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Does the Transtheoretical Model of Behavior Change Provide a Useful Basis for Interventions to Promote Fruit and Vegetable Consumption?

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Abstract

Purpose—To determine whether Transtheoretical Model (TTM) constructs differ between individuals making successful versus unsuccessful stage transitions for consumption of five or more servings of fruit and vegetables each day and thus provide a useful basis for designing health promotion interventions.

Design—Longitudinal, observational study. A randomly selected, multiethnic cohort of adults assessed at 6-month intervals over 2 years.

Setting—General community, Hawaii.

Subjects—There were 700 participants (62.6% female; mean = 47 ± 17.1 years; 31.1% Asian, 22.1% Native Hawaiian/Pacific Islander, 35.0% Caucasian; 25.1% participation rate).

Measures—Stage of readiness, experiential and behavioral processes of change, pros, cons, self-efficacy, and self-reported fruit and vegetable consumption.

Analysis—The study used *t*-tests to determine which TTM variable scores differed consistently between those making “successful” versus “unsuccessful” stage transitions from precontemplation, preparation, and maintenance. Sample sizes for contemplation and action prohibited similar analyses.

Results—Compared to those remaining in precontemplation, individuals successfully progressing from precontemplation showed significantly greater use of behavioral processes (collectively and self-liberation) and consciousness raising ($p < .001$). However, only self-liberation demonstrated significant differences consistently over time.

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Manuscript format: research; Research purpose: relationship testing; Study design: longitudinal; Outcome measure: cognitive, behavioral; Setting: state; Health focus: nutrition; Strategy: behavior change; Target population age: adults; Target population circumstances: education/income level, geographic location, and race/ethnicity.

For this study, work was performed at the Department of Public Health Sciences, John A. Burns School of Medicine, University of Hawaii at Manoa, 1960 East-West Road Honolulu, Hawaii 96822.

Conclusion—This longitudinal investigation reveals that TTM behavioral processes, particularly self-liberation, predict successful transition out of precontemplation for adult fruit and vegetable consumption, suggesting that public health messages tailored according to these TTM variables may be effective for this group. However, for adults prepared to adopt or maintain fruit and vegetable consumption, tailoring based on variables from other theories is needed.

Keywords

Transtheoretical Model; Fruit and Vegetable Consumption; Stage Transitions; Processes of Change; Longitudinal Study; Prevention Research

PURPOSE

Increased fruit and vegetable consumption worldwide could reduce heart disease, stroke, and some cancers by 31%, 19%, and 12% to 20%, respectively.¹ The combination of low fruit and vegetable intake with high energy intake also plays a major role in high obesity rates.² Despite a national fruit and vegetable campaign and ongoing promotion efforts,³ Americans showed no increase in fruit and vegetable consumption between 1988 and 2002.⁴ Consistently, only 11% of adults met guidelines for both fruits (at least two servings per day) and vegetables (at least three servings per day).⁴ These data indicate a need for improved understanding of how individuals make positive health behavior changes.

Stage models of health behavior change postulate a number of discrete stages of readiness to change behavior, and different factors are hypothesized to be important in influencing movement between different stages.⁵ An important public health implication of stage models is that different interventions are appropriate at different stages of behavior change. The Transtheoretical Model (TTM)⁶ is the most popular stage model and is also one of the most popular theories in the field of health promotion.⁷ In addition to five stages of readiness to change (precontemplation, contemplation, preparation, action, maintenance), the TTM postulates that movement between stages is influenced by 10 change processes (Table 1), as well as pros and cons to changing and self-efficacy.⁶ Change processes (or strategies) are divided into experiential (emotional/cognitive) and behavioral (observable, social/situational) processes. In order to promote successful movement through the stages and attain sustained improvements in fruit and vegetable consumption, the TTM posits that public health interventions need to be tailored to those factors that induce these forward stage transitions.⁶

Researchers have expressed uncertainty⁸ and lack of consensus⁹ about which TTM variables predict forward movement through the stages. Studies applying the TTM to exercise behavior change in adolescents¹⁰ and adults¹¹ have generated findings that have either been nonsignificant¹⁰ and/or have been only partly consistent with hypothesized influences of the change processes on behavior change.¹¹ Regarding fruit and vegetable consumption, the fundamental question of how individuals who make successful forward stage transitions differ from those who do not remains unanswered.^{7,12}

To our knowledge, only one longitudinal test of the TTM applied to stage transitions in adult fruit consumption has been published.^{13,14} Its findings have countered TTM hypotheses regarding the important influencing factors at each stage.^{6,15} Cross-sectional analyses of fruit and vegetable consumption^{14,16,17} and dietary fat intake¹⁸ also reveal findings contrary to the TTM assumption that experiential processes (emotional/cognitive strategies) are more appropriate for inducing stage transitions in those less ready to change and that behavioral processes (social/situational strategies) are more suitable in the later stages. Further investigation is needed to determine which of the TTM constructs differ between those

making successful transitions (i.e., forward movement through the stages; stability in the case of “maintenance” stage) and unsuccessful stage transitions for fruit and vegetable consumption.

The lack of superiority of recent TTM-based fruit or vegetable interventions may reflect the uncertainty as to which TTM constructs are important in specific stage transitions.^{8,19} Systematic reviews note that stage-based interventions show limited evidence of positive effect on behavior change,^{12,20} and the evidence suggesting that TTM-based interventions are more effective at improving fruit and vegetable consumption than other kinds of interventions is also limited.^{7,12}

Only if it can be clearly demonstrated that TTM constructs differ significantly between individuals making “successful” and “unsuccessful” stage transitions, can the TTM be seen as providing a useful basis for tailoring interventions.^{5,21} The present study tests the following TTM hypotheses: (1) compared with those who remain in precontemplation, those who successfully progress from precontemplation have higher perceived pros of changing and more frequently utilize experiential processes of change; (2) compared with those who remain in preparation or regress to an earlier stage, those who successfully progress from preparation have lower perceived cons of changing, higher self-efficacy, and more frequent utilization of change processes; and (3) compared with those who regress to an earlier stage, those who are successfully stable in maintenance have higher self-efficacy and more frequently utilize behavioral processes of change. The current study is unique in testing these TTM-generated hypotheses in a large longitudinal study of adults, where the entire TTM for fruit and vegetable consumption is included.

METHODS

Design

A hired survey firm recruited Hawaiian residents by using random digit dialing and programming into a computer-assisted telephone interview system a questionnaire that assessed all TTM constructs. This included stage of readiness to consume five or more servings of fruits and vegetables each day, processes of change, self-efficacy, and decisional balance for fruit and vegetable consumption, in addition to demographic and fruit and vegetable intake questions. The same interviews were repeated 6, 12, 18, and 24 months later. Interviewers attended a 2-day training covering interview techniques, monitoring procedures, ethical issues, and role-playing difficult situations. Trained study staff performed checks on two to three interviews at each time point, determining interviewer quality. Using scores from 1 (very poor) to 5 (excellent), interviewers received appropriately high scores on adherence to protocol (mean = 4.4, SD = .3), politeness (mean = 4.1, SD = .8), articulation (mean = 4.7, SD = .4), and professionalism (mean = 4.7, SD = .4).

Sample

A total of 41,463 calls were attempted with 4392 calls resulting in contact, of which, 2785 calls (63.4%) reached eligible households and 1607 reached businesses or ineligible households (paggers, nonresidents, non-English speakers). By asking for an adult household member who had the most recent birthday, 700 adults (18 years or older) were recruited (25.1% participation rate). The baseline survey supported TTM hypotheses regarding stage differences in self-efficacy, pros and cons, and fruit/vegetable consumption; however, most experiential and behavioral processes were higher in the earlier stages, then leveled off. Results from the baseline survey have been described in detail elsewhere.¹⁶

Participants provided informed consent prior to the baseline interview, and all procedures were approved by the University of Hawaii Human Participants Committee. Participants

were offered incentives to complete 30-minute phone interviews (\$10 per interview, \$25 for final) at 6-month intervals over 2 years.

Measures

An assessment of intake was made using the National Cancer Institute Fruit and Vegetable screener.²² In the interview, self-efficacy to eat fruits and vegetables in challenging situations was assessed using the 6-item Self-Efficacy Questionnaire;²³ the pros and cons of fruit/vegetable consumption were assessed using the two-factor, 10-item Decisional Balance Questionnaire;²⁴ and the processes of change (in the context of fruit/vegetable consumption) were assessed using the 36-item Processes of Change Questionnaire.²⁵ The questionnaires were piloted by interviews for interpretability and ease of administration. Reliability and validity details of all measures have been reported previously.¹⁶

Definition of Unsuccessful Versus Successful Stage Transition

Stage transitions were examined over four periods—baseline to 6 months, 6 to 12 months, 12 to 18 months, and 18 to 24 months—to replicate results within the study. TTM stage was numerically coded as follows: precontemplation = 1; contemplation = 2; preparation = 3; action = 4; and maintenance = 5. For each of the four transition periods, stage transition scores between time 1 (T1) and time 2 (T2) were calculated (T2 stage minus T1 stage). With two exceptions, stage progression (stage transition score > 0) was defined as “successful,” whereas stage regression or no change (stage transition score = 0) was defined as “unsuccessful.” The first exception was that stage transitions from precontemplation at T1 to action or maintenance at T2 (stage transition score > 2) were deemed implausible. A total of 64 transitions were identified as implausible. As defined by the TTM, precontemplators have no intention to change a specified behavior in the next 6 months. A stage transition from precontemplation to action or maintenance within 6 months would suggest the self-assessment of stage was most likely inaccurate. The second exception was that “success” among those in the maintenance stage was defined as no stage change (stage transition score = 0). Furthermore, because successful transition from action to maintenance would require one to sustain actual behavior change for over 6 months, individuals reporting that they remained in the action stage (consuming the target amount of fruits/vegetables for less than 6 months) were assumed to have experienced relapse and therefore deemed “unsuccessful.”

Analyses

In this study, *t*-tests were used to determine which TTM variables were consistently different between those making “successful” versus “unsuccessful” stage transitions from precontemplation, preparation, and maintenance. Sample sizes for contemplation and action prohibited similar analyses. Analyses were repeated for each transition period (0 to 6 months, 6 to 12 months, 12 to 18 months, and 18 to 24 months). At each transition period, mean *time 1* (i.e., *T1*) TTM variable scores were compared between those classified as making “successful” versus “unsuccessful” stage transitions. A consistent pattern of significant between-group differences would be suggestive of predictive indicators of stage transition. A consistent pattern was defined as TTM variable scores that significantly differed between “successful” and “unsuccessful” stage transitions over two or more transition periods. Given the large number of comparisons (15 variables by four stage transitions), a Bonferroni correction was applied to the *p*value ($0.05/60 = .0008$). Significance was set at $p < .001$. Significant findings were reanalyzed using analysis of covariance to control for significant differences in the distributions of sex, race/ethnicity, age, education, income, and marital status between those who were successful versus unsuccessful in each of the stage transitions.

RESULTS

Table 2 presents participants' baseline sociodemographic information. Compared to the general population of Hawaii in 2006,²⁶ the sample was similar in terms of age, but it comprised a higher proportion of women and Caucasians; a somewhat higher proportion of highly educated and divorced/separated, Black, Hispanic and other ethnicity participants; and a lower proportion of those in higher income groups (< \$50,000/year).

Of the 700 total participants, 678 (96.9%) reported their stage of change for fruit and vegetable consumption at least at one of the five time points. Response rates for each of the five time points were as follows: 0 months, 91.7% (n = 642); 6 months, 73% (n = 511); 12 months, 63.6% (n = 445); 18 months, 60.3% (n = 422); and 24 months, 56.4% (n = 395). A total of 520 (74.3%) participants reported their stage of change for fruit and vegetable consumption at a minimum of one transition period (e.g., two consecutive time points). Chi-square analyses showed that those with stage transition data were more likely older (55+ years) and married, with at least some college education, and had a greater income (> \$49,999) compared to those without stage transition data. At the first stage transition (0 to 6 months; n = 429), 17.5% had missing data and were not included in analyses for that transition. At the second (6 to 12 months; n = 360), third (12 to 18 months; n = 316), and fourth (18 to 24 months; n = 308) transitions, 30.8%, 39.2%, and 40.8%, respectively, were missing stage data for at least one of the two assessments. A total of 194 (37%) participants had data for all four stage transition periods.

For the first four time points, there was little variation in the stage distribution. A majority of the participants were in precontemplation (30.1% to 32.5%), preparation (34.4% to 39.9%), and maintenance (21.3% to 26.1%). Similarly, there was little variation across time points of those in contemplation (2.1% to 5.3%) and action (2.5% to 5.4%). At time point 5, fewer participants were in precontemplation (23.8%) and slightly more in preparation (40.3%) and maintenance (28.9%). The proportion in contemplation and action at time point 5 were within the range of previous time points. Stage Transitions from Precontemplation

Few *time 1 (T1)* TTM variable scores were indicative of successful transition out of precontemplation (Table 3) based on findings conforming to the Bonferroni-adjusted *p* value ($p < .001$). Greater scores for the behavioral processes collectively, self-liberation, and consciousness raising were indicative of successful stage transition. Given the definition of a "consistent pattern" as significant differences between "successful" and "unsuccessful" stage transitions over two or more transition periods, self-liberation was the only process indicative of successful stage transition. After adjusting for demographic covariates, none of these findings remained significant at the adjusted *p*-value. However, moderate effect sizes (adjusted $\eta^2 = .076$, 0 to 6 month transition; and $.096$, 6 to 12 month transition) were retained.

Stage Transitions from Preparation

Since none of the TTM variable scores were consistently indicative of stage transitions out of preparation, tabulated results are not presented. At only the 6 to 12 month transition, scores were lower among those who successfully transitioned out of preparation ($p < .001$).

Stability in Maintenance

None of the TTM variable scores differed significantly between individuals who successfully remained in maintenance as compared with "unsuccessfully" regressing to an earlier stage.

DISCUSSION

This is the first longitudinal study to investigate whether the hypothesized TTM constructs differ significantly between those making “successful” and “unsuccessful” stage transitions in adult fruit and vegetable consumption. The study provides limited support that the hypothesized TTM constructs predict successful transitions out of precontemplation. Contrary to model hypotheses, the TTM variables did not predict forward stage transitions from preparation or the prevention of regression from maintenance to earlier stages.

In applications to eating behavior change, it has long been assumed that the experiential processes consciousness raising (CR), dramatic relief (DR), and environmental evaluation (ER), and higher perceived pros, predict progress out of precontemplation but that behavioral processes only become relevant in later stage transitions.^{27,28} This study provides little support for the importance of experiential processes. Rather, one behavioral process, self-liberation (SL), demonstrated a consistent ability to significantly predict this stage transition. This finding is consistent with the only longitudinal study addressing processes of change in stage transitions for fruit intake: in contrast to general assumptions De Vet et al.¹⁴ reported that behavioral processes collectively predicted progression from precontemplation, with self-liberation being the strongest predictor. Two additional behavioral processes, stimulus control (SC) and reinforcement management (RM), also predicted this transition in the de Vet et al. study. De Vet et al.¹⁴ also noted that more frequent use of four experiential processes (ER, SR, CR, DR) predicted forward transition out of precontemplation. These longitudinal results, consistent with our cross-sectional analyses¹⁶ and those of de Vet et al.,¹⁴ suggest that behavioral processes are already relevant for early stage transitions.

Strengths of the present study include the careful testing of hypotheses generated by one of the most popular theories in the field of health promotion, the large sample size, and longitudinal design. A significant limitation of our study is the small samples in contemplation and action, preventing examination of transitions from these stages. Additionally, the sample was not representative of the true Hawaiian population. Our sample had a higher proportion of women and highly educated groups compared to the general population of Hawaii. Furthermore, approximately 25% (n = 180) of this sample was excluded from our analyses due to missing data and/or implausible stage transition data. This may limit the generalizability of findings; however, the intention was not to estimate prevalence rates, since the research focus is on testing TTM variable relationships. The questionnaires used to assess processes, self-efficacy, and decisional balance were developed with largely Caucasian samples and so may not fully capture these constructs in our multiethnic population. The cons examined in our questionnaire may not have adequately represented those cons perceived by our study population. This may explain why, contrary to TTM predictions (but consistent with other research),^{13,29} no support was found for cons as a stage transition determinant. It is also possible that repeated administration of questionnaires may have influenced participant responses. However, the probability of this is low considering the similarities of the stage distribution across time points.

The above-mentioned methodological limitations may partly explain differences between our findings and TTM hypotheses. However, it is also possible that the critical factors that move people from one stage to the next may vary by behavior.^{30,31} For addictive behaviors such as smoking, where cessation is the goal, overt behavior change occurs in the action stage. According to the TTM, for smoking cessation the use of behavioral processes is appropriate to individuals in the later stages. In contrast, for fruit and vegetable consumption, there is some evidence that individuals progressing through the early stages may begin making small changes in eating behavior.³² In *adopting* new behaviors (like fruit

and vegetable consumption), individuals have to perform the behavior repeatedly in the action and maintenance stages, potentially requiring different mechanisms for sustained change than for *cessation* behaviors. Candidates for such mechanisms may be the development of autonomy³³ and/or environmental considerations.

Our results may shed light on why interventions tailored to TTM variables have failed to show superiority to nontailored interventions.^{7,8,19} Interventions have generally been based on traditional TTM assumptions that successful change requires the use of experiential processes in the early stages and behavioral processes in the later stages of change. Furthermore, and consistent with cross-sectional results,¹⁶ this study also confirms the need to question traditional TTM assumptions regarding when to use specific processes of change. The behavioral process self-liberation may be important to successful transitions out of precontemplation.

This presents the first empirical evidence as to which TTM constructs are important in specific stage transitions for adult fruit and vegetable consumption. If these findings are replicated in other longitudinal studies, public health interventions aiming to promote adult fruit and vegetable consumption by tailoring messages according to TTM behavioral processes, particularly self-liberation, may be effective for precontemplators. However, our results highlight the limitations of the TTM in explaining other stage transitions in fruit and vegetable consumption and emphasize the need for other theories or new or integrated models to assist us in understanding fruit and vegetable consumption and promoting behavior change.

SO WHAT? Implications for Health Promotion Practitioners and Researchers What is already known on this topic?

No previous longitudinal studies have investigated whether adults making “successful” and “unsuccessful” stage transitions in adult fruit and vegetable consumption differ in terms of variables specified by the Transtheoretical Model (TTM).

What does this article add?

Our findings challenge usual assumptions about what facilitates progression through the stages of change. Use of self-liberation (a behavioral process) predicted successful transitions from precontemplation more so than the experiential processes generally assumed to be useful at this stage. Also contrary to hypotheses, TTM variables did not predict forward stage transitions from preparation or the prevention of regression from maintenance to earlier stages.

What are the implications for health promotion practice or research?

Practitioners aiming to improve fruit and vegetable consumption among precontemplators may find behavioral processes, particularly self-liberation, useful. However, for adults in preparation or maintenance, strategies informed by other theories are needed.

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Table 1

Processes of Change for Increasing Fruit and Vegetable (FV) Consumption

Process of Change	Description	Sample Item (“How Often Did...”)
Experiential processes		
Consciousness raising (CR)	Raising awareness of the need to eat more FV	...you read about eating more vegetables and fruits?
Environmental reevaluation (ER)	Assessing how one’s FV intake affects others.	...you think that eating more fruits and vegetables would make you a better role model?
Dramatic relief (DR)	Experiencing and expressing feelings about not eating enough FV.	...you become disturbed when you considered how eating too few fruits and vegetables can have a bad effect on your health?
Self reevaluation (SR)	Reappraising how one feels about oneself with respect to eating FV.	...you feel you’re taking responsibility for your health when you eat fruits and vegetables?
Social liberation (SO)	Considering the impact of the environment or others on one’s ability to eat FV.	...you become aware that more people are making fruits and vegetables available at events?
Behavioral processes		
Counterconditioning (CC)	Substituting FV for less healthy foods.	...you have fruit instead of sweets for dessert?
Helping relationships (HR)	Being open about the problem with someone who cares.	...someone support you in your decision to eat more vegetables and fruits?
Reinforcement management (RM)	Being rewarded by self or others for making changes.	...your family praises you for eating fruits and vegetables?
Self-liberation (SL)	Choosing and committing to act with regard to eating more FV.	...you make a promise to yourself to eat more vegetables and fruits?
Stimulus control (SC)	Using cues to promote eating FV.	...you remind yourself to have vegetables and fruits for snacks?
Interpersonal systems control (IP)	Seeking out others who promote eating FV or avoiding those who discourage eating FV.	...you spend time with people who encouraged you to eat more vegetables and fruits?
Planning ahead (PA)	Being proactive about situations that facilitate eating enough FV.	...you plan your meals in advance so you’re able to eat more vegetables and fruits?

Table 2

Demographic Characteristics Baseline Population (N = 700) and 2006 General Hawaiian Population

Characteristic	2006 Behavioral Risk Factor Surveillance System (BRFSS): Hawaii (%)	Number of Study Participants (%)
Gender		
Male	49.4	36.6
Female	50.6	62.6
Missing	0	0.9
Race/Ethnicity [†]		
Caucasian/white	26.5	35.0
Black	1.1	1.9
Hispanic	7.5	10.1
Other	41.4	63.1
Multiracial	23.5	Not comparable*
Missing	0	0
Age group		
18–34	29.3	24.9
35–54	37.5	39.0
55+	33.3	36.0
Missing	0	0.1
Highest educational level		
< High school graduation	5.8	3.3
High school graduate	30.0	27.7
Some college	28.9	28.9
College graduate	35.2	40.0
Missing	0	0.1
Total annual household income (\$)		
<10,000	Not comparable*	7.6
10,000–19,999		8.0
20,000–29,999		11.0
30,000–39,999		10.1
40,000–49,999		10.7
50,000	49.8	40.0
Missing	0	12.6
Marital status		
Married	59.2	51.4
Divorced/separated	8.5	14.7
Widowed	5.6	6.4
Other	26.6	27.2
Missing	0	0.2

[†]Values will not add to 100%.

* BRFSS data were classified differently and cannot be compared directly with our sample data.

Table 3

Mean (M) Transtheoretical Model Variable Scores Those Who “Successfully” Progressed from Precontemplation to Contemplation or Preparation Versus “Unsuccessfully” Remained in Precontemplation^{*, †}

Variable	0 months–6 months Unsuccessful (n = 97)		Successful (n = 43)		p	6–12 months Unsuccessful (n = 73)		Successful (n = 33)		p-value	12–18 months Unsuccessful (n = 68)		Successful (n = 28)		p-value	18–24 months Unsuccessful (n = 61)		Successful (n = 38)		p-value
	M	SD	M	SD		M	SD	M	SD		M	SD	M	SD		M	SD	M	SD	
Self-efficacy	2.99	0.94	3.00	0.81	0.944	3.33	1.01	3.12	0.97	0.318	3.32	0.98	3.15	1.16	0.477	3.35	0.98	3.25	0.83	0.627
Pros	3.53	1.11	3.99	0.72	0.005	3.43	1.09	4.01	0.93	0.009	3.36	1.14	4.14	0.86	0.002	3.49	1.03	3.78	1.03	0.178
Cons	1.79	0.85	1.81	0.73	0.893	1.80	0.76	1.91	0.77	0.503	1.70	0.68	1.85	0.90	0.379	1.66	0.76	1.67	0.67	0.919
EXP	2.55	0.93	3.05	0.89	0.003	2.40	0.91	3.07	0.95	0.001	2.40	0.85	3.00	0.78	0.002	2.57	0.93	2.83	0.84	0.156
CR	2.13	1.02	2.68	1.24	0.007	1.96	0.88	2.80	1.11	<0.001	2.05	0.92	2.58	0.96	0.013	2.15	0.95	2.35	0.94	0.313
DR	2.19	1.04	2.66	1.12	0.017	2.18	0.99	2.87	1.11	0.002	2.13	0.97	2.62	0.98	0.027	2.26	0.96	2.54	1.00	0.166
ER	2.63	1.21	3.33	1.13	0.002	2.49	1.18	3.29	1.01	0.001	2.45	1.08	3.21	1.13	0.002	2.65	1.18	2.98	1.12	0.169
SR	2.97	1.16	3.43	0.87	0.011	2.79	1.08	3.49	1.04	0.002	2.80	1.06	3.61	0.83	0.001	3.04	1.09	3.39	0.93	0.111
SO	2.69	1.14	3.04	1.06	0.095	2.57	1.09	2.88	1.09	0.179	2.55	1.04	2.95	0.85	0.074	2.73	1.10	2.89	0.95	0.454
BEH	2.24	0.77	2.79	0.81	<0.001	2.23	0.83	2.57	0.81	0.049	2.25	0.78	2.70	0.66	0.009	2.33	0.74	2.44	0.75	0.461
CC	2.70	0.95	3.09	1.05	0.029	2.72	1.11	3.14	1.04	0.070	2.80	1.05	3.15	0.86	0.123	2.80	1.02	2.96	0.95	0.416
HR	2.26	1.06	2.87	1.14	0.003	2.22	1.14	2.29	1.19	0.776	2.19	0.99	2.52	1.06	0.145	2.19	1.02	2.26	1.07	0.738
RM	1.71	0.87	2.36	1.14	0.002	1.75	0.89	2.00	1.05	0.216	1.63	0.86	2.04	0.98	0.045	1.78	0.92	1.82	0.91	0.834
SC	2.08	0.92	2.50	1.08	0.018	2.05	0.92	2.41	0.89	0.057	2.21	0.86	2.51	1.01	0.137	2.21	0.81	2.42	0.93	0.231
SL	2.43	1.07	3.13	0.89	<0.001	2.41	1.12	3.01	0.94	0.009	2.45	1.06	3.30	0.90	<0.001	2.68	1.08	2.75	0.99	0.724

* Transtheoretical Model variables at the first time point were used to predict successful versus unsuccessful stage transitions. Data analyzed by *t*-tests.

† Significant findings are those that met the Bonferroni-adjusted *p*-value of <0.001 based on 60 comparisons (15 variables by four stage transition periods).

M, mean; SD, standard deviation; EXP, BEH, the aggregates of experiential (EXP) and behavioral (BEH) processes; CR, consciousness raising; DR, dramatic relief; ER, environmental reevaluation; SR, self-reevaluation; SO, social liberation; CC, counterconditioning; HR, helping relationships; RM, reinforcement management; SC, stimulus control; SL, self-liberation.