage. The follow-up reports (6- and 12-month phases) provided feedback about changes since the previous assessment. Participants also received a stage-matched manual at baseline to help them progress at their own pace in between reports. Specific sun protection behaviors were measured, but not used in the generation of the interactive progress reports.

Measures

Algorithm staging at baseline—A staging algorithm was used to identify participants that were at risk of sun exposure, that is, at the precontemplation, contemplation, or preparation stages of change. If participants reported that they do not protect themselves from exposure to the sun consistently (that is, whenever they know they will be out in the sun for more than 15 minutes), and they haven't done so in the past 12 months, they were classified as at-risk for sun exposure. Subjects were in: (1) the Precontemplation stage if they were not intending to protect themselves from exposure to the sun in the next 12 months; (2) the Contemplation stage if there were intending to protect themselves from the sun in the next 12 months; and (3) the Preparation stage if they were intending to protect themselves in the following month.

Outcomes and predictive validity—At follow-up, participants would have progressed to: (1) the action/maintenance stage if they protected themselves from exposure to the sun consistently (anytime they know they will be out in the sun for more than about 15 minutes) for at least a year. For the evaluation of predictive validity of the clusters and analysis of outcome, participants were classified as progressing if their sun protection behavior stage changed to the action or maintenance stage at 12 and 24 months after the intervention.

External validity and sun protection—The Sun Protection Behavior Scale (SPBS) is a brief inventory that measures of sun protection "during the summer" in terms of sunscreen use and sun avoidance (Weinstock et al., 2000).

Internal consistency indexes for the scales were excellent (Sunscreen Use $\alpha = 0.86$, 3 items; Sun Avoidance $\alpha = 0.82$, 4 items). The total score of this scale (the total of seven items from both subscales) was used (minimum score = 7; maximum score = 35).

Procedure

Initial clustering at baseline: Pros, cons, and self-efficacy—Cluster analysis attempts to classify individuals that share certain properties into relatively homogeneous subgroups that are different in some respects from the individuals in other groups (Aldenderfer & Blashfield, 1984; Everitt, Landau, & Leese, 2001). An initial cluster analysis was conducted within pre-Action stages of change of sun protection (Santiago-Rivas, 2010; 2012; under review). The Decisional Balance (pros and cons) and self-efficacy measures were used in the clustering procedure. For this initial analysis, all the variables included in cluster identification procedures (Decisional Balance –pros and cons-, and self efficacy) were standardized to T- scores ($M = 50$, $SD = 10$).

Once the participants were assigned to the stages at baseline, random multiple subsamples were drawn from each stage of change, and they were used in the cluster analysis. The number of subssamples was based on the number of participants in the stage. Three random samples of 190 participants were selected without replacement (each observation in the data set has an equivalent chance of being chosen; once chosen it can not be selected again for following procedures) from the precontemplation stage (N=570). Two random samples ranging of 106 to 107 participants were selected without replacement from the contemplation stage (N= 213). Two random samples ranging of 129 to 130 participants were selected without replacement from the preparation stage (N=259). A four-cluster solution was identified across all subsamples from all three stages. Once a replicable number of clusters was identified, this clustering solution was applied to the total sample by stage. These groups were included in the present study.

Outcome of cluster profiles—Predictive validity of the clusters was evaluated by examining cluster transition from their initial stage to action /maintenance stages of sun protection at 12 and 24 months after the intervention. Those who were not currently protecting themselves from sun exposure were classified as being in a pre-action stage, and those who constantly protect themselves from sun exposure were classified as members of the action/maintenance stages (using the applicable algorithm). This procedure was followed to explore if cluster membership influenced stage movement in the manner predicted by the TTM. Identifying cluster differences in SPBS at 12 and 24 months after the intervention assessed external validity of the clusters. This follow-up analysis of outcomes was conducted by stage.

Results

Study 1. Precontemplation

Previous analysis—In a previous analysis, a four-cluster solution described the data best for precontemplation (Santiago-Rivas et al., 2012): The *immotive* cluster was the group that most clearly exemplified the precontemplation stage, and the *progressing* group exhibited a profile that resembles more advanced stages (e. g., action). The *disengaged* subtype (which resembles the *immotive* cluster, but with scores below average) was the one that reported more risk behaviors, and was the least effective in the implementation of strategies that

reduce unprotected sun exposure. The *early progressing* cluster resembled the *progressing* cluster, but with scores below average on the pros and cons of sun protection.

Present results and predictive validity: Outcomes and stage transition—The cluster distribution at 12 months was (N =413): *immotive* (n =99), *progressing* (n =152), *early progressing* (n =123), and *disengaged* (n =39). The cluster distribution at 24 months was (N = 382): *immotive* (n =91), *progressing* (n =142), *early progressing* (n =111), and *disengaged* (n =38).

Chi-square tests were performed to evaluate differences in the transition to action/maintenance stages across clusters. Significant differences in progress were found for this outcome at 12 months, $\chi 2$ (3) = 8.61, p <. 05; Cramer's Φ^2 = .145, and at 24 months, $\chi 2$ (3) = 15.5, p <. 01; Cramer's Φ^2 = .202. The effect size was higher at the 24-month time point (see Figure 1).

Present results and external validation: Behavioral variables—Analysis of Variance was performed to evaluate differences between profiles for the SPBS: F (3, 409) = 27.63, p < .001, $\eta 2$ = .177 at 12 months; F (3, 378) = 33.27, p < .001, $\eta 2$ = .195 at 24 months (see Table 1). The effect size was higher at the 24-month time point.

Study 2. Contemplation

Previous analysis—In a previous analysis, a four-cluster solution described the data best for contemplation (Santiago-Rivas et al., unpublished manuscript): the *classic contemplators* cluster was the group that most clearly exemplified the contemplation stage, and the *progressing* cluster exhibits a profile that resembles more advanced stages (e. g., action). The *early contemplators* group was more similar to the precontemplation stage. The *disengaged* cluster, which resembles the *early contemplators* cluster but with a below average level, was the one that reported more risk behaviors across most of the variables included in the analysis.

Present results and predictive validity: Outcomes and stage transition—The cluster distribution at 12 months was (N = 154): *classic contemplators* (n =36), *progressing* (n =50), *early contemplators* (n =54), and *disengaged* (n =14). The cluster distribution at 24 months was (N = 148): *classic contemplators* (n =33), *progressing* (n =50), *early contemplators* (n =54), and *disengaged* (n =11).

Chi-square tests were performed to evaluate differences across profiles in the transition of the clusters to action/maintenance stages (see Figure 2). Significant differences were found for this outcome at 12 months, $\chi 2$ (3) = 22.55, p <.001; Cramer's Φ^2 =.384, and at 24 months, $\chi 2$ (3) = 20.10, p <. 001; Cramer's Φ^2 = .370.

Present results and external validation: Behavioral variables—Analysis of Variance was performed to evaluate differences between profiles for the SPBS: F (3, 150) = 9.98, p < .001, $\eta 2$ = .138 at 12 months; F (3, 144) = 10.69, p < .001, $\eta 2$ = .150 at 24 months. The effect size was higher at the 24-month time point (see Table 2)

Study 3. Preparation

Previous analysis—In a previous analysis, a four-cluster solution described the data best for preparation (Santiago-Rivas et al., 2010): The *early preparation* group had a profile similar to previous stages (e.g., precontemplation). The *progressing* cluster resembled a profile characteristic of more advanced stages (e. g., action). The *disengaged* cluster was the one that reported more risk behaviors across most of the variables included in the analysis.

Different from other studies, there was no cluster that most clearly exemplified the Preparation stage. The *level preparation* cluster showed scores a profile similar to contemplation/preparation, but the scores of the pros and cons were slightly below average.

Present results and predictive validity: Outcomes and stage transition—The cluster distribution at 12 months was (N = 202): *level preparation* (n =90), *progressing* (n =32), *early preparation* (n =61), and *disengaged* (n =19). The cluster distribution at 24 months was (N = 189): *level preparation* (n=88), *progressing* (n=32), *early preparation* (n=52), and *disengaged* (n=17).

Chi-square tests were performed to evaluate differences between profiles in the transition of participants to action/maintenance stages (see Figure 3). Significant differences were found for this outcome at 12 months, $\chi 2$ (3) = 10.76, p < .05; Cramer's Φ^2 = .232, and 24 months $\chi 2$ (3) = 12.40, p < .01; Cramer's Φ^2 = .257.

Present results and external validation: Behavioral variables—Analysis of Variance was performed to evaluate differences between profiles for the SPBS: F (3, 198) = 6.22, p < .001, $\eta 2$ = .08 at 12 months; F (3, 185) = 6.90, p < .001, $\eta 2$ = .09 at 24 months (see Table 3).

Discussion

The purpose of this study was to examine the predictive and external validity of clusters within stages of change. That is, if baseline subgroups from each of the pre-action stages of the TTM at baseline (precontemplation, contemplation, and preparation) vary and change in the manner predicted by the model using a longitudinal approach (follow-up assessments at 12 and 24 months) with an at-risk population.

It was found that, across stages, the cluster that resembled more advanced stages in general reported a greater rate of progress to action and maintenance stages than the other clusters. This type of subgroup, which was found in all three stages (the *progressing* clusters), surpassed the other subgroups in terms of the number of participants in more advanced stages at the following time points. In terms of the other clusters, there was a comparably low rate of progression to action/maintenance for those in precontemplation and for both time points. Findings from the assessment of external validity demonstrated clear differences between subtypes within the stages in terms of the SPBS scores. These differences were found at 12 months and 24 months after the completion of a multiple risk expert systems interventions. It was found that cluster that resembled more advanced stages in general reported more sun protection behavior that those that resembled earlier stages or that reported low scores on the pros, cons, and self-efficacy measures at baseline.

Limitations of the study include the size of samples and the subgroups. It is usual for samples to get smaller across time. It should be noted that some subgroups remained very small, and thus these analyses may have limited statistical power. Also, this study was limited to one specific population, primary care patients (Prochaska et al., 2005; Santiago-Rivas et al., 2010, 2012, unpublished manuscript). This population mostly consisted of female and Caucasian individuals. Whether these results would generalize beyond this at-risk population of patients cannot yet be determined. In addition, specific variables outcomes were measured. Results are relevant for these outcomes. Other important aspects of sun protection behavior (e.g., attitudes toward tanned appearance, skin cancer history, skin complexion, processes of change) were not included in the study.

The staging algorithm developed by the TTM was used to classify participants and measure predictive validity. Other stage models use different algorithms and definitions of stage, shaping the conclusions made about the effect of stage-based interventions on behavior acquisition. Other theories, such as the Health Action Process Approach (HAPA), use phases or stages to predict behavior and for the development of interventions. In terms of the HAPA, its basic assumption is that the initiation and maintenance of health behavior must be considered as a process consisting of at least two stages: a motivational phase and a volition phase. Also, it classifies individuals as non-intenders, intenders, and actors (Lippke, Ziegelmann, & Schwarzer, 2005; Schwarzer, 2008). Craciun, Schüz, and Lippke (2011) reported that sun behavior variables typically used in the later phases of the HAPA (e. g., self-efficacy and strategic planning) mediate between intention to use sunscreen and sunscreen use. Also, it was reported that when measured one month after a HAPA-based intervention to increase frequency of sunscreen usage, individuals in the volitional group reported to use more sunscreen than those in the motivational and control groups (Craciun, Schüz, Lippke, & Schwarzer, 2011). The motivational treatment had no effect at all. The volition phase is the stage that takes place after an intention to perform a certain health behavior has been formed (similar to contemplation and preparation from the TTM). These results support the use of tailored interventions that highlight the importance of intention as a predictor of sun protection behavior.

Many interventions have been developed to increase sun protection behaviors, some targeting appearance-based behaviors, others targeting sun exposure and outdoor recreation activities, and others targeting implementation intentions (Dobbinson et al., 2008; Glanz, Maddock, Lew, & Murakami-Akatsuka, 2008; Jackson & Aiken, 2006; Mahler, Kuli, Butler, Gerrard, & Gibbons, 2008; Mahler, Kuli, Gerrard & Gibbons 2007; Olson, Gaffney, Starr, & Dietrich, 2008; Rossi, Blais, & Weinstock, 1994). Some of these interventions have a longitudinal aspect to assess change, some don't. For those who have a longitudinal piece, follow-up data were collected at 2 weeks, 1 month, 3 months, 5 months, or 1 year. The present study identifies characteristics of groups of individuals (clusters using the pros, cons, and self-efficacy of sun protection) to predict behavior modification 1 year and 2 years after baseline. Clusters were used to examine the rate of specific sun protection habits at longer terms than previous interventions. The applicability of the findings rests on the notion that specific information, in this case the intentions of the individual to change behavior (stage), and cognitive variables, serves as a reliable predictor of future behavior. As part of the intervention, feedback was provided regarding stage membership and other cognitive and behavioral variables, producing meaningful long-term effects. In addition, tailored interventions based on the expert system approach can provide individualized results to large percentages of at-risk populations at the same time.

On the other hand, the existence of the cluster profiles should not be viewed as adding additional stages to the stages. The existence of clusters should be viewed as complementary information, particularly important for populations at high risk. If a researcher is interested in working only with the precontemplation stage, which is formed by individuals who are not considering sun protection behavior, results from this study could facilitate the identification of specific strategies that would help specific clusters of people within that stage. Specific clusters might benefit of more feedback regarding their self-efficacy, while other cluster might progress when the pros are the focus of their individualized intervention, or a combination of both. A large proportion of the at-risk population for skin cancer is in the precontemplation stage (this stage was the largest group in the study and reported the lowest retention rate at the 24-month phase). Individuals in this stage can be a resistant, and strategies should be designed to enhance their intentions to start the process of behavior change. In our study, sun avoidance was identified as a salient marker behavior. Future

research needs to determine the relevance of other variable as an outcome for stage-based interventions

As part of the current intervention, the researchers contacted the at-risk population. It was demonstrated that proactively providing stage-matched programs for behavior change can provide high impact in a patient population. Results support the use of high levels of tailoring and retailoring on variables from the TTM.

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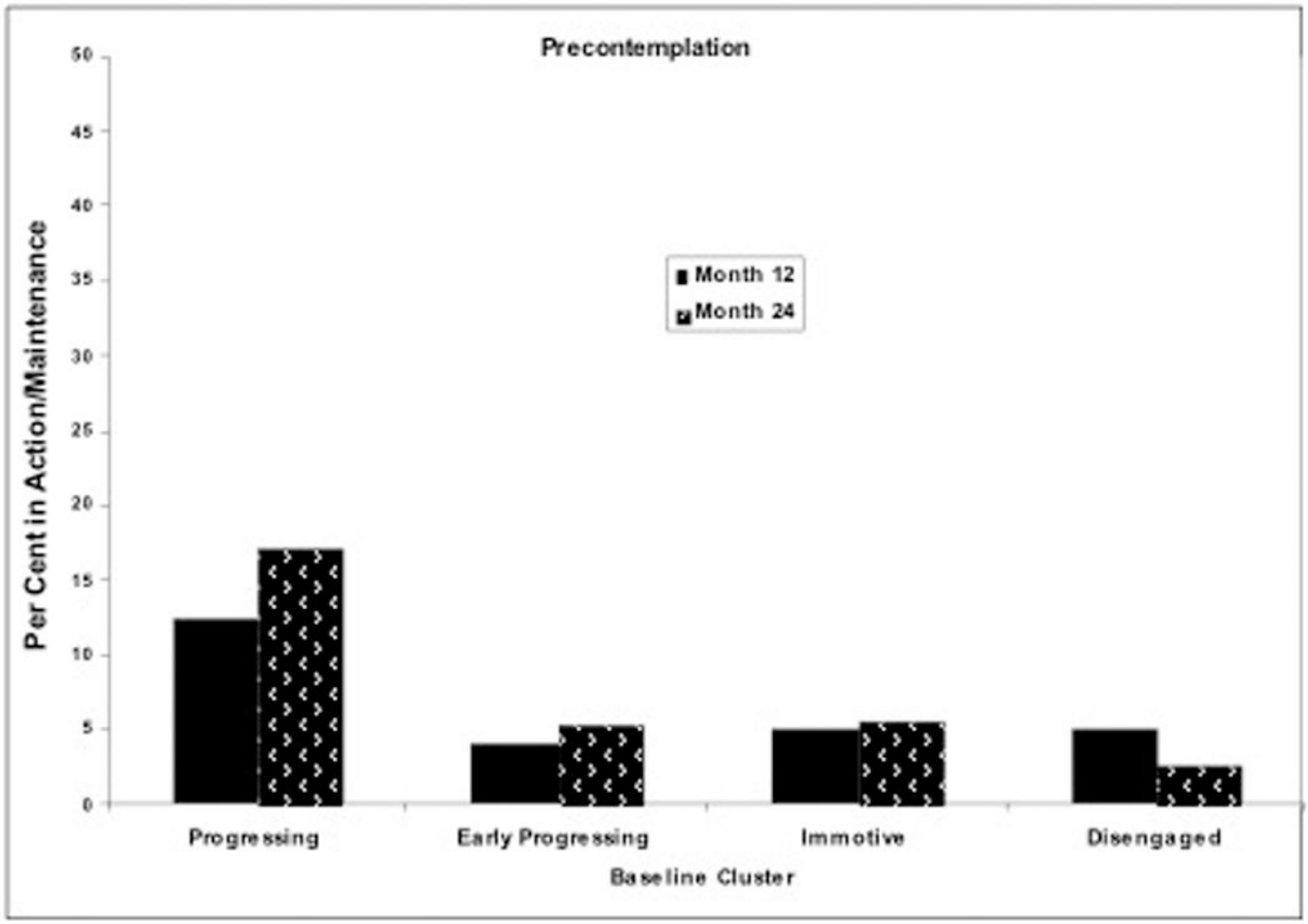

Figure 1.

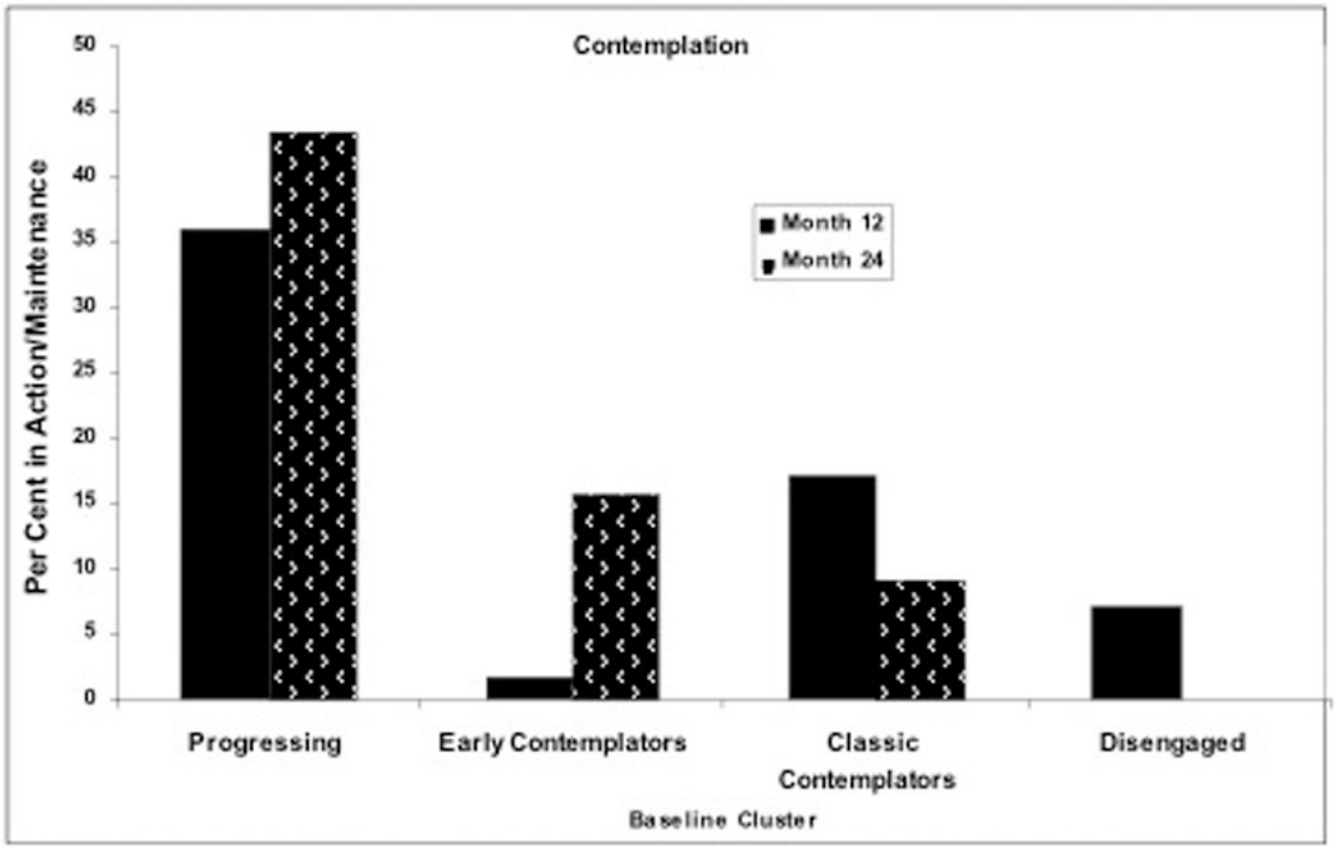

Figure 2.

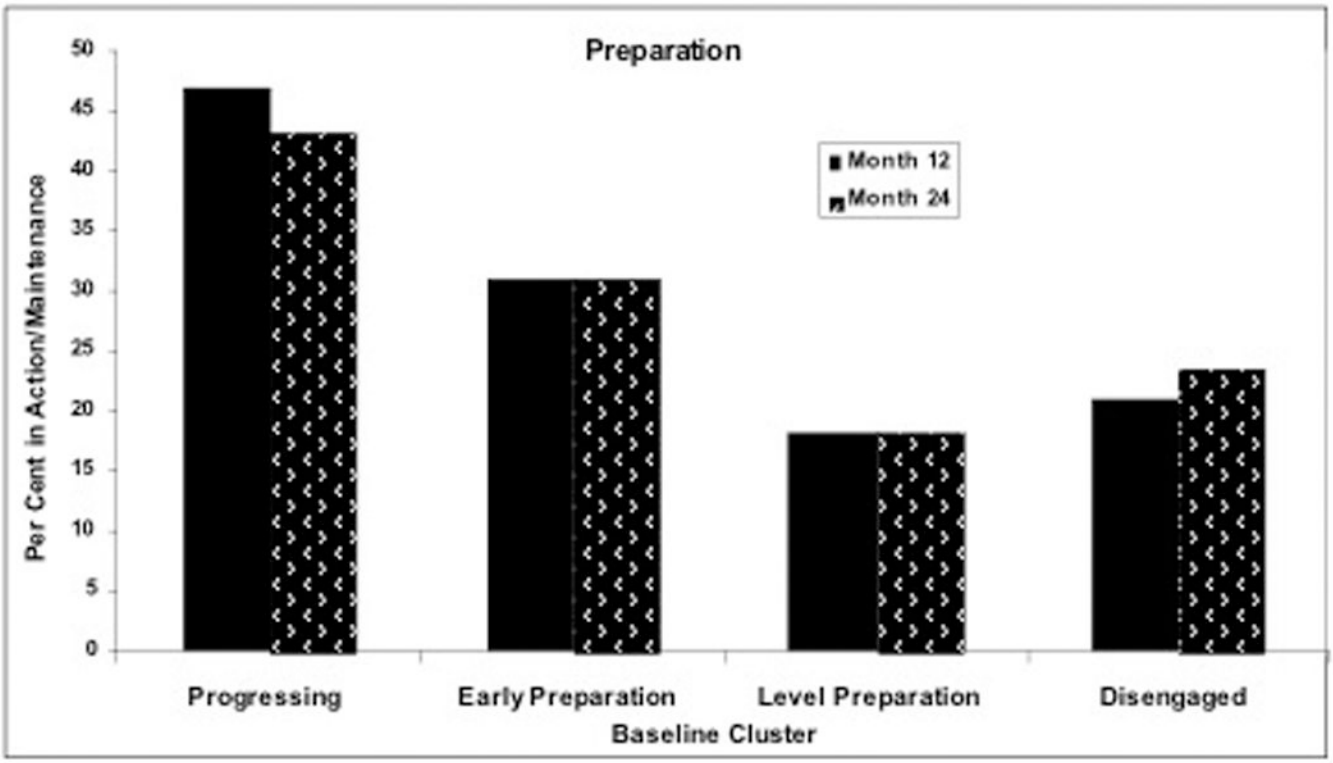

Figure 3.

Table 1

Scores of Sun Protection Behavior Scale (SPBS) by profile: Mean, standard deviation, and post hoc test comparisons at 12-month and 24-month time point for precontemplation

	Early Progressing	Progressing	Immotive	Disengaged	*Post hoc test*
SPBS					
12 months, $F(3, 409) = 27.63$, $p < .001$					
	19.6 (5.2)	22.8 (5.1)	17.6 (5.3)	16.4 (5.4)	P> all; E>I, D *
24 months, $F(3, 378) = 33.27$, $p < .001$					
	20.2 (5.0)	23.4 (5.0)	18.1 (5.4)	15.8 (4.7)	P> all; E>I, D *

* E=Early Progressing, P=Progressing, I=Immotive, D=Disengaged

Table 2

Scores of Sun Protection Behavior Scale (SPBS) by profile: Mean, standard deviation, and post hoc test comparisons at 12-month and 24-month time point for contemplation

	Early Contemplators	Classic Contemplators	Progressing	Disengaged	*Post hoc test*
SPBS					
12 months, $F(3, 150) = 9.98$, $p < .001$					
	21.9 (4.5)	24.1 (5.1)	26.0 (4.4)	19.9 (4.8)	P>E, D; C>D *
24 months, $F(3, 144) = 10.69$, $p < .001$					
	22.3 (4.5)	23.9 (3.1)	27.0 (4.9)	21.8 (5.8)	P>all *

* E=Early Contemplators, C= Classic Contemplators, P=Progressing, D=Disengaged

Table 3

Scores of Sun Protection Behavior Scale (SPBS) by profile: Mean, standard deviation, and post hoc test comparisons at 12-month and 24-month time point for preparation

	Early Preparation	**Level Preparation**	**Progressing**	**Disengaged**	***Post hoc test***
SPBS					
12 months, $F(3, 198) = 6.22$, $p < .001$					
	25.4 (4.4)	24.0 (5.1)	27.1 (4.4)	21.7 (5.7)	P>L, D; E>D *
24 months, $F(3, 185) = 6.90$, $p < .001$					
	25.4 (5.3)	23.7 (5.4)	28.4 (4.4)	22.8 (6.0)	P> L, D

* E=Early Preparation, L=Level Preparation, P=Progressing, D= Disengaged