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## **Predictors of Successful Behavior Change Within and Across Multiple Health Risk Behaviors**

Southey F. Saul  
*University of Rhode Island, southeysaul@gmail.com*

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PREDICTORS OF SUCCESSFUL BEHAVIOR CHANGE  
WITHIN AND ACROSS MULTIPLE HEALTH RISK  
BEHAVIORS

BY  
SOUTHEY F. SAUL

A MASTER'S THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE  
REQUIREMENTS FOR THE DEGREE OF  
MASTER OF ARTS  
IN  
CLINICAL PSYCHOLOGY

UNIVERSITY OF RHODE ISLAND

2016

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MASTER OF ARTS IN CLINICAL PSYCHOLOGY

OF

SOUTHEY F. SAUL

APPROVED:

Thesis Committee:

Major Professor

\_\_\_\_\_  
James O. Prochaska

\_\_\_\_\_  
Andrea L. Paiva

\_\_\_\_\_  
Bryan Blissmer

\_\_\_\_\_  
Nasser H. Zawia  
DEAN OF THE GRADUATE SCHOOL

UNIVERSITY OF RHODE ISLAND  
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## ABSTRACT

Discovering trends in the differences and similarities of variables predicting change across different behaviors may shed light on why some behaviors appear more easily changed than others. Discovering the best predictors of healthy behavior change may contribute to the development of more effective evidence-based interventions that foster healthy behavior change across multiple health domains.

This study was designed to examine whether there are consistent treatment group, stage of change, demographic, behavior severity, and effort effects that predict long-term changes across three affective behaviors (stress management, emotional eating, depression prevention). The four effects were then compared to three other behaviors previously published in univariate analyses (smoking, healthy diet, sun exposure).

Data were analyzed from multiple randomized controlled trials (RCTs) using Transtheoretical Model (TTM) tailored interventions and comparison groups ( $N = 1085$  stress management;  $N = 458$  emotional eating;  $N = 196$  depression prevention).

Univariate logistic regressions were performed within each of the new affective behaviors to determine whether the four effects were significant predictors of successful behavior change. Multivariate logistic regressions were then used to assess which of the four effects were most predictive within these three behaviors. Similar multivariate logistic regressions were also done for the three behaviors that had been previously published in univariate analyses (smoking, healthy diet, sun exposure). Informal comparisons were then made across the predictors of all six of the health behaviors.

For stress management, treatment group and stage were the strongest predictors of change. For emotional eating, treatment group and cons of change were predictors of change. For depression prevention, depression severity and self-efficacy were predictors of change. For smoking, treatment group, stage, severity, self-efficacy, and behavioral processes of change were change predictors. For healthy diet, treatment group, stage, gender, and severity were predictors of change. For sun exposure, treatment group, stage, severity, pros of changing, cons of changing, and self-efficacy were all predictors of change. Treatment group was a strong predictor of change across five of the six behaviors. Behavior changes were not consistently related to fixed demographic variables.

Future intervention research can target the four effects to discover whether advancements can be made in these six different health behaviors.

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Data used for this project were drawn from multiple grants examining the efficacy of smoking, diet, and sun exposure interventions, including a grant from the National Institute on Aging (NIA) (#AG 024490-01A2, Principal Investigator, Prochaska), multiple grants from the National Cancer Institute (NCI) (#CA 50087, CA 27821, CA 85990, Principal Investigator, Prochaska; #CA 85999, Principal Investigator, Velicer; #AR 430521, Principal Investigator, Weinstock), and a grant from the American Cancer Society (ACS) (#MSRG-05-092-01-CPPB, Principal Investigator, Blissmer). Data was also used from National Cancer Institute (NCI) Small Business Innovation Research Grant (#R44 CA 81948-01, Principal Investigator, Evers) assessing a clinical trial of a stress-management program. Data was also drawn from a National Institute of Mental Health (NIMH) grant (#R44 MH 60522, Principal Investigator, Levesque) assessing the efficacy of a computer-tailored intervention for depression prevention. Data was also drawn from a National Heart, Lung, and Blood Institute (NHLBI) funded grant (#R44 HL070549, Principal Investigator, Johnson) exploring multiple behaviors for weight management, and

intervention effectiveness on a population basis. Special appreciation also goes to Pro-Change Behavior Systems, Inc., for making data available to me.

As a secondary data analysis that did not access participant personal health information (PHI), the Institutional Review Board (IRB) granted this project an exemption. All statistical procedures were conducted with SPSS, and all literature was accessed through the URI library reference databases.

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# CHAPTER 1

## INTRODUCTION

Health behavior change research has shown that populations at risk for multiple health behaviors simultaneously experience higher morbidity, disability, and premature mortality rates (Doll et al., 2004; Khavik et al., 2008; Mokdad et al., 2004). In fact, most of the United States' adult population suffers from two or more health behavior risks (Fine et al., 2001; Poortinga, 2007). Moreover, in 2005, only 3% of adults in the United States met health criteria for being a healthy weight, exercising regularly, being a nonsmoker, and eating enough fruits and vegetables (Reeves & Rafferty, 2005).

Thus, investigating the predictors of successful behavior change both within individual behaviors and across multiple different behaviors (e.g. smoking and healthy eating) will enhance our understanding of the dynamic relationships between different health risk behaviors. Discovering trends in the differences and similarities of variables predicting change across different behaviors may shed light on why some behaviors appear more easily changed than others. Furthermore, discovering the best predictors of healthy behavior change may contribute to the development of more effective evidence-based interventions that foster healthy behavior change across multiple health domains.

## CHAPTER 2

### REVIEW OF LITERATURE

The presence of multiple risk factors is believed to have a multiplicative rather than additive effect on medical consequences and costs (Edington et al., 1997). A 2014 summary report of the National Institute of Health (NIH) on the Science of Behavior Change identified changing multiple risk behaviors as a top priority for NIH, which, in turn, has increased multiple behavior change funding and research. Thus, it is not surprising that some call multiple health behavior change research the future of preventive medicine (Prochaska, 2008).

#### **Transtheoretical Model (TTM) of Behavior Change.**

Several models of health behavior change have received notable support, such as the Social Cognitive Theory (Bandura, 1976) and the Theory of Planned Behavior (Ajzen, 1991). One model, which is perhaps the most influential integrative model of behavior change, is the Transtheoretical Model of Behavior Change (TTM) (Prochaska & DiClemente, 1983). Drawing on multiple theories, the TTM not only presents a way to conceptualize behavior change, but also provides a foundation for developing assessments of an individual's readiness to change and for tailoring individualized interventions catalyzing behavior change (Prochaska, DiClemente, & Norcross, 1992). Computer Tailored Interventions (CTIs) based on the TTM have made significant impacts on the simultaneous treatment of multiple health risk

behaviors. The TTM has subsequently been applied to a wide range of health behaviors across a variety of populations and settings (Hall & Rossi, 2008).

### **Current Predictors of Behavior Change.**

Different health behaviors have different behavior change characteristics, which may relate to successful change. That is, change characteristics can vary between acquisition and cessation, addictive and non-addictive, frequent and infrequent, legal and illegal, public and private, and socially and not socially acceptable behaviors. However, research has not adequately addressed whether such differences between behaviors account for either different rates of successful change or other predictors of change. In part, this may be due to lack of appropriate methodologies. Demographic differences have not revealed any consistent effects either. TTM constructs and the basic relationships between them have held across diverse problem behaviors and across gender, socioeconomic status, age, and minority status (Prochaska et al., 1994; Blissmer et al., 2010). Though behavior and demographic differences have not been able to account for success rate differences across behaviors, the presence of other potential common factors related to behavior change may provide better alternatives. Research has revealed predictors of success in changing single behaviors, but recent research thus far has suggested that common principles, skills, and mediators may apply and be related across multiple behaviors (e.g. Blissmer et al., 2010; King et al., 1996). Such commonalities contributing to successful change across multiple behaviors may help in developing more effective behavior interventions targeting multiple behaviors.

**Treatment.** For instance, despite using the same TTM-tailored CTIs for each of these different behaviors, these success rate differences remain consistent between behaviors. And furthermore, control groups have also shown large healthy change differences, suggesting that the different success rates between different behaviors cannot be a function of the TTM CTI treatment alone.

**Stage of Change.** Existing TTM research and research beyond the scope of the TTM demonstrate that those expressing greater behavioral intentions to change (further along in the stages of change at baseline) are more likely to change a behavior (e.g. Prochaska et al., 1994; Hellman et al., 1991). In the TTM, behavior change can be measured by an individual's movement through five stages: Precontemplation (no intention to change behavior over the next six months), Contemplation (intending to change behavior in the next six months), Preparation (intending to change in the next month), Action (the behavior is currently being modified), and Maintenance (the behavior was changed in the last six months or longer).

**Behavior Severity.** Intention to change alone, however, is not enough to explain successful behavior change. For example, one meta-analysis revealed that less than half of those with positive intentions to change actually take action on change (Sheehan, 2002). A second potential common factor in the TTM predicting successful change within a behavior is the severity of the behavior at baseline. Behavior severity is a measure of habit strength, and is the distance between an individual's current risk behavior (e.g. 18 cigarettes per day) and the respective public health behavior criterion (e.g. 0 cigarettes per day). That is, those at baseline who require greater quantitative behavioral changes to reach behavior criterion are less likely to be successful.

**Effort.** A fourth predictor of successful behavior change across multiple behaviors may be the amount of effort being made at baseline in working toward changing a behavior (Redding et al., 2011; Prochaska et al., 1985). Within the TTM context, effort may be defined by the use of decisional balance, self-efficacy, and processes of change.

Decisional balance measures the number of pros and cons of changing a behavior the individual has identified, and thus examines the pattern of cognitive and motivational shifts across the stages of change, made up of predetermined positives of changing a specific behavior (pros) and negatives of changing that behavior (cons). Decisional balance is considered helpful in understanding the motivational changes as decisional balance shifts in critical ways across the five stages (Velicer, DiClemente, Prochaska & Brandenburg, 1985).

Self-efficacy measures an individual's perceived ability or confidence to succeed at a task, and further serves as a mediator for the individual's performance on future tasks, goals, or challenges (Bandura, 1977). For example, the confidence version of self-efficacy has been used for sun exposure, while the converse of temptations has been used for smoking and diet. The scores are in the opposite direction with high confidence and low temptations reflecting better efforts.

Progress through each of the five stages is achieved via different (covert or overt) processes of change. These include different techniques and when attempting to change a behavior. In the literature, 10 processes have received the greatest empirical support (Prochaska & DiClemente, 1983; Prochaska et al., 1992), five of which are experiential (consciousness raising, dramatic relief, environmental re-evaluation,

social liberation, and self-reevaluation), and five are behavioral (stimulus control, helping relationships, counter-conditioning, reinforcement management, and self-liberation). Research has shown that successful self-changers tend to experience different processes of change when in different stages of change (Prochaska et al., 1985). The processes deemed most helpful to a particular stage should guide therapeutic interventions to ensure progression from one stage to the next (Prochaska & DiClemente, 1986). For example, Fowler, Follick & Abrams (1992) found that certain processes of change used during the early portion of a weight control treatment were the best predictors of treatment attendance and weight loss outcome.

### **Multiple Health Behavior Change (MHBC).**

Previous studies have revealed the consistency of treatment group, stage of change, behavior severity and effort variables in predicting change within individual behaviors (Velicer et al., 2007b; Prochaska et al., 1985; Redding et al., 2011). A more recent study using TTM CTIs found that treatment, stage, severity and effort predicted successful change in smoking, healthy diet and sun exposure (Blissmer et al., 2010). Changes analyzed independently at 24-month follow-ups were related to treatment and these three effects at baseline. Such findings are promising, as treatment, stage, severity and effort are all dynamic and amenable to change unlike demographics or the type of risk behavior, which are more trait or stable variables. However, research has not examined how these four effects relate to success rate differences within other unexamined health behaviors (i.e. stress management) or *across* multiple behaviors. This study will fill these research gaps by: (1) identifying how treatment, stage, severity and effort predict behavior change in affective behaviors not examined by

Blissmer et al., 2010 (emotional eating, depression management, and stress management); (2) examining relationships in a multivariate analysis for behaviors previously examined (smoking, healthy eating, sun exposure) as well as the three new affective behaviors; (3) informally identifying whether patterns of prediction hold across the six behaviors.

Conversely, any resulting variable differences across the behaviors may shed light on why some behaviors yield greater successful change than others. For example, if some behaviors require greater efforts to reach Action, then success rates are likely to be lower. By exploring these effects amongst the different behaviors, researchers can theoretically assess the amount of changes in these factors that is needed to meet each behavior criterion from baseline, and how an individual's resources can be translated or allocated differently between multiple behaviors.

Lastly, understanding the behavioral variable constructs both within and across behaviors may lead to a more cumulative and integrative science of behavior change, which may be used by policy makers and the public health field. Decision makers can use results to adopt and examine the relative effectiveness of wellness programs.

Stage, severity and effort patterns allow clinicians and scientists to gain more accurate expectations of successful change.

## CHAPTER 3

### METHODOLOGY

#### **Sample.**

This study involves secondary data analysis, and pools data across multiple randomized controlled trials, all of which use similar TTM CTIs and outcome measures (at-risk vs. not at-risk; reaching criterion vs. not; pre-Action vs. Action/Maintenance stages). These studies were used to pool baseline measures for each of the six behaviors (stress management, managing emotional eating, depression prevention, smoking, healthy diet, sun exposure). All CTIs are based on full TTM tailoring and include assessments and feedback on behavior stage, severity, and at least one of the effort variables (pros and cons of change, self-efficacy, processes of change), with most also including a control group. Data was pooled across these studies in order to gain more aggregate statistics for each behavior and the respective variables. All primary studies were approved by the Institutional Review Board at the University of Rhode Island or Pro-Change Behavior Systems, Inc.

**Stress Management Sample.** Data was utilized from a randomized controlled trial that used a national sample of 1,085 adults who were proactively recruited for participation in a clinical trial. The sample included adults with a history of stress-related symptoms in pre-Action stages for practicing stress management (not currently practicing stress management). The demographics and stage distributions for the

treatment and control groups were comparable. The majority were married, non-Hispanic Caucasian females with a mean age of 55 years (Evers et al., 2006).

**Emotional Eating Sample.** Data was utilized from a national sample of 1,277 overweight and moderately obese adults (mean age=45.37; mean BMI=30.75; 47.6% female, 79.1% White, 6.5% Black, 7.0% Hispanic, and 7.2% other) (Johnson et al., 2008).

**Depression Prevention Sample.** Data was utilized from a randomized controlled trial that used a sample of 350 adults who were screened in the primary clinics of a private medical group and public outpatient center. The sample included adults experiencing at least mild symptoms of depression but not involved in planning to seek treatment for depression. Baseline sample characteristics showed that participants came from diverse backgrounds. There were no significant differences on any baseline measures or demographic characteristics. The majority were married, non-Hispanic Caucasian females (Levesque et al., 2011).

**Smoking, Healthy Diet and Sun Sample.** Data was utilized from a pooled dataset from three separate randomized controlled trials from a National Cancer Institute Center grant which used common interventions, procedures, measures, and assessment schedules, in trials that recruited parents (Prochaska et al., 2004), primary care patients (Prochaska et al., 2005), and employees (Velicer et al., 2004) who were at-risk for at least one targeted behavior (smoking, healthy diet, or sun exposure). The demographics and stage distributions for the combined treatment and control groups ( $N = 9,461$ ) were comparable, so it was reasonable to pool the data from all three

trials. The majority were married, non-Hispanic Caucasian females with a mean age of 44 years.

### **Measures.**

The measures used in the analyses described below were administered in each of the trials listed above. For more detailed information on these measures please see the cited studies in the preceding section.

### **Demographics.**

Baseline demographics were available for gender, age, and marital status (Table 1).

### **Stage of Change.**

Stage of Change for each behavior are used to proxy risk status and success rates. The five stages for all behaviors were: Precontemplation (PC- not meeting criteria and not planning to meet criteria in the next 6 months); Contemplation (C- not meeting criteria but planning to meet criteria in the next 6 months); Preparation (P- not meeting criteria but planning to meet criteria in the next 30 days); Action (A- meeting criteria for less than 6 months); Maintenance (M- meeting criteria for more than 6 months). Participants in the pre-Action stages (PC, C, or P) are considered to be “at-risk” and participants in A or M are considered to be “not at-risk” (Prochaska & DiClemente, 1983). Moving from the pre-Action stages to A/M is considered success for all behaviors, across all samples. Below is a description of the public health criteria or Center for Disease Control’s criteria, as applicable, that were used for each behavior

for classifying “at-risk” status. Stage of change for intentions to reach public health criteria for each behavior was assessed using the same definitions.

**Stress Management.** Managing stress in effective and healthy ways included exercising, seeking social support, and using relaxation techniques (Evers et al., 2006).

**Emotional Eating.** Stage of change for managing emotional eating assessed readiness to not rely on eating to cope with emotional distress (Johnson et al., 2008) measured by the 9-item Distress Eating Scale (Johnson et al., 1999).

**Depression Prevention.** Depression prevention was defined as effectively practicing strategies to reduce or prevent depression. This includes controlling negative thinking, engaging in healthy and pleasant activities, practicing stress management, exercising, and receiving professional help when needed (Levesque et al., 2011).

**Smoking Cessation.** Point prevalence smoking abstinence was measured by asking about current smoking and intention to quit if currently smoking (Velicer et al., 2007; Prochaska et al., 1993; Velicer & Prochaska, 1999; Prochaska et al., 2001).

**Healthy Diet.** Stage of change for healthy diet assessed readiness to reduce dietary fat to no more than 30% of calories (Prochaska et al., 2004; Prochaska et al., 2005), which is a reliable and valid measure (Sarkin et al., 2001).

**Sun Exposure.** Sun exposure was measured by seven items assessing amount of time spent in the sun and amount of protection used when exposed to the sun, with lower scores reflecting less healthy sun exposure (Blissmer et al., 2010; Weinstock et al., 2002). A sun protection algorithm classified subjects by stage based on a combination of their intentions and behaviors to protect themselves from the sun

consistently by: (a) avoiding sun exposure, (b) covering up with clothing/hats, and (c) using SPF 15 sunscreens (Weinstock et al., 2002). This algorithm classified subjects by stage based on their behavior and intentions to protect themselves from sun exposure by consistently using SPF 15 sunscreens.

### **Severity.**

Severity variables reflect the degree of risk for a given behavior, and are reflected by the relative proximity of reaching that specific behavior's criterion. Behavior specific measures are defined under each behavior defined previously.

**Stress Management.** Measured by the Rhode Island Stress and Coping Inventory (RISCI) (Fava, Ruggiero & Grimley, 1998). The RISCI is a 10-item measure of perceived stress and coping items. Participants rate how often, on a 5-point Likert scale (1 = *never* to 5 = *repeatedly*) they felt stressed or able to cope in specific situations. Each of the five-item Stress and Coping subscales have good reliability with alpha coefficients of .85 and .87, respectively.

**Emotional Eating.** The 9-item Distress Eating Scale ( $\alpha = .90$ ; Johnson et al., 1999) was used to measure severity for managing emotional eating.

**Depression Prevention.** Measured by the Beck Depression Inventory, Second Edition (BDI-II) (Beck & Steer, 1996) and questions assessing current treatment for depression, age, and history of bipolar disorder. Individuals were eligible for the study if the BDI-II score was at least 14, the cutoff for mild depression.

**Smoking.** Number of cigarettes smoked was used as the best single item from Fagerstrom's scale of addiction severity (Fagerstrom, Heatherton, & Kozlowski, 1990).

**Healthy Diet.** Severity was measured by total score on healthy eating behaviors, with lower scores reflecting a less healthy diet (Prochaska et al., 2004; Prochaska et al., 2005).

**Sun Exposure.** Sun exposure severity was measured by seven items assessing amount of time spent in the sun and amount of protection used when exposed to the sun, with lower scores reflecting less healthy sun exposure (Weinstock et al., 2002).

### **Outcome Measures.**

Success was measured by the percentage of each group who progressing to the Action or Maintenance stages at final follow-up, which was 24 months for all behaviors except stress management, which had a final follow-up of 18 month. This outcome represents those who had progressed from being at -risk (below not meeting public health criteria) to being at low risk/not at-risk (at or below the criteria; meeting public health criteria), such as progressing from high fat (>30% of calories from fat) to low fat diet. It is important to note that improvement alone, such as reducing number of cigarettes, was not counted as long-term success.

### **Treatment.**

**Emotional Eating Sample.** Intervention group participants received four fully tailored reports (baseline, 3, 6 and 9 months) that provided feedback on stage of change, decisional balance, self-efficacy, and up to six stage-matched processes of

change, and a stage-matched manual addressing energy balance behaviors and fruit and vegetable consumption. Control participants completed assessments at baseline and 6 months. Follow-up assessments were conducted with all participants at 12 and 24 months (Johnson et al., 2008).

**Effort.** Effort was measured for each behavior individually, and was assessed using decisional balance and processes of change measures. The Decisional Balance Inventory uses two subscales of Pros and Cons for changing a behavior (Prochaska et al., 1994). Subjects responded using a five-point Likert scale of importance (1 = *Not At All Important*; 3 = *Somewhat Important*; 5 = *Very Important*). Processes of change are strategies that individuals use to modify problem behaviors. The Processes of Change Questionnaire (Prochaska et al., 1988) measuring 10 processes of change in a statistically well-defined and reliable measure. Subjects respond using a five-point Likert scale of frequency of use in the past month (1 = *Never*; 3 = *Occasionally*; 5 = *Repeatedly*).

### **Hypotheses and Planned Analyses.**

For each behavior, participants who are at-risk (not meeting criterion, and therefore in pre-Action stages) at baseline will be selected for the sample. Mean baseline demographic, stage, severity, and effort variables will be assessed for each behavior from the pooled selected RCTs to predict successful change at final long-term follow-up. Frequencies of the percent of participants successfully reaching behavior criterion at final follow-up (percentage moving to Action or Maintenance)

will be calculated for the treatment group and control group (if control group existed in the RCT).

### **Hypothesis 1.**

Blissmer et al.'s (2010) univariate level analyses will be extended by examining three new behaviors (stress management, emotional eating, depression prevention). It is predicted that the outcomes of Blissmer's study will hold true for these behaviors and that treatment, stage, severity and effort will be significant predictors of successful change.

**Analyses.** Within each of the three new behavior samples, a series of univariate logistic regressions will be conducted on demographics, treatment group, stage of change, severity, pros, cons, self-efficacy and processes of change (specific to each behavior) with those in A/M vs. those remaining in pre-Action at final follow-up being used as the dependent variable.

### **Hypothesis 2. Predictors of Successful Change Within Behavior at Follow-up.**

**2a. Stage of Change.** It is expected that stage of change will be the best predictor of successful change for each behavior.

**2b. Treatment.** It is expected that being in the treatment group, opposed to control group, will significantly predict successful change within each behavior.

**2c. Severity.** It is expected that behavior severity will significantly predict successful change within each behavior.

**2d. Effort.** It is expected that effort (pros of change, cons of change, self-efficacy, and processes of change) will significantly predict successful change within each behavior.

**Analyses 2a-2d.** Multivariate logistic regressions are used to explore how treatment, stage, severity and effort variables compare as predictors of successfully reaching behavior criterion within each behavior. These multivariate analyses can expand upon Blissmer et al.'s (2010) univariate level analyses (and the additional affective behaviors in Hypothesis 1) by comparing the consistency and magnitude of the four variable effects across all six behaviors with a multivariate approach.

**Hypothesis 3. Predictors of Successful Change Across Behaviors at Final Follow-up.** Informal analyses can compare the logistic regression results from Hypothesis 2 and examine the odds ratios of all behaviors. These informal comparisons across behaviors can explore any consistency in the order and magnitude of the four effects across behaviors.

## CHAPTER 4

### FINDINGS

**Hypothesis 1.** Blissmer et al.'s (2010) univariate level analyses were extended by examining three new behaviors (stress management, emotional eating, depression prevention). It was predicted that the outcomes of Blissmer's study would hold true for these behaviors and that treatment, stage, severity and effort would be significant predictors of successful change.

**Treatment.** Table 2 shows that stress management and emotional eating treatment groups had significantly more participants who progressed to Action or Maintenance at final follow-up. The effect sizes were small-medium.

**Stage of Change.** Table 2 shows that stage was a significant predictor for stress management, such that participants in Precontemplation at baseline had the smallest percentage in Action or Maintenance at long-term follow-up, and those in Preparation had the highest percentage. This effect size was small-medium. Though not significant, emotional eating and depression prevention participants in Precontemplation at baseline also had the smallest percentage in Action or Maintenance at long-term follow-up, and those in Preparation had the highest percentage.

**Demographics.** Table 2 shows that no consistent demographic effects were found across the three behaviors. Females progressed to Action or Maintenance significantly more at final follow-up for stress management, but not emotional eating or depression

prevention. The youngest group was significantly more likely to progress to Action or Maintenance at follow-up for stress management, but not emotional eating or depression prevention. Table 2 shows that effect sizes were small for both demographic variables.

**Severity.** As shown in Table 3, those in Action or Maintenance at final follow-up for depression management had significantly lower depression severity rating scores at baseline. The effect size was medium. Behavior severity at baseline was not significant for stress management or emotional eating at follow-up.

**Decisional Balance.** Those in Action or Maintenance at final follow-up for stress management had significantly more pros of changing at baseline (Table 3). Those in Action or Maintenance at final follow-up for emotional eating had significantly less cons of changing at baseline. The effect sizes ranged from small for stress management to medium for emotional eating.

**Self-Efficacy.** For depression prevention, the confidence version of self-efficacy was significantly higher for participants who progressed to Action or Maintenance at final follow-up (Table 3). This effect size was medium.

**Processes of Change.** Those applying more experiential process of change and behavioral processes of change for stress management at baseline were significantly more likely to progress to Action or Maintenance at final follow-up (Table 3). Those in Action or Maintenance at final follow-up for emotional eating applied significantly more behavioral processes at baseline. Effects ranged from small-medium for emotional eating to medium for stress management.

**Hypothesis 2. Predictors of Successful Change Within Behavior at Follow-up.** Six separate multivariate logistic regression analyses were conducted, one for each of the six behaviors, to assess which of the variables that were significant at the univariate level were the strongest predictors of successful change in each behavior at the multivariate level. Shown in Table 4, multivariate logistic regressions for each of the six behaviors included the respective behavior's variables that were significant at the univariate level in Hypothesis 1. Variables that remained significant at the multivariate level were therefore predictors of successfully reaching Action-Maintenance.

**Stress Management.** The multivariate logistic regression for stress management examined treatment group, stage, gender, age, pros of changing, experiential processes of change, and behavioral processes of change. Of these variables, treatment group and stage remained significant predictors of successful change, with treatment group being the strongest predictor of change.

**Emotional Eating.** The multivariate logistic regression for emotional eating examined treatment group, cons of changing, and behavioral processes of change. Treatment group was the strongest predictor of change, followed by cons of changing.

**Depression Prevention.** The depression prevention logistic regression examined depression severity and the confidence version of self-efficacy, both of which remained significant predictors at the multivariate level, with self-efficacy being most predictive of successful change.

**Smoking.** The multivariate logistic regression for smoking examined treatment group, stage, age, severity, pros of changing, temptations version of self-efficacy, experiential processes of change, and behavioral processes of change as predictors of

successful change. In order of magnitude, stage, treatment group, behavioral processes, self-efficacy and severity were significant predictors of successful change at the multivariate level.

**Healthy Diet.** The multivariate logistic regression for healthy diet included treatment group, stage, gender, age, severity, and pros of changing. In order of magnitude, group, stage, gender and severity remained significant predictors of change at the multivariate level.

**Sun Exposure.** Lastly, the multivariate logistic regression for sun exposure included nearly all variables—treatment group, stage, gender, age, marital status, severity, pros of changing, cons of changing, and the confidence version of self-efficacy. In order of strongest predictor of change, group, severity, stage, the confidence version of self-efficacy, cons of changing and pros of changing remained significant predictors of change at the multivariate level.

**2a. Stage of Change.** We expected that stage of change would be the best predictor of successful change for each behavior.

**Analysis 2a.** Stage of change was predictive of reaching Action-Maintenance for stress management, smoking, healthy diet, and sun exposure. Of these behaviors, stage was the best predictor of change for smoking. Interestingly, pre-Action stage was not predictive of successful change for emotional eating or depression management.

**2b. Treatment.** We expected that being in the treatment group, opposed to control group, would significantly predict successful change within each behavior.

**Analysis 2b.** Treatment group was predictive of reaching Action-Maintenance for stress management, emotional eating, smoking, healthy diet, and sun exposure.

**2c. Severity.** We expected that behavior severity would significantly predict successful change within each behavior.

**Analysis 2c.** Behavior severity was predictive of reaching Action-Maintenance for depression prevention, smoking, healthy diet, and sun exposure. Interestingly, these were the same behaviors with behavior severity as a significant predictor of change at the univariate level.

**2d. Effort.** We expected that effort (pros of changing, cons of changing, self-efficacy, experiential processes of change, behavioral processes of change) would significantly predict successful change within each behavior.

**Analysis 2d.** Emotional eating, depression prevention, smoking, and sun exposure behaviors had at least one effort variable predictive of successful change. Of all effort variables, self-efficacy was a significant predictor for the greatest number of behaviors, with depression management, smoking, and sun exposure. Following self-efficacy, the number of cons of changing was predictive of change for both emotional eating and sun exposure. Pros of changing was a significant predictor for sun exposure, while the number of behavioral processes of change used was a significant predictor for smoking. Interestingly, number of experiential processes of change was not predictive of reaching Action-Maintenance for any of the six behaviors.

### **Hypothesis 3. Predictors of Successful Change Across Behaviors at Follow-up.**

Informal analyses compared the multivariate logistic regression results from Hypothesis 2 by examining the odds ratios of all variables across all six behaviors.

Informal comparisons were made across the six behaviors to explore any consistency in the order and magnitude of the four effects across behaviors.

**Analyses.** Overall, treatment group was the most prominent predictor of successful change. Treatment group was the strongest variable predictive of successful change for stress management, emotional eating, healthy diet and sun exposure, while it was the second strongest predictor for smoking. Treatment group in emotional eating was the largest effect size across all six behaviors.

Contrary to our expectations, though stage was a significant predictor of change for stress management, smoking, healthy diet, and sun exposure, stage was not the strongest predictor of change across the behaviors. Stage was the strongest predictor of progressing to Action-Maintenance only for smoking.

No consistent demographic effects were revealed. Age and marital status were not significant predictors of change across any of the six behaviors, while gender was a significant predictor of change only for healthy diet. Females were more likely to progress to Action-Maintenance than males for healthy diet.

## CHAPTER 5

### CONCLUSION

When predictor variables were examined collectively within each of the six behaviors, analyses revealed some consistent predictors of successful health behavior change across the behaviors, but also revealed some notable differences. Specifically, there is support for the treatment group effect across five of the six behaviors, including stress management, emotional eating, smoking, healthy diet, and sun exposure. The considerably smaller sample size for depression prevention may account for treatment group failing to meet significance in that behavior. There is also support for the stage effect for stress management, smoking, healthy diet, and sun exposure. Lastly, there is support for the behavior severity effect for depression prevention, smoking, healthy diet, and sun exposure. Across all variables and behaviors, treatment group remained the most consistent predictor of reaching Action-Maintenance, followed by stage and behavior severity.

Though predictor variables were not consistent across every behavior, treatment group collectively remained the largest and strongest predictor of change for five of the six behaviors. Treatment group is the only effect that is unique to treatment conditions, and remained a significant predictor of change despite some change observed in control groups. Thus, these results can help us understand why and how control groups show behavior change over time. Future research should address the interaction of factors such as stage, demographics, severity, and effort with treatment

group to improve behavior change interventions. For example, research has revealed that when we control for stage effects by focusing on one stage, there are critical effort effects (Anatchkova, Velicer, & Prochaska, 2006; Velicer, Redding, Anatchkova, Fava, & Prochaska, 2007a).

The findings supporting the treatment group effect across five of the six behaviors also provide support for the development of more randomized controlled trials that use TTM-tailored interventions. Furthermore, evidence of the treatment effect also supports the use and potential efficacy of TTM-tailored interventions targeting novel, previously unexamined behaviors.

Multivariate analyses also indicate a potential linear relationship between behavior sample size and number of significant predictor variables. Across all six behaviors, sun exposure had both the largest sample and the most variables predictive of successful change, with six of the predictor variables remaining significant at the multivariate level. Sun was followed by smoking, with five significant predictor variables and the second largest sample size. In contrast, emotional eating and depression prevention only had two significant predictor variables and had the smallest sample sizes.

At the multivariate level, at least one effort variable was a significant predictor of reaching Action-Maintenance for four of the six behaviors, including emotional eating, depression prevention, smoking, and sun exposure. However, there were no specific effort variables that were consistently predictive of successful change across behaviors. Interestingly, there were no consistent effects within the three new affective behaviors.

Also, it may be worth emphasizing that each of the significant predictors of change for the affective behaviors at the multivariable level were also significant predictors for at least one, if not more, of the previously explored health behaviors. This may be an indicator that affective behaviors have more behavior change variables in common with other health behaviors than otherwise thought. Therefore, further research is warranted to parse out further similarities and differences across predictor variables in the different behaviors.

Overall, multivariate logistic regression analyses revealed a greater number of significant behavior change predictors in the previously examined health behaviors (smoking, healthy diet, sun exposure) compared to the three affective behaviors (stress management, emotional eating, depression prevention). Smaller sample sizes in the emotional eating and depression prevention samples may partially explain failure to reach significance in multiple predictor variables. Moreover, weight-specific studies are prone to greater dropout rates (e.g. Yachobovitch-Gavan, Steinberg, Endevelt, & Benyamini, 2015), and therefore attrition is a notable limitation of most weight management studies. Such findings demonstrate that larger sizes and further research is needed to explore predictors of behaviors pertaining to affect and mental health.

Perhaps most reassuring, is that the four effects, which are significant predictors of change though somewhat variable across behaviors, are amenable to change, which the problem behavior and inconsistent demographic effects are not. Recent research has uncovered how to assist people in progressing through the stages (Dijkstra, Conijn, & de Vries, 2006). Additionally, research has revealed how to reduce baseline behavior severity, such as motivational interviewing (MI) to reduce the number of

cigarettes smoked (Carpenter, Hughes, Solomon, & Callas, 2004), which could be applied to other behaviors. Furthermore, tailored feedback can be provided to help guide individuals to incorporate more effort with change variables, such as processes of change, and pros and cons of changing (Noar et al., 2007). Future research in behavior change may develop from interventions intending to maximize the four effects that are predictive of long-term outcome (Glasgow et al., 2004).

This paper builds upon the findings of Blissmer et al. (2010) by assessing treatment, stage, severity and effort effects separately for three new affective behaviors, while also examining the relationships between the four effects both within all six behaviors and across the six behaviors. More research needs to explore the relationship between the four effects and affective behaviors as effects are less consistent compared to more traditional health behaviors, such as smoking, healthy eating, and sun exposure.

Given that the treatment effect is most significant across behaviors, we need to consider that the treatment may be impacting the other variables of stage, severity and effort. That is, baseline measures of stage, severity and effort may be impacted by the TTM treatment over the course of treatment. Therefore, stage, effort and severity variables abilities to predict successful behavior change may be affected as the TTM treatment itself is influencing predictive capabilities longitudinally.

In other words, treatment is clearly the independent variable when examining the percentage of participants who successfully progressed to A/M. The remaining three variables, stage, effort and severity, may be considered as more intermediate variables, rather than independent variables. That is, the treatment independent variable may

modify stage, severity and effort variables, and therefore influencing their abilities to predict successful behavior change. Thus, the predictive strength of these three variables may appear less remarkable as they are undergoing change from baseline over the course of treatment. Treatment has the opportunity to act on stage, severity and effort.

**Limitations.** Again, small sample sizes for emotional eating and depression prevention may have prevented effect trends from reaching statistical significance. Research with larger samples may reveal significant effects across these affective behaviors. Similarly, more representative samples may also yield clearer demographic effects.

Moreover, a majority of emotional eating and depression prevention participants were in Preparation at baseline, whereas a majority of stress management participants were in Precontemplation at baseline. Thus, it is not surprising that stage was significant for stress management, as few participants were in Preparation, compared to emotional eating and depression.

For example, the stage effect for stress management is significant, but not for emotional eating or depression prevention. However, there is evidence of a stage effect trend, such that all three behaviors' effect sizes range from small to small-medium, hinting toward our original hypothesis that analyses would reveal a significant stage effect. Unfortunately, however, emotional eating and depression prevention lack a reasonable sample size in comparison to stress management.

The heterogeneity of the combined samples may be a limitation, due to the noise that is introduced. Heterogeneity in the measures may have influenced the results as well.

For example, the pros and cons of changing (e.g. stress management) differ from the pros and cons of the behavior (e.g. smoking), and self-efficacy is measured either by confidence (e.g. emotional eating) or temptations (e.g. smoking). Furthermore, the affective behaviors had cut-off scores for Action-Maintenance criteria, while smoking used abstinence as Action-Maintenance criteria.

APPENDICES

Table 1. Baseline demographics

<i>Variables</i>	Stress Management N (%)	Emotional Eating N (%)	Depression Prevention N (%)
Stage			
PC	542 (50.0)	37 (8.1)	44 (22.4)
C	368 (33.9)	79 (17.2)	32 (16.3)
Prep	175 (16.1)	342 (74.7)	120 (61.2)
Gender			
Male	333 (31.1)	97 (21.2)	67 (34.2)
Female	739 (68.9)	361 (78.8)	129 (65.8)
Age			
34 and younger	97 (8.9)	97 (21.2)	51 (26.0)
35-49	236 (21.8)	191 (41.7)	57 (29.1)
50-64	458 (42.2)	158 (34.5)	61 (31.1)
65 and older	294 (27.1)	12 (2.6)	27 (13.8)
Marital status			
Married	713 (66.9)	328 (72.1)	88 (44.9)
Not married/Living with partner	37 (3.5)	22 (4.8)	25 (12.8)
Single	86 (8.1)	41 (9.0)	50 (25.5)
Separated	19 (1.8)	6 (1.3)	8 (4.1)
Divorced	102 (9.6)	49 (10.8)	17 (8.7)
Widowed	109 (10.2)	9 (2.0)	8 (4.1)

Table 2. Percentage in Action/Maintenance at final follow-up for each behavior by baseline treatment, stage and demographic variables

Variables Condition	% in Action/Maintenance		
	Stress Management N (%)	Emotional Eating N (%)	Depression Prevention N (%)
Control Group Treatment Group Sig. Phi	193 (44.7) 216 (62.4) p < .001 .18	32 (26.7) 44 (44.9) p < .01 .19	41 (57.7) 40 (66.7) p > .05 .09
Stage PC C Prep Sig. Phi	160 (43.6) 164 (58.8) 85 (64.4) p < .001 .17	4 (22.2) 12 (27.3) 60 (38.5) p > .05 .12	13 (46.4) 12 (54.5) 56 (69.1) p > .05 .20
Gender Male Female Sig. Phi	101 (44.3) 304 (56.3) p < .01 .11	16 (38.1) 60 (34.1) p > .05 -.03	55 (64.0) 26 (57.8) p > .05 -.06
Age 34 and younger 35-49 50-64 65 and older Sig. Phi	35 (59.3) 94 (53.4) 193 (56.4) 87 (43.4) p < .01 .11	13 (33.3) 29 (32.6) 31 (37.3) 3 (42.9) p > .05 .06	19 (76.0) 25 (59.5) 27 (61.4) 10 (50.0) p > .05 .16
Marital Status Married Not married/Living with partner Single Separated Divorced Widowed Sig. Phi	261 (50.8) 14 (63.6) 29 (49.2) 6 (66.7) 42 (59.2) 47 (52.8) p > .05 .07	58 (35.4) 3 (50.0) 5 (31.2) 0 (0.0) 6 (25.0) 4 (80.0) p > .05 .19	42 (62.7) 5 (41.7) 19 (70.4) 0 10 (66.7) 5 (71.4) p > .05 .25

Table 3. Baseline severity and effort variables by success at final follow up

Baseline variables		Stress Management	Emotional Eating	Depression Prevention
		<i>M (SD)</i>		
Stress severity (RISCI-Stress)	N= 361 Pre-action	15.90 (4.5)		
	N= 398 A/M	16.32 (4.2)		
	F	1.77		
	Sig.	p > .05		
	Eta-squared	.00		
Stress severity (RISCI-Coping)	N= 355 Pre-action	17.96 (3.7)		
	N= 398 A/M	18.08 (3.4)		
	F	0.24		
	Sig.	p > .05		
	Eta-squared	.00		
Emotional Eating Severity	N= 141 Pre-action		37.74 (7.1)	
	N= 76 A/M		38.62 (7.6)	
	F		.71	
	Sig.		p > .05	
	Eta-squared		.00	
Depression Severity (BDI)	N= 50 Pre-action			25.38 (7.8)
	N= 81 A/M			21.86 (5.7)
	F			8.81
	Sig.			p < .01
	Eta-squared			.06
Pros of Changing	Pre-action	3.36 (.9)	14.91(3.0)	15.20 (3.9)
	A/M	3.68 (.8)	14.99 (3.5)	14.61 (3.6)
	F	25.62	.03	.81
	Sig.	p < .001	p > .05	p > .05
	Eta-squared	.03	.00	.01
Cons of Changing	Pre-action	2.57 (.8)	12.67 (2.8)	9.83 (3.7)
	A/M	2.64 (.7)	11.20 (2.9)	9.06 (3.6)
	F	1.34	12.90	1.37
	Sig.	p > .05	p < .001	p > .05
	Eta-squared	.00	.06	.01
Self-efficacy	Pre-action	3.01 (.8)	16.42 (4.6)	14.46 (4.3)
	A/M	3.00 (.7)	17.58 (4.3)	16.66 (4.4)
	F	.05	3.29	7.74
	Sig.	p > .05	p > .05	p < .01
	Eta-squared	.00	.02	.06
Experiential processes	Pre-action	40.21 (10.6)	47.02 (9.2)	34.80 (9.4)
	A/M	44.81 (9.7)	48.34 (10.0)	36.75 (8.4)
	F	37.35	.96	.67
	Sig.	p < .001	p > .05	p > .05
	Eta-squared	.05	.00	.01
Behavioral processes	Pre-action	35.97 (9.7)	39.1 (9.6)	39.90 (8.4)
	A/M	39.63 (10.1)	42.47 (9.8)	42.38 (9.8)
	F	25.20	5.85	.93
	Sig.	p < .001	p < .05	p > .05
	Eta-squared	.03	.03	.02

Table 4. Predictors of successful change within behaviors at follow-up

Baseline variables	Stress Management	Emotional Eating	Depression	Smoking	Diet	Sun
Treatment Group	1.9***	2.16*	--	1.34**	1.47***	2.08***
Stage of Change	1.29*	--	--	1.58***	1.26***	1.11***
Gender	1.28	--	--	--	1.19*	1.08
Age	.91	--	--	1.09	1.09	.99
Marital Status	--	--	--	--	--	0.984
Severity	--	--	0.93*	0.97***	1.07***	1.19***
Pros	1.18	--	--	0.94	0.987	1.03*
Cons	--	0.851**	--	--	--	0.962***
Self-efficacy	--	--	1.11*	0.84*	--	1.1***
Experiential processes	1.02	--	--	0.88	--	--
Behavioral processes	1.02	1.03	--	1.22*	--	--

\*\*\*p < .001; \*\*p < .01; \*p < .05

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