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INTEGRATING THE TRANSTHEORETICAL MODEL:

A QUANTITATIVE ANALYSIS

IN THE AREA OF SUN EXPOSURE

BY

JANET L. JOHNSON

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE

REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

PSYCHOLOGY

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Abstract

The constructs involved in the Transtheoretical Model (TTM) have been shown to have similar relationships to the Stages of Change across a variety of behaviors. While much work has been done investigating the way the constructs interact cross-sectionally and longitudinally, a completely integrated look at all the constructs of the TTM has not yet been successful. This study integrated all constructs of the TTM related to increase of sun protective behavior across three time points.

The sample used in this study is a portion of a sample collected for three larger, multiple behavior intervention studies. Assessments were collected at baseline, 6-, and 12-month intervals. At baseline, these larger samples included 1472 people in worksites, 1816 parents, and 3875 physician patients at risk for sun exposure. Of these, 341 worksite, 431 parent, and 1012 physician had data at all three time points with all necessary variables.

Structural equation modeling was utilized to evaluate panel designs involving seven TTM constructs at baseline, 6-, and 12-month time points. Different models were run within each pre-action Stage of Change. Due to the complexity of the model, a step approach was taken to evaluate the relationships among the constructs.

The Precontemplation group showed relationships between Experiential Processes, Pros and sun protective behavior. The Contemplation and Preparation samples both showed important relationships between Cons and Confidence with behavior. There were more significant paths in the Preparation model indicating greater variance possibly due to more stage movement at follow-up time points.

While not all paths found confirm expectations based on the TTM, there was strong support for the theory. Additional work needs to be done to further investigate these relationships among individual stage transitions or transition groups. A better understanding of the empirical relationships between these constructs will help further understanding of the theory and improve interventions based on the TTM

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Introduction

The Transtheoretical Model (TTM) incorporates constructs from a variety of areas into a consistent theory of intentional behavior change. The model has developed in the last 20 years by being appropriately flexible to change. While there is strong empirical evidence for the constructs involved in the model, there has been relatively little research done to tie the model together into a parsimonious whole. By reviewing what we know, new conceptions of the model can be proposed and tested to increase the utility of the model in predicting change. The majority of studies investigating the structure of the TTM have been in the area of smoking cessation. While this study will examine the relationships of the TTM in the area of reducing sun exposure, these previous studies will serve as a guide for predicting relationships.

The TTM is a stage theory. As Weinstein, Rothman & Sutton (1998) describe, a stage theory must (1) have a clear categorization system for the stages, (2) have a predefined order, and (3) show that common barriers to change occur in the same stage while different barriers to change occur in different stages. These three requirements have been adequately met for the TTM and will be described below.

Defining Stage

The stage of change construct has been the most influential aspect of the TTM. It has created what Kuhn (1970) would call a paradigm shift. Researchers and clinicians in almost every area of health and other non-health related fields have identified with the concept that people change, not in one grand movement, but in small steps or stages. While the TTM is often misnamed and misunderstood by being

called the stage of change model, this one construct has had a profound impact on the area of health behavior change.

People are thought to proceed through a series of stages to bring about behavior change. Stage of Change, originally developed in the area of smoking cessation, has also been adapted to the area of sun exposure (Rossi, Blais, et al., 1995; Rossi, Redding, et al., 1995; Rossi, et al, unpublished data). Individuals who are not intending to improve their sun protective behavior in the next 12 months are considered to be in Precontemplation. Those people who are intending to change in the next year, but not in the next month are categorized as Contemplators. Individuals in the Preparation stage are intending to improve sun protective behavior in the next month. People in the Action and Maintenance stages are currently engaging in sun protective behavior. Those in Action have only been using sun protection for less than 12 months while those in Maintenance have engaged in the behavior for more than 12 months. The time frame associated with sun staging is 12 months, rather than 6 as seen other staging algorithms, to attempt to control for seasonal variations.

Ordering of Stage

By definition, the stages of change fall into a temporal order. Precontemplation is followed by contemplation, preparation, action, and maintenance, respectively. However, people do not always flow linearly through this path. Instead, people are thought to travel in a spiral pattern through the stages (Prochaska, DiClemente, & Norcross, 1992). This pattern allows people to move both forward, progressing, and backward, regressing, through the stages.

A latent transition analysis showed that the best fitting model of change for stages involved regression to the previous stage and one and two stage progressions (Velicer, Martin, & Collins, 1996; Evers, et al., 1998). This pattern of change is consistent with the proposed spiral of change and the ordering of the stages.

Commonalities and Differences between Stages

The stages of change are seen as the organizing construct for the TTM. The other constructs show clear patterns across the stages.

Processes of Change. The processes of change were originally developed by Prochaska (1979) as a synthesis of psychotherapy techniques. Processes of change are behavioral, cognitive, and emotional strategies that are used to bring about change. There have been ten processes of change consistently found for a variety of behaviors (Rossi, 1992). These processes are divided into two hierarchical concepts, experiential and behavioral processes (Prochaska & DiClemente, 1983). Experiential processes include consciousness raising, dramatic relief, environmental reevaluation, self reevaluation, and social liberation. Behavioral processes include self liberation, stimulus control, counter conditioning, reinforcement management, and helping relationships.

The processes of change are expected to differ across the stages of change. Cross-sectional data have shown that consciousness raising is highest in contemplation, while self-reevaluation is high in both contemplation and action. Action has the highest values for stimulus control, counter conditioning, reinforcement management, self-liberation, and helping relationships. Maintenance continues to have a high level for both stimulus control and counter conditioning. (Prochaska &

DiClemente, 1983). Therefore, experiential processes are expected to be important in early stages, while behavioral processes are more important in later stages (Prochaska, DiClemente, & Norcross, 1992). A cross-sequential analysis confirmed this expectation (Prochaska, et al., 1991). Experiential processes peaked in contemplation and behavioral processes peaked in action. Thus, through cross-sectional and cross-sequential data, the processes of change have been shown to be related to the stages of change.

Decisional Balance. The decisional balance construct was originally developed based on Janis and Mann's (1977) theory of decision making. This construct was designed to measure the perceived benefits and barriers to making a behavior change. In order for change to occur, the pros must outweigh the cons of behavior change. In both cross-sectional and cross-sequential analysis, the cons of behavior change have been found to outweigh the pros of behavior change for precontemplators (Rossi, Blais, Weinstock, & Redding, 1995; Velicer et al., 1996; Velicer, et al., 1985). The pros of behavior change begin to increase, while the cons of behavior change begin to decrease in contemplation and continue their trajectories of change through the stages. This relationship of cons of change decreasing across stage, while pros of change increase across stages has been found in at least 12 different behaviors (Prochaska et al., 1994). Therefore, the decisional balance is not only a good measure showing stage differences for smoking, but it also generalizes to a variety of other health behaviors, including sun protection.

Confidence. Bandura (1977) originally developed self-efficacy as a measure of a person's confidence to do a certain behavior. Self-efficacy for sun exposure has

been applied to two different situations, confidence to use sunscreen and to avoid sun exposure (Maddock et al., 1998). This situational self-efficacy for sun exposure has been found to increase across the stages of change (Rossi, et al., 1998).

While there has been comparatively little empirical work published on the TTM longitudinally, what has been is informative for making predictions on how the constructs interrelate with stage of change. Two important studies to understanding change based on the TTM are found in the area of smoking cessation. First, Prochaska, et al. (1991) found that different constructs were successful in predicting movement from the different stages. Progression from precontemplation was associated with an increase in the cons of smoking [pros of behavior change] along with an increase in self-reevaluation. Progression from contemplation was associated with an increase in cons of smoking [pros of behavior change] and a decrease in temptation. Progression from action involved a decrease in pros of smoking [cons of behavior change], cons of smoking [pros of behavior change] and self-reevaluation, and an increase in self-efficacy and helping relationships.

A second longitudinal test of the model tested a priori predictions of differences on the TTM constructs based on stage movement (Velicer, et al., 1999). This study found that cons of smoking [pros of behavior change] were essentially important for movement out of precontemplation. Pros of smoking [cons of behavior change] did not become important until contemplation and preparation. The paper also found that temptation was closely associated with behavior change, thus

important in later stages. These relationships illustrate that different constructs become important at different stages of change.

From this cross-sectional and longitudinal evidence, it has been shown that the three TTM constructs show predictable differences across stages. Thus, the TTM meets the three requirements for a stage theory defined by Weinstein, Rothman, and Sutton (1998). The stages of change are clearly categorized into a predefined order and show differing barriers to change in different stages.

Joseph, Breslin, and Skinner (1999) present further criteria on which to judge a theory. First, a theory should be internally consistent. It should be able to predict relationships among its constructs. Second, these relationships should be parsimonious. The relationships of stage of change to the other TTM constructs discussed above have been well established. However, how the constructs other than stage of change relate to one another has received less attention. Specifically, how the TTM constructs can fit together into a parsimonious whole has yet to be fully examined.

Integrating the Transtheoretical Model

A few studies have already proposed alternative models for relating the constructs of the TTM in the area of smoking cessation. Velicer et al. (1996) proposed two models for how the constructs could be related. The processes of change are seen as the independent variables in the TTM (Prochaska, et al., 1991). From there, the authors debate whether change in cognition influences behavior or change in behavior influences cognition:

Processes of change → Cognition → Behavior

or

Processes of change → Behavior → Cognition

Initial tests were done using panel designs to test the cognition/behavior relationship. They found that change in behavior predicted later change in cognition for the pros of smoking [cons of behavior change]. The analysis of the cons of smoking [pros of behavior change] is more complicated. Since cons of smoking [pros of behavior change] are curvilinear across stage, they predicted that for early stages, change in cons of smoking [pros of behavior change] would predict change in behavior. While for later stages they proposed change in behavior would predict change in cons of smoking [pros of behavior change]. Due to sample size limits, the relationship in the early stages could not be evaluated. However, for later stages, changes in behavior did produce changes in the cons of smoking [pros of behavior change]. Thus supporting that behavior predicts cognition for later stages with the pros of behavior change and for all stages with the cons of behavior change. One drawback to this study, however, is that behavior was much more stable than either pros or cons. This made it harder to predict change in behavior since there was very little change over time. Therefore, if a sample has less stable behavior, different relationships due to increased variance may be found.

Another study examined these proposed models for smoking cessation more closely. Blais (1993) examined the assumption that the processes of change are the independent variables in the model. Blais again used panel designs to test whether processes predicted pros or cons of smoking or if pros and cons of smoking predicted

processes. By testing stage transitions she found that processes of change sometimes predicted the pros or cons of smoking, but pros or cons of smoking never predicted processes. Specifically, she found that experiential processes predicted change in cons of smoking [pros of behavior change] for people moving from precontemplation to contemplation. She also found that both experiential and behavioral processes predicted pros of smoking [cons of behavior change] for the contemplation to preparation progression. Thus, the assumption that processes predict cognition and/or behavior appears to be supported. However, Blais was not able to truly test the relationship of behavior to processes and cognition due to the lack of a continuous outcome measure in the area of smoking.

These studies give some support for integrating the TTM, however, there are still serious questions on exactly how the constructs are interrelated. The original models proposed by Velicer et al. (1996) have yet to be fully tested. Blais' work shows that the processes start the process of change. But whether cognition mediates the relationship with behavior or behavior mediates the relationship with cognition is still unclear.

Hypotheses

A study where all the constructs are incorporated into an integrated model is needed to determine which model appropriately represents the change process. The ultimate goal of this study is to create a parsimonious structural model that represents the relationships among the constructs of the Transtheoretical Model. In order to answer this question more fully, stage differences will also be examined.

First, differences within each of the pre-action stages of change will be investigated. Given that the TTM is a stage model, the relationships between the constructs are expected to be different for different levels of stage. Thus stage is predicted to act as a moderator to the relationships between the constructs. For this reason, the sample will first be divided into separate samples based on the baseline stage of change and analyzed separately. Previous studies help form predictions about which variables may be important within each stage.

Precontemplation. The following associations related to people in Precontemplation have been discussed above:

- Progression from precontemplation was associated with an increase in the pros of behavior change and an increase in self reevaluation, an experiential process of change (Prochaska, et al., 1991).
- The pros of behavior change are important for movement out of precontemplation (Velicer, et al., 1999).
- The pros of behavior change are expected to predict change in behavior for early stages, however this prediction was not able to be evaluated (Velicer, et al., 1996).
- Experiential processes of change predicted change in the pros of behavior change (Blais, 1993).

Therefore, it is expected that experiential processes of change will influence the pros of behavior change, which will then influence behavior in this sample. There are no clear predictions based on previous research as to where self-efficacy might fit into this model. Figure 1 shows the predicted panel design for Precontemplators.

Contemplation. The following associations related to people in Contemplation have been discussed above:

- Progression from Contemplation was associated with an increase in pros of behavior change and self-efficacy (Prochaska, et al., 1991).
- Cons of behavior change and self-efficacy become important in contemplation (Velicer, et al., 1999).
- Change in behavior predicts change in the cons of behavior change while pros of behavior change are expected to predict change in behavior (Velicer, et al., 1996).
- Both experiential and behavioral processes of change predict cons of behavior change for contemplation (Blais, 1993).

Therefore, previous research predicts that both experiential and behavioral processes will be important for predicting behavior, self-efficacy, and the pros of behavior change. Behavior is also expected to predict the cons of behavior change. The significant difference between the models for precontemplation and contemplation is the addition of the behavioral processes as independent variables and the importance of self-efficacy into the model. Figure 2 shows the predicted panel design for contemplators.

Preparation. The following relationships have been discussed above for the Preparation stage of change:

- Cons of behavior change and self-efficacy become important in later stages, such as preparation (Velicer, et al., 1999).

- Behavior predicts changes in both the pros and cons of behavior change (Velicer, et al., 1996).
- Behavioral processes of change, cons of behavior change, and self-efficacy are important for movement into action (Prochaska, et al., 1991).

Additionally, there are expected to be more relationships in general in this stage group than in the other two due to the transitional nature of the Preparation stage. Therefore, for people in Preparation, the behavioral processes are expected to predict behavior, which will influence both the pros and cons of behavior change. Self-efficacy will also be important in this stage, but whether it predicts or is predicted by behavior is not clear from previous Transtheoretical Model research. However, the concept of reciprocal determinism from the Social Cognitive Theory predicts that confidence both predicts and is predicted by behavior. Figure 3 shows the predicted panel design for people in preparation including only those paths specifically predicted.

Methodological Issues

While most of the predictions have support from previous research, there are a few problems in testing these models of behavior change. The pros of behavior change and some processes of change are curvilinear across stages. Since most statistical analyses assume linear relationships, relationships that are really there may not be detected due to the inadequacies of the statistical techniques. By dividing the sample into stage of change groups, it is hoped that most of the curvilinearity will be controlled.

Method

Participants

The sample used in this study is a portion of a sample collected from three larger, multiple behavior intervention studies designed to increase smoking cessation, sun protective behavior, and eating a low-fat diet. Assessments were collected at baseline, 6-, and 12-month intervals. The three samples combined here were drawn from larger samples collected from a worksite, parent, and physician office populations. At baseline, these larger samples included 1474 people from worksites, 1816 parents, and 3875 physician patients at risk for sun exposure. Individuals were considered at risk if they were in either the Precontemplation, Contemplation, or Preparation stage of change. Of these, 341 worksite, 451 parent, and 1012 physician participants had data at all three time points with all necessary variables. The number of participants with complete data is low due to the design of the intervention study, which only collected Process of Change items from the treatment group. The three samples combined are 59.8% female, 76.6% married and 94.5% white. Of this sub-population, 32.6% (588) are in Precontemplation, 21.5% (388) are in Contemplation, and 45.9% (828) are in Preparation at baseline. Table 1 presents demographic variables broken down by the three samples. While there were significant differences between samples, these differences were expected due to the channels of recruitment.

Measures

Stage of Change. Stage of change is measured using an algorithm of several questions that assess behavioral intentions and actions for reducing sun exposure. An additional stage measure for use of SPF15 sunscreen has also been developed. Both

algorithms have been well developed across more than 10 different study populations (Rossi, et al., 1995).

Processes of Change. The processes of change are cognitive, emotional, and behavioral strategies utilized to bring about change. The application of the processes of change to reduction of sun exposure is under development, however, initial results show the familiar hierarchical structure representing the processes of change organized on two higher order factors, experiential and behavioral (Maddock, et al., 1998; Rossi, 1992). Due to the complex nature of the measurement models, scores for the processes of change will act as the manifest variables making up the latent construct of the higher order experiential and behavioral processes of change for these models.

Decisional Balance. The decisional balance inventory is an 8-item scale measured on a 5-point Likert scale consisting of two subscales, the Pros and Cons of reducing sun exposure. The Pros represent positive aspects of changing behavior that can help facilitate change. The Cons represent negative aspects of changing behavior considered barriers to change. The decisional balance measure shows good internal consistency with Cronbach alphas of .78 for Pros and .74 for Cons. Decisional balance for reducing sun exposure has been found to show patterns similar to other behaviors across the stages of change (Maddock, et al., 1998; Prochaska, et al., 1994).

Confidence. Situational self-efficacy is a 7-item scale scored on a 5-point Likert scale measuring level of confidence to practice sun protective behaviors in challenging situations. A hierarchical model structure of one general factor with two primary factors, sunscreen use and sun avoidance, best fits previous data (Maddock, et

al., 1998). Both the general measure of confidence ($\alpha=.84$) and the two subscales, sunscreen use ($\alpha=.88$) and sun avoidance ($\alpha=.76$) show good internal consistency. Situational self-efficacy for sun exposure has also been found to have a strong relationship with the stages of change (Rossi, et al., 1998).

Sun Protection Behavior Scale. There has been no clear outcome measure yet agreed upon, nor any objective biochemical measure of ultraviolet radiation exposure that can easily be employed on a large scale intervention (Creech & Mayer, 1998). Therefore, self-report measures have been relied upon in most studies. Consensus has been reached on those aspects of behavior that are recommended for effective reduction of UVR exposure. They include using SPF15 sunscreen, avoiding sun exposure during peak hours, staying in the shade, and wearing sun protective clothing (Consensus Development Panel, 1991; Rossi, 1989; Rossi et al., 1995). The Sun Protection Behavior Scale (SPBS) was developed to assess the level of use for these sun protective behaviors. The 9-item scale has three factors, sunscreen use, sun avoidance, and hat use. Internal consistency for these three scales has been found to be good for adult samples: sunscreen use ($\alpha=.86$), sun avoidance ($\alpha=.82$), and hat use ($\alpha=.83$). The SPBS has also been found to have a strong relationship to the stages of change (Maddock, et al., 1998; Rossi, et al., 1998; Weinstock, et al., 2000).

Procedure

The three samples were collected as part of larger intervention studies designed to reduce risk for smoking, diet, and sun exposure. In each sample there was another arm of intervention, either at the school, worksite, or physician office level. The

treatment group analyzed in this study refers to that of the home-based expert system treatment classification, regardless of the other arms or levels of intervention.

The parent sample was collected with parents of students participating in similar high school interventions. One parent or guardian per student was recruited for the study with a 75% participation rate. The parents were randomly assigned to either home-based expert system intervention or no-treatment control. At the 12-month follow-up, 92% of the parents were retained.

The worksite sample was implemented with employees from 24 worksites (12 treatment and 12 control). Three companies (1 treatment and 2 control sites) dropped out of the study. Independent of the worksite treatment classification, individuals were randomly assigned to either home-based expert system intervention or no-treatment control condition. Of the 86% of employees screened, 78% of the eligible employees were recruited for the study. At the 12-month follow-up, 84% of the employees were retained.

The physician sample was collected from 78 physician offices. Individuals were randomly assigned to either home-based expert system treatment or no-treatment control. Of those eligible for participation, 91% completed the baseline survey. Approximately 80% of the sample completed the 12-month follow-up.

For all three samples, only the treatment group was asked the Processes of Change items. Therefore all analyses will be conducted on only the treatment group from each study.

Analysis Procedure

Structural equation modeling will be utilized to evaluate the panel designs discussed above. Structural equation modeling (Bentler, 1980) is a statistical technique that simultaneously estimates relationships between multiple constructs across time.

Due to the complexity of the model, a step approach will be taken to evaluate the relationships among the constructs (Evers and Harlow, 1997; Evers, 1998). Step 1 involves modeling all the constructs within a single time point. This step will be done on the overall baseline sample. Step 2 models each individual construct across the three time points. Step 3 models evaluate longitudinal cross-lags for each pair of variable subsets. Step 4 brings together information learned in the previous steps to pull the full model together. Steps 2 through 4 will be done within each baseline stage of change group. A final step will look at the invariance of the models based on stage movement within the stage of change groups.

Step 1 involves an exploration of the measurement structure of each of the constructs. Due to the complexity of the full models, simple, strong measures of the constructs are needed. Nunnally (1978) showed that a minimum of three items are needed to adequately represent a construct. Therefore, the best three items or parcels will be used to represent each measure. All TTM constructs will be evaluated in the baseline sample to confirm previously found structure. These measures will then be reduced to three manifest variables per construct. The reduced measurement structure will be confirmed in the sample of participants who have complete longitudinal data (N=1804). A final analysis in Step 1 will integrate all constructs into one model.

For Steps 2 through 4 the sample will be categorized by baseline stage of change. These three groups, Precontemplation (N=588), Contemplation (N=388), and Preparation (N=828), will be treated as separate samples. The following analyses will be run in each of these three samples.

Step 2 will look at each construct independently across time to investigate the nature of the relationship. Two models will be run, one including all paths, including one between baseline and 12 month, and one with that path removed. This will determine if the direct paths between baseline and 12 months are necessary in the overall models. These models will be run independently for each of the constructs within each of the three baseline stage of change samples.

Step 3 will investigate the relationships among constructs. Cross-lag models between two constructs will be run within each of the stage of change samples. These models will be run for each pairwise combination of constructs. Non-significant paths within each model will be removed and the reduced model will be analyzed again. Chi-square difference tests and other measures of fit will determine whether specific paths are important in the overall model.

Step 4 will integrate the information found in the previous steps. Within each stage of change sample, all significant paths from previous steps will be included into one overall model including all constructs at all three time points. The overall models for each stage group will be evaluated. Several indices will be utilized to suggest model modification, including the Wald test, Lagrange Multiplier test, significance of proposed paths, and overall fit of the model. Careful consideration will be given prior to adding or subtracting paths in the proposed models.

These final three models will then be compared to investigate differential relationships among constructs based on baseline stage of change. There are several ways to compare models across the different stage of change populations (Maruyama, 1998). Most simply, the same model could be run on each stage of change sample and then fit indices and parameter estimates compared. Also, models within each stage of change could be modified to best fit that sample and then reduced models compared as to whether the basic processes seem to be the same. Confidence intervals could be calculated around the parameter estimates to determine if estimates in the different samples are significantly different. These two methods of comparing models are limited in that there is no direct comparison of the goodness of fit between the different samples. Also, if parameter estimates are found not to differ by confidence interval estimates, it does not necessarily mean that they are equal between the samples. A third method of comparing models between multiple samples simultaneously estimates a single theoretical model on multiple samples. This method allows for direct comparison of fit indices and parameter estimates. While the simultaneous sample analysis may yield the strongest statistical support for empirical

estimates. Overall fit will not be able to be evaluated since the groups have different samples sizes.

Results

Step 1: Measurement Structure

Step 1 examined the measurement models of each TTM construct to find the best fitting reduced model to use in later analyses. The constructs were first examined with all participants who had baseline data in the treatment group (N=3427). The simplified measurement models were then compared on a smaller sample of those participants that also have complete longitudinal data (N=1804). This second analysis is to confirm that the measures are appropriate for the participants that will be included in later analyses. Each construct has slightly different sample sizes due to missing data in the full baseline sample.

Processes of Change. Three processes from each of the experiential and behavioral constructs were selected, Consciousness Raising, Dramatic Relief, and Self Reevaluation for experiential processes and Stimulus Control, Reinforcement Management, and Self Liberation for behavioral processes. These processes showed strong factor loadings in a full item model (see Appendix A). To simplify the measurement model for further analyses, scale scores were computed by summing the two items for each process. This model shows excellent fit in both the full baseline $\chi^2(8)=151.07$, CFI=.980, RMSEA=.075, AASR=.016 and the longitudinal baseline sample, $\chi^2(8)=68.86$, CFI=.984, RMSEA=.065, AASR=.014.

Decisional Balance. The three best indicators of the Pros and Cons were selected for the simplified measurement model. This simplified model shows good fit in the full baseline sample, $\chi^2(8)=174.06$, CFI=.973, RMSEA=.079, AASR=.024 and

in the longitudinal baseline sample, $\chi^2(8)=124.43$, CFI=.964, RMSEA=.090, AASR=.027.

Confidence. Scale scores of the two Confidence subscales cannot easily be used to represent the confidence construct since three markers are needed for stable estimates of latent constructs (Nunnally, 1978). Therefore, the three best representative items of general confidence were selected, including one item from the sunscreen use factor, and two from the avoidance factor. The factor loadings show adequate strength, although the sunscreen use item is low. However, since there are zero degrees of freedom for these models there are no fit indices.

Behavior. In addition to two subscales not being sufficient representations of a construct, as discussed above, the correlation between the two behavioral subscales is very small, indicating that one general behavior factor is inappropriate. Therefore, both subscales will be incorporated into the full model and tested independently in future steps. Despite the small correlation, the measurement structure of these two subscales is good in both the full baseline sample, $\chi^2(8)=152.50$, CFI=.986, RMSEA=.056, AASR=.021 and the longitudinal baseline sample, $\chi^2(8)=91.02$, CFI=.986, RMSEA=.076, AASR=.021.

Figure 4 presents a single integrated model including all seven reduced measurement structures run on the longitudinal baseline sample. This model shows adequate fit, $\chi^2(168)=2184.56$, CFI=.890, RMSEA=.082, AASR=.050. Table 2 lists the correlations between the factors. The highest correlation after that between Experiential and Behavioral Processes is between Behavioral Processes and Confidence. All correlations, except that between Pros and Cons, are statistically

significant. See Appendix A for more details on the process for determining the final measurement structure.

Step 2: Longitudinal Stability

This step evaluated each construct independently across time (baseline, 6-, and 12-months) to investigate the nature of the longitudinal relationship. The path between the constructs at baseline and 12-months was examined to determine if this path was necessary to best represent the data. The error for each item was also correlated between all time points. All seven constructs were run independently in the three stage samples.

Precontemplation. All seven constructs show excellent fit across the three time points. The measurement structure for all constructs is similar to that found in Step 1. Adjacent time point stability estimates range from .543 to .781. The Chi-squared difference test for all constructs showed a significant ($p < .01$) decrease in fit when the baseline to 12-month path was removed from the model, indicating the need to retain this path in future models. These paths ranged from .160 to .288.

Contemplation. The seven constructs again show good fit across time for all seven TTM constructs with similar measurement structure as found in Step 1. Stability at adjacent time points range from .480 to .768. The Chi-squared difference test for the Experiential Processes, Pros, Cons, Confidence, Avoidance, and Sunscreen Use constructs showed a significant decrease in fit when the baseline to 12-month path was removed from the model, indicating the need to retain this path in future models. This path was not necessary for model fit for the Behavioral Processes, with a non-

significant Chi-squared difference test. The significant paths ranged from .194 to .283.

Preparation. The measurement models in this sample are like those found in Step 1 and all show excellent fit across the time points. Adjacent time point stability paths range from .513 to .778. The Chi-squared difference test for all constructs showed a significant ($p < .01$) decrease in fit when the baseline to 12-month path was removed from the model. These paths ranged from .162 to .286.

Appendix B presents models from this step in greater detail and discusses the correlations between item error estimates. In general, the seven constructs showed consistent measurement structure, reasonable stability across the three time points, and indicate a need for estimating paths between baseline and the 12-month time point.

Step 3: Pairwise Cross-lagged Models

Step 3 examined the relationships among pairs of constructs. Cross-lag models between each combination of two constructs were run within the three stage of change samples. Non-significant paths within each model were removed to produce a reduced model. Chi-square difference tests and other measures of fit were used to determine whether specific paths were retained for future models.

Precontemplation. Three specific predictions were made for this stage sample. First, Experiential Processes were expected to act as independent variables, specifically predicting Pros. Consistent with expectations, increases in Experiential Processes at both baseline and 6-months predict increases in the Pros of behavior change at subsequent time points. Second, the Pros of behavior change were expected to predict behavior. This relationship is less clear. High levels of Pros at baseline

significantly predict higher 6-month Avoidance along with high levels of Pros at 6-months predicting increases in Sunscreen Use at 12-months. However, baseline Avoidance and Sunscreen Use also predict Pros at 6-months. In contrast, the Cons of behavior change were expected to be predicted by behavior. As expected, high levels of Avoidance at baseline and 6-months significantly predict lower levels of Cons at subsequent time points. However, a complex relationship where higher levels of Sunscreen Use are predicted by higher levels of baseline Cons and lower levels of Cons at 6-months was not expected. Overall, the three predictions for the Precontemplation sample were supported in this step of the analysis. However, several additional relationships between constructs were also found. See Appendix C for a detailed report of all 21 pairwise cross-tab models for the Precontemplation sample.

Contemplation. Four sets of hypotheses were made for this stage sample. First, Experiential Processes were expected to act as independent variables, specifically predicting Pros and behavior. Baseline Experiential Processes did significantly predict increases in both Pros and Sunscreen Use at 6-months. However, Experiential Processes were not related to Avoidance behavior. A second hypothesis also expected Behavioral Processes to predict Pros and Behavior. These predictions were also confirmed with higher Behavioral Processes predicting higher levels of Pros and Avoidance behavior at subsequent time points. The third hypothesis expected the Pros of behavior change to influence behavior. High Pros at the 6-month time point significantly predict increases in both Avoidance, and Sunscreen Use. Finally, the Cons of behavior change were expected to be predicted by behavior. As expected,

increases in Avoidance at both baseline and 6-months significantly predict subsequent decreases in the Cons. However, there are no significant relationships between Sunscreen Use and Cons. Thus, all predictions for the Contemplation stage were at least partially supported. Additionally, several other relationships between constructs were also found. See Appendix C for a detailed report of all 21 pairwise cross-tab models for the Contemplation sample.

Preparation. Again, several hypothesized relationships were specifically predicted for this stage sample. First, Behavioral Processes were expected to be more involved in this sample, specifically, predicting behavior. While there are no significant relationships between Behavioral Processes and Sunscreen use, this anticipated relationship was found for Avoidance. Higher reported use of Behavioral Processes predicted more Avoidance behavior at all subsequent time points. Secondly, behavior was expected to predict both the Pros and Cons of behavior change. However, there were no significant cross-lagged paths between either of the behavior subscales and Pros. While both Avoidance and Sunscreen Use predicted Cons, there were differing relationships. With Avoidance, all adjacent time point cross-lagged paths were significant, indicating that while increases in Avoidance predicted decreases in Cons, so too did increases in Cons predict decreases in Avoidance. However, only increases in baseline Sunscreen Use predicted higher levels of Cons at both follow-up time points. Finally, while no explicit hypotheses were made for Confidence, it was expected that Confidence would influence the behavior constructs. Higher levels of Confidence were found to be related to both higher Avoidance at all time points and higher Sunscreen Use at 6-months only.

Additionally, higher levels of Avoidance at 6-months significantly predicted higher levels of Confidence at 12-months, thus showing a somewhat reciprocal relationship. Unlike the other two stage samples, not all hypothesized relationships were supported at this step in the Preparation sample. Additional, non-predicted relationships were also found between the constructs. A more detailed explanation of these relationships is presented in Appendix C.

Step 4: Integration

This step integrates the information found in the previous steps. Within each stage of change sample, all significant regression paths from Step 3 are included into one overall model including all seven constructs at all three time points. The models are then simplified by removing non-significant paths and looking at the Wald and Lagrange Multiplier tests.

Precontemplation. The first integrated model included all significant regression paths in this sample discussed above in Step 3. This model shows good fit, $\chi^2(1699)=3587.54$, CFI=.932, RMSEA=.044, AASR=.051. However, several paths were not significant with the Wald test confirming that they could be removed without reducing the overall fit of the model. These paths were removed until all remaining paths were significant. This final model is presented in Figure 5. This model shows good fit, $\chi^2(1723)=3611.20$, CFI=.932, RMSEA=.043, AASR=.051. The fit of model is not significantly different than the first integrated model, $\chi^2_{\Delta}(24) = 23.64$ indicating that those paths removed are not necessary in the overall fit of the model.

The underlying measurement structure and correlations between factors and errors are not presented to simplify the figure. However, the measurement structures and correlations were similar to that found in the previous steps.

All constructs show reasonable stability, ranging from .312 to .724. The Pros (.357 and .448) and Sunscreen Use (.352 and .312) constructs have the lowest stability between adjacent time points. All stability paths between baseline and 12 months are significant, ranging from .143 to .279. These parameters are listed in Table 3.

The strongest regression paths are between Experiential Processes and Pros of behavior change and Confidence and Sunscreen Use at adjacent stages. The only other paths that showed a consistent relationship between baseline and 6-months and 6- and 12-months were between Sunscreen Use and Experiential Processes.

Experiential Processes were also found to significantly predict Behavioral Processes, Confidence, and Sunscreen Use but only at 6-months. Behavioral Processes at both baseline and 6-months predicted Cons at 12-months (.099, not shown), however, in opposite directions. High Pros of behavior change at 6-months significantly predict more Sunscreen Use at 12 months. Baseline Cons of behavior change predicted lower Pros at 6-months and higher Sunscreen Use at 12-months (.062, not shown). In addition to predicting higher Avoidance, Confidence also predicted lower Cons of behavior change at 6-months. Avoidance is positively related to Confidence at 6-months and negatively related to Cons of behavior change at 12-months. Sunscreen Use at 6-months predicts increases in Behavioral Processes as well as the relationship with Experiential Processes described above.

Table 4 presents the R^2 values for all constructs at 6- and 12-months. Confidence and previous Avoidance behavior account for 44.7% of variance of Avoidance at 6-months. Even more variance, 60.1%, in Avoidance behavior was accounted for at 12-months by Confidence and previous Avoidance behavior at both baseline and 6-months. Experiential Processes and previous Sunscreen Use accounted for 47.1% of the variance in Sunscreen Use behavior at 6-months. Sunscreen Use at 12-months had 63.9% of the variance accounted for by the Pros at 6-months and Cons at baseline along with previous Sunscreen Use at both baseline and 6-months.

Contemplation. The first integrated model in this sample again included all significant regression paths discussed above in Step 3. This model shows good fit, $\chi^2(1715)=3273.01$, CFI=.901, RMSEA=.048, AASR=.067. However, several paths were not significant and the Wald test indicated that they could be removed without reducing the overall fit of the model. These paths were removed until all paths remaining were significant and the Wald test did not show any additional regression paths to be removed. This final model is presented in Figure 6. This model shows good fit, $\chi^2(1730)=3307.25$, CFI=.899, RMSEA=.049, AASR=.068. The fit of this reduced model is not significantly different than the first integrated model at the $p < .01$ level, $\chi^2_{\Delta}(15) = 34.25$.

Almost all constructs show reasonable stability across the time points (see Table 5). Avoidance, however, is much lower than the other constructs with .285 and .286 stability parameters between adjacent time points. The Pros of behavior change show low stability between baseline and 6 months (.287), but a reasonable stability between 6 and 12 months (.552). The other six constructs have a range of adjacent

time stability from .532 to .752. All baseline to 12 month paths are also significant, ranging from .159 to .285.

The strongest relationship is between Confidence and Avoidance behavior at adjacent time points, with higher Confidence predicting more Avoidance. The only other constructs showing consistent relationships across baseline to 6-months and 6- to 12-months are Cons and Confidence, however, the relationships are complex. Higher Cons at baseline predict lower Confidence at both 6- and 12-months (-.150, not shown). In contrast, high Cons at 6 months predicted higher Confidence at 12 months. Two other constructs strongly predicted the Pros of behavior change at 6-months, Experiential Processes and Confidence. However, these relationships were not seen between 6 and 12 months.

In addition to the above relationships, several other relationships were significant. High Experiential Processes predicted more Sunscreen Use. High Cons of behavior change at baseline significantly predicted lower Behavioral Processes and Avoidance as well as the relationships discussed above with Confidence. In addition to the relationships with Confidence discussed above, baseline Confidence also predicted higher Experiential Processes at 12-months (.097, not shown). Sunscreen Use at baseline predicted less Avoidance at 6-months. Finally, more Avoidance at 6-months predicted lower Cons of behavior change at 12-months. Behavioral Processes and Pros did not significantly predict any other constructs in this sample.

Table 6 presents the R^2 values for all constructs at 6- and 12-months. Cons, Confidence, Sunscreen Use, and previous Avoidance behavior account for 47.2% of variance of Avoidance at 6-months. Only Confidence and previous Avoidance

behavior at both baseline and 6-months predicted 12-month Avoidance, accounting for 51.3% of the variance. Experiential Processes and previous Sunscreen Use accounted for 48.0% of the variance in Sunscreen Use behavior at 6-months. Sunscreen Use at 12-months had 63.9% of the variance accounted for by previous Sunscreen Use at both baseline and 6-months.

Preparation. The first integrated model included all significant regression paths for this sample discussed above in Step 3. This model shows good fit, $\chi^2(1707)=4381.76$, CFI=.919, RMSEA=.044, AASR=.055. However, several paths were not significant and the Wald test indicated that they could be removed without reducing the overall fit of the model. These paths were removed until the Wald test did not indicate any additional regression paths should be removed. This final model is presented in Figure 7. This model shows good fit, $\chi^2(1721)=4388.48$, CFI=.919, RMSEA=.043, AASR=.056. The fit of this reduced model is not significantly different than the first integrated model $\chi^2_{\Delta}(14) = 6.72$.

The stability estimates again appear reasonable for most constructs (see Table 7). Similar to the other two samples, the reliability of the Pros of behavior change and Avoidance between adjacent time points is low. However, the other constructs all show good stability, ranging from .476 to .781 between adjacent time points and .068 and .300 between baseline and 12-months.

Several strong relationships were found in this sample. The strongest single regression path is between baseline Experiential Processes and the Pros of behavior change. However, there is no similar path between 6- and 12-months, nor are Experiential Processes related to any other construct. Confidence shows a strong,

consistent pattern with Avoidance behavior. Higher levels of Confidence predict more Avoidance across adjacent time points as well as between baseline and 12-months (.210, not shown). Pros of behavior change and Behavioral Processes show a somewhat complex relationship. Higher Pros predict higher levels of Behavioral Processes at adjacent time points, however, baseline Pros predict lower levels of Behavioral Processes at 12-months (-.124, not shown).

Avoidance and Cons of behavior change are strongly related in both directions, however those relationships are both positive and negative. While higher Avoidance at baseline predicts higher Cons at 6-months, higher Avoidance at 6-months predicts lower Cons at 12-months. In contrast, higher Cons at baseline predict less Avoidance behavior while higher Cons at 6-months predict more Avoidance at 12-months.

Several additional relationships between constructs were significant. Increases in baseline Behavioral Processes predicted increases in the Pros of behavior change at 6-months. Contrary to expectations, high levels of Behavioral Processes at 6-months predicted less Avoidance. The relationships between Cons and Confidence with Avoidance are described above. Additionally, high baseline Cons of behavior change significantly predict lower Behavioral Processes and Confidence at 6-months and lower Pros at both 6-and 12- months (-.060, not shown). Also, higher baseline Confidence predicts higher levels of Behavioral Processes, lower Cons of behavior change, and more Sunscreen Use behavior at 6-months. Finally, the behavior constructs show additional relationships. Similar to Avoidance, more Sunscreen Use at baseline significantly predicts more Cons at 6-months. Also, more Avoidance at 6-months predicts higher Confidence at 12-months.

Table 8 presents the R^2 values for all constructs at 6- and 12-months. Confidence, Cons, and previous Avoidance behavior account for 42.1% of variance of Avoidance at 6-months. Additionally, Behavioral Processes, Cons, Confidence, and previous Avoidance behavior at both baseline and 6-months accounted for 57.7% of the variance. Confidence and previous Sunscreen Use accounted for 49.0% of the variance in Sunscreen Use behavior at 6-months. Sunscreen Use at 12-months had 65.9% of the variance accounted for simply by previous Sunscreen Use at both baseline and 6-months.

Discussion

The Process

Due to the complexity of the proposed integrated models, a step approach was adopted to simplify model development. By breaking down the model into smaller steps, information was gained in each step that allowed progression towards the final integrated models. Along the way, several important observations were made.

In Step 1 we found that the majority of the measurement structures of the TTM constructs were very strong. However, more work may be needed on the behavior scale due to the small correlation found between the two subscales of Avoidance and Sunscreen Use. Due to such a small correlation, both subscales were included in later models rather than a single indicator of behavior. Similarly, the Confidence scale, when limited to only three items, was weaker than other constructs due to the underlying two subscale structure. The one item from the Sunscreen scale had a much lower factor loading than the two items from the Avoidance subscale. Part of the limitation of this factor structure is an artifact of using only three indicators for the general Confidence factor in the reduced model. When examining the full item level structure presented in Appendix A, the Confidence measure shows good fit when several indicators on both subscales are utilized. These difficulties with both the Confidence and behavior measures could be lessened by looking at the two behaviors independently. The Confidence measure could also be reduced to either the avoidance or sunscreen use subscales.

The measurement model including all baseline measures shows interesting correlations between factors. The highest correlation after that between Experiential

and Behavioral Processes was between Behavioral Processes and Confidence. This strong correlation may be due to the Behavioral Processes being driven by the self liberation scale score. Self liberation measures a person's commitment to making a behavior change. This construct appears similar to that of a person's Confidence to make a behavior change. Therefore, this high correlation demonstrates the similarity between these two constructs of the TTM that are seldom examined together.

Step 2 investigated the stability of the TTM constructs over the three time points. All measures were reasonably stable when examined independently in all three samples. However, when pairwise cross-lag models and the final integrated models were examined, a few constructs showed lower stability. The Pros, for example, showed much lower stability in the integrated model than when examined independently in Step 2. This lack of stability when compared with other constructs may explain why the Pros did not act as a good predictor for other constructs in the integrated models.

Step 3 was really just a stepping stone to reduce the number of paths included in the integrated models. Several constructs showed significant relationships within this step that did not hold up in the integrated models. These relationships could be true associations, but simply be too weak to hold up in the larger more complex models. Alternatively, these paths could simply be artifacts, with two constructs showing a relationship that is explained better by the relationship with a third variable that only enters in the integrated models.

The Models

Precontemplation. The final integrated model for the Precontemplation sample at least partially supported all hypothesized relationships. Experiential Processes strongly predicted the Pros of behavior change at subsequent time points. The Pros predicted Sunscreen Use while Avoidance behavior significantly predicted the Cons between 6- and 12-months. In addition to these hypothesized paths, Confidence also strongly predicted Avoidance behavior at subsequent time points. While not specifically predicted this and other paths are consistent with model expectations.

However, a few paths were significant but in the opposite direction than expected. Sunscreen Use predicted Pros in addition to being predicted by it, as was the expected direction. Similarly, while the Cons were predicted by Avoidance behavior as expected, contrary to predictions baseline levels of Cons also significantly predicted Avoidance. Also unexpectedly, Sunscreen Use predicted Experiential and Behavioral Processes.

While there is not a clear picture of relationships for the Precontemplation sample, all the hypothesized relationships were at least partially supported. Several constructs showed unexpected relationships, especially relationships in the opposite direction. These may indicate a need to rethink assumptions that have been made about the order of changes in the constructs. A person's behavior may have an impact on their thoughts about changing behavior. It is important to understand that a person's past behavior influences future behavior as well as other more cognitive constructs (Sutton, 1994). However, in order to understand the process of behavior

change, discovering which variables influence behavior may help us to better recognize how to bring about change in behavior. Those constructs that predicted increases in sun protective behaviors in this sample were Experiential Processes, Pros of behavior change, and Confidence. Experiential Processes also predicted both the Pros and Confidence. These relationships also represent the strongest paths in the integrated model. Therefore, for people in the Precontemplation stage, interventions designed to increase these constructs may have the most impact on increasing sun protective behavior.

Contemplation. The final integrated model for this sample only partially supported some of the hypothesized relationships. Experiential and Behavioral Processes were expected to predict the Pros of behavior change, Confidence, and behavior. The Experiential Processes were found to significantly predict Pros and Sunscreen use. However, they did not predict Confidence, nor did the Behavioral Processes predict any other constructs. The Pros of behavior change were expected to predict behavior, however, there were no significant relationships between these two constructs. The Cons of behavior change were hypothesized to be predicted by behavior. While this was partially supported between 6- and 12-months, Cons significantly predicted Avoidance behavior between baseline and 6-months.

Several additional relationships were also found. Similar to the Precontemplation model, Confidence was a strong predictor of Avoidance behavior. Confidence also strongly predicted increases in the Pros of behavior change. In addition to the predicted relationship between behavior and Cons discussed above, Cons acted as a predictor of Behavioral Processes and Confidence, with lower Cons

indicating more process use and higher Confidence. Overall, Confidence and the Cons of behavior change showed the most predictive relationships with the other constructs. Both also directly predicted Avoidance behavior as well as other TTM constructs. Therefore, it appears that these two constructs may be the most important for intervention during this stage.

Preparation. The final integrated model for the Preparation sample at least partially supported three of the four hypothesized relationships. As expected the Cons of behavior change were strongly predicted by both measures of behavior. However, the directions of those relationships were somewhat surprising. Higher levels of sun protective behavior at baseline predicted higher Cons. This is contrary to the prediction that small behavioral steps will help to reduce the Cons of behavior change. However, the expected negative relationship was found between Avoidance behavior at 6-months and Cons at 12-months. These relationships may indicate that small steps, like using sunscreen may enhance the Cons, however, once sufficient behavior change has been made, the Cons appear to be reduced.

Expectations about Confidence being important in this stage were also confirmed. Confidence predicted Behavioral Processes, Cons of behavior change, and both measures of behavior. Two of the strongest relationships in the model are between Confidence and Avoidance. Another hypothesis that was supported in the final model was that of Behavioral Processes predicting behavior. However, again this was in the opposite direction with more process use predicting less behavior.

The one specific hypothesis not supported was that of behavior predicting the Pros of behavior change. Experiential and Behavioral Processes along with Cons were

the only constructs to significantly predict Pros. As in the previous two samples, the relationship between Experiential Processes and Pros is strong between baseline and 6-months. However, as expected, Experiential Processes showed no other significant relationships. Overall, Confidence was the best predictor of behavior in this sample. Additionally, there were more relationships between constructs in this sample than in the previous two. This may be a sign of greater variance in this sample due to the changing nature of the Preparation stage of change.

Similarities Across Stage Models. The strongest paths in these integrated models are consistent across the three stage samples. Experiential Processes were only expected to be important in Precontemplation and Contemplation. However, the strong relationship between Experiential Processes and Pros was found in all three samples. Additionally, Confidence was found to significantly predict Avoidance behavior in all samples. There were no specific predictions for Confidence although it was expected to become important in the later stages. Other than these relationships, there were no other comparable paths across all three stages.

In addition to these similarities across all three samples, there were several corresponding paths between pairs of stage groups. Both the Precontemplation and Contemplation stages showed relationships between Experiential Processes and Sunscreen Use and the lack predictive paths from Behavioral Processes or Pros to any other construct. Experiential Processes were expected to be important in both of these stages. However, Pros were expected to predict behavior in both stages and Behavioral Processes were expected to become important in the Contemplation sample.

The model from Preparation also showed similarities to the model from the Contemplation group. Cons and Avoidance behavior were related in both of these stage samples. As predicted, Avoidance predicted the Cons. However, there was a reciprocal relationship with Cons also predicting Avoidance. These relationships were in the expected direction with lower Cons predicting more Avoidance, similarly, more Avoidance behavior predicting lower Cons. The Cons of behavior change also significantly predicted Confidence in both these stage samples. Most of the paths were in an expected direction with lower Cons predicting higher Confidence. However, in the Confidence group, lower Cons at 6-months predicted lower Confidence at 12-months. Another reciprocal relationship was found in the Preparation group with Confidence also predicting Cons.

Limitations

The primary limitations of these analyses lie in the sample. First, three large samples were combined together to provide sufficient sample size for the stage group analyses. Each of these three samples represents a different segment of the general population. They were not equivalent on demographic characteristics at baseline. If demographic variables have any influence on the constructs examined in these analyses, combining these samples may mask such differences. However, it was hoped that by combining the three samples, the total sample would better represent the general population.

A second, and more important limitation of the sample is that all participants who were included in this study were from the treatment group. The Processes of Change were only collected on those individuals in the treatment conditions. This

may have both theoretical and statistical implications. By only exploring the relationships between constructs on those who have undergone an intervention, natural change within the population is not modeled. DiClemente and Prochaska (1982) found that the TTM could be used to explain natural change as well as change initiated by a clinical intervention, however, processes were utilized differentially by these two groups. Self-quitters rated processes such as feedback, stimulus control and social management less important than those who participated in formal cessation programs (DiClemente & Prochaska, 1982). Therefore, relationships found among the treatment group may not be similar to that found among individuals who did not complete an intervention. Individuals in the control group may report less process use than those in the treatment group. Since the Processes were not collected from the control groups in these samples, that comparison cannot be empirically tested. Additionally, there may be statistical limitations to only examining the treatment group. The intervention may be creating more variance than would normally be found between these variables as people progress through the stages. This higher level of variance may create inflated correlations and relationships between the TTM constructs. Again, without the ability to compare between a treatment and control group, the relationships found must be carefully interpreted.

A final limitation related to the sample is that of missing data. Due to the need for responses to so many variables, a large proportion of the sample could not be utilized. Since we only included individuals from the treatment group at risk for sun exposure, the analyses in this study are only using 52.7% of those collected at baseline. Therefore, almost half the possible sample was not available for at least one

of the follow-up time points. This missing data needs to be further analyzed in order to determine if it is missing at random or missing in a more systematic way that may impact the results of these models. While this sample may have its limitations, the complex model structures used in these analyses requires a large amount of data, both in sample size and number of variables. The number of existing longitudinal data sets that include all TTM construct variables on a sufficient number of individuals for the above analyses are few. As in most secondary data analyses, we must make the best of the data we have and look to future studies to collect data better suited to these types of analyses.

In addition to sample limitations, there may be issues with the theoretical basis for making our hypotheses. While most of the previous research has begun in the smoking cessation area, this study focused on the area of reducing sun exposure. A continuous behavioral outcome measure was needed to test how well the TTM constructs predict actual behavior. The Sun Protection Behavior Scale provides such a measure. There is no similar continuous measure in the area of smoking cessation. While there have been several proposed methods of measuring smoking outcome (Velicer et al., 1992, Velicer et al., 1996) there has yet to be clear consensus on the best measure. Previous studies have found that the relationships of the TTM generalize well to a variety of behavioral areas (Prochaska et al., 1994; Rossi & Redding, 2001). The hypotheses for this study were developed based on previous research from the smoking cessation literature. Some of the discrepancies between expected and actual relationships found in this study may be due either to differences between the content area of sun protective behavior and smoking cessation or basic

mis-specifications of the hypothesized relationships. This confound makes clear interpretation of the results difficult. It is hoped that the findings in the area of sun exposure could be generalized to other areas. However, future studies are needed to verify the generalizability of the relationships between TTM constructs in other areas.

Future Directions

Perhaps a better test of the stage aspect of the TTM would be to test individual stage transitions rather than simply differentiating on baseline stage of change. While the breakdown used in this study was an attempt to create more homogenous subgroups that would follow similar patterns of change, that may not have happened. Of those who started in the Precontemplation stage, only 57.3% were still in Precontemplation at 12-months. Even for this most stable stage, almost half the sample had progressed to later stages at follow-up. Contemplation and Preparation were even less stable. For those who started in Contemplation, only 26.4% remained in this stage at the 12-month follow-up. For those who began in Preparation, 46.0% reported being in Preparation again at the 12-month time point. However, only 27.7% of the people in Preparation at baseline remained stable in this stage throughout the time frame. Despite the attempt to create homogeneous subgroups, there is still a large amount of heterogeneity in stage of change within the samples across time. This high rate of stage movement may be due to the success of the intervention. Further partitioning of the samples into stage transitions rather than simple baseline stage groups may create a clearer representation of the relationships that help to facilitate change from one stage to another.

However, due to the complexity of the models found in this study, a further break down of the samples may not be feasible. The size of the sample may not allow for individual stage transitions to be tested. For example, even the largest transition between Preparation and Action has only 139 people. This would not be sufficient to create a stable matrix between the 21 manifest items at three time points, or 63 manifest variables. A more basic breakdown could be examined between those individuals who progressed from their baseline stage compared to those who remained stable. However, first a system for determining stage transition groupings would be needed. Some individuals either progressed or regressed a stage at the 6-month interval, only to return to their baseline stage at 12-months. These individuals could be considered to be either stable, if looking between baseline and 12-months, or progressing or regressing, if looking between baseline and 6-months. Some determination would have to be made as to who would be included in the stable subgroups and who would be classified in the progressing subgroups. Norman et al. (1998) developed a classification system based on dynamic typology clustering that could be used for partitioning stage transitions. The stage samples could be further divided based on this classification system. However, the sample might still be too small to fully test all subgroup samples.

To simplify the models so that they may be tested on these smaller samples, a more basic model testing method could be used rather than including all constructs included in this study. One possibility would involve removing entire constructs from individual models. Those constructs not found to be statistically important in the stage samples in this study could be removed in further stage transition models. For

example, the Cons of behavior change showed little involvement in the Precontemplation stage. While this construct was more important in later stages, it could be removed from analyses involving stage transitions from the Precontemplation stage. Alternatively, rather than removing a single construct, a set of analyses similar to Step 3 could be compared between the stable and progressing subgroups. This may at least create a glimpse of where differences lie between those who progress through the stages and those who remain stable. A third possibility could be examined where select variables are modeled at specific time points, rather than having all constructs at all time points. Instead of using the full cross-lagged models analyzed in this study, more theoretically driven models could be proposed for different stage transitions. Those constructs that are seen as only predictors, such as the Experiential and Behavioral Processes, would only be included from the baseline time point where as those seen as outcomes, such as behavior would only be included at the follow-up time points. This type of simplified model was run on a sample of smokers in Precontemplation (Evans et al., 1999). Strong relationships were found as expected with Processes predicting Decisional Balance that then predicted behavior. However, by looking at the constructs at only one time point each, non-expected directional relationships could not be tested. Although these simplified models may not provide as stringent a test of the relationships between TTM constructs, they may allow models to converge using the smaller sample sizes involved with the stage transition sub-samples.

The next step, after more work has refined the models in the area of sun protective behavior, is to examine the relationships between these variables in other

health behaviors. Ideally, this type of research would return to the foundation of the TTM, to smoking cessation. However, as discussed above, there are concerns about what behavioral criteria could be used in this area. Additional areas, such as exercise, diet, condom use, or alcohol use where the TTM has been applied have continuous outcome measures that would make them more suitable for these types of analyses. The analyses described in this study, along with the further analyses described above could be applied to these other health behaviors to test the generalizability of the relationships between the TTM constructs. The only limitations on which behaviors could be analyzed are those having large enough samples with all TTM constructs and inclusion of a continuous outcome measure. Once these data sets exist, secondary data analysis to investigate the underlying relationships between the TTM constructs could be done.

Implications for Intervention

There was no clear determination with these analyses as to whether cognition predicted behavior or behavior predicted cognition. Paths in both directions were found in all stage models. If we had determined that cognition clearly influenced behavior, interventions should be focused around changing a person's pros and cons before teaching them how to modify their behavior. This is primarily the state of the current interventions based on the TTM. However, if we had found that behavior changes have an impact on cognition, there may be a remarkable change to interventions. Instead of focusing on a person's pros and cons, more emphasis should be given to making small changes in behavior. Small steps, such as reducing the amount of time spent in the sun should be encouraged to increase confidence and

reduce the cons of behavior change. Because the direction of these relationships was not clearly defined by these analyses, both strategies should be used in building interventions to increase behavior change.

The TTM as a Theory

A theory is a general statement positing relationships that are expected to explain some aspect of the world around us. Theories are used to examine why something happens. A good theory should clearly explain the interrelationships between constructs, be based on empirical data, and be able to be falsified (Blalock, 1969). The TTM was developed and continues to be developed based on empirical data. The relationships between variables are specified and have initially been examined, primarily using cross-sectional data. The above analysis attempted to further specify these relationships longitudinally.

A theory can also be evaluated based on certain criteria: falsifiability, reliance on facts, clear and reasonable assumptions, clear and operationalized constructs, clear prediction of relationships, parsimony, and generalizability (Chafetz, 1978). The TTM as discussed above, has a strong reliance on empirical data. The assumption that there are stages of change has been carefully examined above and found to be appropriate. Researchers using the TTM are careful to define their constructs. Intensive measure development has been undertaken for each construct. There are already clear relationships between stages and the other constructs. This study demonstrated different patterns of relationships between variables among the stages of change. While not creating a completely clear picture, the above research does add to the understanding of relationships between constructs. While finding parsimonious

patterns of relationships was a goal of the study, simple relationships were not found. However, this may simply reflect the fact that behavior change is not an easily explainable process. Behavior change is not easy, otherwise anyone who simply wanted to change would with little difficulty. Past research has shown how difficult change is, even with strong intentions. While parsimony is admirable, it may not be realistic in the area of health behavior change. The final criteria for evaluating a theory is generalizability. The model has been applied to a variety of areas within the health behavior arena and in a multitude of other areas. While the simple application of the model to other behaviors without evaluation of the relationships in the new behavior has been criticized (Joseph, Breslin & Skinner, 1999), these applications have shown remarkable similarity to the relationships found in smoking cessation. Interventions based on the TTM in other health related areas have been found to be effective in producing behavior change (Rossi, Blais, et al., 1995; Rossi, Redding, et al., 1995; Weinstock et al., 2000). Studies similar to this one replicated in other behavior areas may help further enhance those interventions.

The overall strength of the TTM comes from its reliance on explaining relationships found in empirical data and the ability of the model to generalize to a variety of behaviors. While there is still work to do to further understand the underlying question of why and how people change, the TTM provides at least a rough framework for that analysis.

Table 1. Sample Demographics by Sample

	Sample			
	Parent	Worksite	Physician	Total
<u>Stage baseline</u> $\chi^2_{(df=4)}=4.85, p>.05$				
PC	35.0% (158)	30.2% (103)	32.3% (327)	32.6% (588)
C	18.2% (82)	23.5% (80)	22.3% (388)	21.5% (388)
PR	46.8% (211)	46.3% (158)	45.4% (828)	45.9% (828)
<u>Stage 6-month</u> $\chi^2_{(df=8)}=5.53, p>.05$				
PC	31.6% (142)	29.7% (101)	33.2% (336)	32.2% (579)
C	16.3% (73)	19.4% (66)	18.2% (184)	17.9% (323)
PR	37.6% (169)	34.7% (118)	34.1% (345)	35.1% (632)
A	14.5% (65)	16.2% (55)	14.2% (144)	14.7% (264)
M			0.2% (2)	0.1% (2)
<u>Stage 12-month</u> $\chi^2_{(df=8)}=17.82, p<.05$				
PC	28.1% (126)	25.2% (86)	32.3% (326)	29.9% (538)
C	14.5% (65)	16.1% (55)	15.1% (152)	15.1% (272)
PR	33.2% (149)	41.1% (140)	33.0% (333)	34.6% (622)
A	14.9% (67)	9.1% (31)	10.5% (106)	11.3% (204)
M	9.4% (42)	8.5% (29)	9.1% (92)	9.1% (163)
<u>Gender</u> $\chi^2_{(df=2)}=92.93, p<.001$				
Male	27.5% (124)	60.1% (205)	36.1% (365)	38.5% (694)
Female	72.5% (327)	39.9% (136)	63.9% (647)	61.5% (1110)
<u>Marital Status</u> $\chi^2_{(df=4)}=74.87, p<.001$				
Married/living	84.6% (380)	79.7% (271)	71.8% (724)	76.5% (1375)
Not married	0.4% (2)	11.2% (38)	15.1% (152)	10.7% (192)
Sep/Div/Wid	14.9% (67)	9.1% (31)	13.2% (123)	12.8% (231)
<u>Race</u> $\chi^2_{(df=6)}=14.67, p<.05$				
White	94.4% (424)	92.1% (313)	96.7% (977)	95.3% (1714)
Black	1.8% (8)	2.6% (9)	0.7% (7)	1.3% (24)
Hispanic	1.8% (8)	2.4% (8)	1.2% (12)	1.6% (28)
Other	2.0% (9)	2.9% (10)	1.4% (14)	1.8% (33)
<u>Education (yrs)</u> $F(2,1798)=2.13, p>.05$				
Mean (SD)	14.46 (3.13)	14.46 (3.21)	14.76 (3.03)	14.63 (3.09)

Table 2. Correlations between Constructs in Baseline Measurement Model

	Experiential Processes	Behavioral Processes	Pros	Cons	Confidence	Avoidance	Sunscreen Use
Experiential Processes	1.00						
Behavioral Processes	.844	1.00					
Pros	.776	.606	1.00				
Cons	-.072	-.308	.019	1.00			
Confidence	.516	.803	.470	-.361	1.00		
Avoidance	.377	.257	.370	.057	.218	1.00	
Sunscreen Use	.303	.577	.288	-.401	.734	-.063	1.00

Table 3. Stability Parameters for the Step 4 Precontemplation Model

	6-months	12-months
<u>Experiential Processes</u>		
baseline	.724	.240
6-months		.592
<u>Behavioral Processes</u>		
baseline	.610	.169
6-months		.631
<u>Pros</u>		
baseline	.357	.143
6-months		.448
<u>Cons</u>		
baseline	.662	.279
6-months		.573
<u>Confidence</u>		
baseline	.490	.229
6-months		.674
<u>Avoidance</u>		
baseline	.352	.238
6-months		.312
<u>Sunscreen Use</u>		
baseline	.620	.203
6-months		.544

Table 4. R^2 values from the Step 4 Precontemplation Model

	6-months	12-months
Experiential Processes	.623	.724
Behavioral Processes	.519	.634
Pros	.564	.674
Cons	.531	.706
Confidence	.469	.713
Avoidance	.447	.601
Sunscreen Use	.471	.639

Table 5. Stability Parameters for the Step 4 Contemplation Model

	6-months	12-months
<u>Experiential Processes</u>		
baseline	.752	.159
6-months		.605
<u>Behavioral Processes</u>		
baseline	.581	.189
6-months		.532
<u>Pros</u>		
baseline	.287	.285
6-months		.552
<u>Cons</u>		
baseline	.741	.239
6-months		.557
<u>Confidence</u>		
baseline	.691	.173
6-months		.676
<u>Avoidance</u>		
baseline	.285	.245
6-months		.286
<u>Sunscreen Use</u>		
baseline	.665	.216
6-months		.635

Table 6. R^2 values from the Step 4 Contemplation Model

	6-months	12-months
Experiential Processes	.565	.590
Behavioral Processes	.379	.439
Pros	.482	.587
Cons	.549	.634
Confidence	.567	.653
Avoidance	.472	.513
Sunscreen Use	.480	.639

Table 7. Stability Parameters for the Step 4 Preparation Model

	6-months	12-months
<u>Experiential Processes</u>		
baseline	.768	.254
6-months		.594
<u>Behavioral Processes</u>		
baseline	.531	.300
6-months		.503
<u>Pros</u>		
baseline	.317	.195
6-months		.586
<u>Cons</u>		
baseline	.599	.271
6-months		.505
<u>Confidence</u>		
baseline	.678	.188
6-months		.476
<u>Avoidance</u>		
baseline	.315	.068
6-months		.329
<u>Sunscreen Use</u>		
baseline	.781	.210
6-months		.654

Table 8. R² values from the Step 4 Preparation Model

	6-months	12-months
Experiential Processes	.590	.650
Behavioral Processes	.466	.603
Pros	.368	.576
Cons	.491	.592
Confidence	.495	.572
Avoidance	.421	.577
Sunscreen Use	.490	.659

Figure 1. Predicted Relationships for Precontemplation Stage

Figure 2. Predicted Relationships for Contemplation Stage

Figure 3. Predicted Relationships for Preparation Stage

Figure 4. Step 1: Measurement Structure for All Constructs

Figure 5. Step 4: Integrated Model for Precontemplation

Figure 6. Step 4: Integrated Model for Contemplation

Figure 7. Step 4: Integrated Model for Preparation

Appendix A – Step 1: Measurement Structure

Processes of Change

The original 15 two item processes were examined to determine the best fitting model for representing both Experiential and Behavioral processes of change. A model with five Experiential Processes and six Behavioral Processes fit the data best once poor items were removed, $\chi^2(285) = 930.93$, CFI = .834, AASR=.061, RMSEA=.065 (see Figure A1). To simplify for further analyses, the three best processes from each of the Experiential and Behavioral constructs were selected, Consciousness Raising, Dramatic Relief, and Self Reevaluation for Experiential processes and Stimulus Control, Reinforcement Management, and Self Liberation for Behavioral processes. To simplify the measurement model for further analyses, scale scores were computed by summing the two items for each process. Figure A2 presents the scale level measurement model for the processes of change in the full baseline sample $\chi^2(8)=151.07$, CFI=.980, RMSEA=.075, AASR=.016 and the longitudinal baseline sample, $\chi^2(8)=68.86$, CFI=.984, RMSEA=.065, AASR=.014. The model shows excellent fit in both samples.

Decisional Balance

A model with the original eight items for Decisional Balance showed good fit in the baseline sample, $\chi^2(19)=327.19$, CFI=.961, RMSEA=.070, AASR=.034 (see Figure A3). The three best indicators of the Pros and Cons were selected for the simplified measurement model. This simplified model also shows good fit in the full baseline sample, $\chi^2(8)=174.06$, CFI=.973, RMSEA=.079, AASR=.024 and in the

longitudinal baseline sample, $\chi^2(8)=124.43$, CFI=.964, RMSEA=.090, AASR=.027.

Figure A4 displays both models.

Confidence

The proposed model with one higher-order factor for the two confidence subscales showed good fit in the baseline sample, $\chi^2(8)=167.89$, CFI=.982, RMSEA=.077, AASR=.021 (see Figure A5). Scale scores of the two factors cannot easily be used to represent the confidence construct since three markers are needed for stable estimates of latent constructs (Nunnally, 1978). The three best representative items were selected for a general confidence factor, including one item from the sunscreen use factor, and two from the avoidance factor. Figure A6 presents this reduced item model in both the full baseline sample and longitudinal baseline sample. There are zero degrees of freedom for these models, therefore there are no indices of fit. The factor loadings show adequate strength, although the sunscreen use item is low.

Behavior

The proposed seven item, two-factor structure was examined initially to simplify the structure to six items. The model presented in Figure A7 shows good fit, $\chi^2(13)=347.79$, CFI=.972, RMSEA=.087, AASR=.027 in the baseline sample. The lowest item from the Avoidance factor was removed and the model again shows good fit, $\chi^2(8)=152.50$, CFI=.986, RMSEA=.056, AASR=.021 in the full baseline sample. Figure A8 presents this model, and the model run on the longitudinal baseline sample which also showed good fit, $\chi^2(8)=91.02$, CFI=.986, RMSEA=.076, AASR=.021. Due to the small correlation between the factors, a single higher order measure of sun

protective behavior could not be formed by items or parcels from these two subscales. Therefore, both scales will be incorporated into the full model and tested independently in future steps.

Figure A1. Step 1: Item Level Measurement Structure of Processes of Change

Figure A2. Step 1: Scale Level Measurement Structure of Processes of Change

Full Baseline Sample
(N=3319)

Longitudinal Sample
(N=1804)

Figure A3. Step 1: Full Item Level Measurement Structure of Decisional Balance

Item Level
(N=3339)

Figure A4. Step 1: Reduced Item Measurement Structure of Decisional Balance

Full Baseline Sample

(N=3339)

Longitudinal Sample

(N=1804)

Figure A5. Step 1: Full Item Level Measurement Structure of Confidence

Item Level

(N=3339)

Figure A6. Step 1: Reduced Item Level Measurement Structure of Confidence

Full Baseline Sample
(N=3339)

Longitudinal Sample
(N=1804)

Figure A7. Step 1: Full Item Level Measurement Structure of Behavior

Item Level
(N=3403)

Figure A8. Step 1: Reduced Item Level Measurement Structure of Behavior

Full Baseline Sample

(N=3187)

Longitudinal Sample

(N=1804)

Appendix B – Step 2: Longitudinal Stability

Precontemplation

Table B1 lists the fit indices for each of the seven constructs both with (Model 1) and without (Model 2) the baseline to 12-month stability parameters. As discussed in the Results, all these estimates were significant indicating the need to retain this path. These models are presented in Figures B1 to B7 for each of the seven constructs. Experiential Processes (Figure B1), Confidence (Figure B5), and Sunscreen Use (Figure B7) show all correlated error paths are significant. Correlated errors for the self liberation parcels in Behavioral Processes and for an item in the Cons model are not significant (see Figures B2 and B4), respectively. Figure B3 shows that two of the three items representing the Pros show non-significant adjacent correlated errors. The Avoidance model has one item with all non-significant correlated errors along with one item with the baseline to 6-month errors not significantly correlated (see Figure B6).

Contemplation

The seven constructs again show good fit across time for all seven TTM constructs. Table B2 presents fit indices for the models with and without the baseline to 12-month stability paths. The Chi-squared difference test for the Experiential Processes, Pros, Cons, Confidence, Avoidance, and Sunscreen Use constructs showed a significant decrease in fit when this path was removed from the model, indicating the need to retain this path in future models. This path was not significant for the Behavioral Processes. Figures B8 to B14 present the models for the seven constructs that include this baseline to 12-month path. Correlated error paths on items across the

time points were also estimated. Experiential Processes (Figure B8), Behavioral Processes (Figure B9), Cons (Figure B11), and Sunscreen Use (Figure B14) show all correlated error paths are significant. Both the Pros and Confidence scales have two items each with non-significant error correlations (see Figures B10 and B12, respectively). Only three of the nine correlated error terms were significant for the Avoidance factor (see Figure B13).

Preparation

Table B3 lists the fit indices for all seven constructs run in the Preparation sample. All seven constructs show excellent fit. The Chi-squared difference test for all constructs showed a significant ($p < .01$) decrease in fit when the baseline to 12-month path was removed from the model, indicating the need to retain this path in future models. Figures B15 to B21 present the models for the seven constructs that include the baseline to 12-month path. Correlated error paths on items across the time points were also estimated. Experiential Processes (Figure B15), Behavioral Processes (Figure B16), and Sunscreen Use (Figure B21) show all correlated error paths are significant. Correlated errors for an item on each of the Pros (Figure B17), Cons (Figure B18), and Confidence (Figure B19) constructs are not significant. The Avoidance model has one item with all non-significant correlated errors along with one item with the baseline to 6-month errors not significantly correlated (see Figure B20).

Table B1. Step 2: Fit Indices for Precontemplation Models

	χ^2	df	CFI	AASR	RMSEA	$\chi^2_{\Delta}(df_{\Delta})$
Experiential Processes						
Model 1	27.85	15	.996	.018	.038	
Model 2	42.34	16	.993	.021	.053	14.49 (1) p<.01
Behavioral Processes						
Model 1	14.76	15	1.00	.015	.000	
Model 2	23.25	16	.997	.018	.028	8.49 (1) p<.01
Pros						
Model 1	19.09	15	.998	.012	.022	
Model 2	25.39	16	.996	.014	.032	6.30 (1) p<.05
Cons						
Model 1	10.54	15	1.00	.009	.000	
Model 2	35.06	16	.994	.019	.045	24.52 (1) p<.01
Confidence						
Model 1	14.14	15	1.00	.012	.000	
Model 2	31.43	16	.994	.019	.041	17.29 (1) p<.01
Avoidance						
Model 1	37.97	15	.994	.031	.051	
Model 2	79.33	16	.984	.049	.082	41.36 (1) p<.01
Sunscreen Use						
Model 1	43.28	15	.994	.030	.057	
Model 2	82.15	16	.986	.041	.084	38.87 (1) p<.01

Table B2. Step 2: Fit Indices for Contemplation Models

	χ^2	df	CFI	AASR	RMSEA	$\chi^2_{\Delta}(df_{\Delta})$
Experiential Processes						
Model 1	24.56	15	.995	.027	.041	
Model 2	29.40	16	.993	.029	.047	4.84 (1) p<.05
Behavioral Processes						
Model 1	17.94	15	.997	.022	.023	
Model 2	19.17	16	.997	.022	.023	1.23 (1) n.s.
Pros						
Model 1	21.49	15	.994	.020	.033	
Model 2	26.05	16	.991	.022	.040	4.56 (1) p<.05
Cons						
Model 1	10.41	15	1.00	.009	.000	
Model 2	25.11	16	.996	.017	.038	14.70 (1) p<.01
Confidence						
Model 1	37.77	15	.977	.032	.063	
Model 2	41.47	16	.974	.031	.064	3.70 (1) p<.05
Avoidance						
Model 1	28.69	15	.993	.031	.049	
Model 2	48.41	16	.984	.045	.072	19.72 (1) p<.01
Sunscreen Use						
Model 1	38.05	15	.993	.034	.063	
Model 2	52.57	16	.988	.040	.077	14.52 (1) p<.01

Table B3. Step 2: Fit Indices for Preparation Models

	χ^2	df	CFI	AASR	RMSEA	$\chi^2_{\Delta}(df_{\Delta})$
Experiential Processes						
Model 1	19.59	15	.999	.009	.019	
Model 2	38.20	16	.995	.015	.041	18.61 (1) p<.01
Behavioral Processes						
Model 1	25.10	15	.996	.015	.029	
Model 2	41.29	16	.990	.020	.044	16.19 (1) p<.01
Pros						
Model 1	25.70	15	.996	.012	.029	
Model 2	35.58	16	.992	.017	.038	9.88 (1) p<.01
Cons						
Model 1	12.86	15	1.00	.008	.000	
Model 2	52.53	16	.990	.022	.053	39.67 (1) p<.01
Confidence						
Model 1	101.18	15	.965	.049	.083	
Model 2	115.82	16	.959	.051	.087	14.64 (1) p<.01
Avoidance						
Model 1	57.43	15	.990	.037	.058	
Model 2	83.53	16	.984	.048	.071	26.10 (1) p<.01
Sunscreen Use						
Model 1	92.47	15	.988	.032	.079	
Model 2	125.17	16	.983	.036	.091	32.70 (1) p<.01

Figure B1. Step 2: Within Construct Relationships for Experiential Processes – Precontemplation

Figure B2. Step 2: Within Construct Relationships for Behavioral Processes – Precontemplation

Figure B3. Step 2: Within Construct Relationships for Pros – Precontemplation

Figure B4. Step 2: Within Construct Relationships for Cons – Precontemplation

Figure B5. Step 2: Within Construct Relationships for Confidence – Precontemplation

Figure B6. Step 2: Within Construct Relationships for Avoidance – Precontemplation

Figure B7. Step 2: Within Construct Relationships for Sunscreen Use – Precontemplation

Figure B8. Step 2: Within Construct Relationships for Experiential Processes – Contemplation

Figure B9. Step 2: Within Construct Relationships for Behavioral Processes – Contemplation

Figure B10. Step 2: Within Construct Relationships for Pros – Contemplation

Figure B11. Step 2: Within Construct Relationships for Cons – Contemplation

Figure B12. Step 2: Within Construct Relationships for Confidence – Contemplation

Figure B13. Step 2: Within Construct Relationships for Avoidance – Contemplation

Figure B14. Step 2: Within Construct Relationships for Sunscreen Use – Contemplation

Figure B15. Step 2: Within Construct Relationships for Experiential Processes – Preparation

Figure B16. Step 2: Within Construct Relationships for Behavioral Processes – Preparation

Figure B17. Step 2: Within Construct Relationships for Pros – Preparation

Figure B18. Step 2: Within Construct Relationships for Cons – Preparation

Figure B19. Step 2: Within Construct Relationships for Confidence – Preparation

Figure B20. Step 2: Within Construct Relationships for Avoidance – Preparation

Figure B21. Step 2: Within Construct Relationships for Sunscreen Use – Preparation

Appendix C – Step 3: Pairwise Cross-lagged Models

Step 3 examined the relationships among pairs of constructs. Cross-lag models between each combination of two constructs were run within the three stage of change samples. Non-significant paths within each model were removed to produce a reduced model. Chi-square difference tests and other measures of fit were used to determine whether specific paths were retained for future models.

Precontemplation. Table C1a presents fit indices and Chi-squared difference tests for the models run between the Experiential and Behavioral Processes and all other constructs. Table C1b presents similar information for models run between the Pros, Cons, Confidence, and behavior constructs. All reduced models show non-significant Chi-squared difference tests, indicating that those parameters that were removed are not necessary for the fit of the model.

Models between Experiential Processes and the six other constructs are presented in Figures C1 through C21. Experiential Processes were expected to act as independent variables, specifically predicting Pros. Consistent with expectations, increases in Experiential Processes at both baseline and 6-months predict increases in the Pros of behavior change at subsequent time points (see Figure C2). Several additional relationships were found, with higher levels of baseline Experiential Processes significantly predicting higher Behavioral Processes (Figure C1), Confidence (Figure C4), Sunscreen Use (Figure C6), and Avoidance at 6-months, along with lower Avoidance levels at 12-months (Figure C5). Additionally, high levels of Experiential Processes at the 6-month time point significantly predicts higher

Sunscreen Use, and Avoidance at 12-months along with lower levels of Cons (Figure C3). Sunscreen Use is the only construct found to significantly predict future levels of Experiential Processes (Figure C6).

Behavioral Processes, while seen as independent variables in the overall model, were not expected to be highly involved for the Precontemplation sample. However, several significant relationships were found. Overall, high levels of Behavioral Processes predict higher Pros (Figure C7) and Avoidance (Figure C10) at subsequent time points. The relationship between Behavioral Processes and Cons is slightly complex, with higher levels of Behavioral Processes predicting lower levels of Cons at subsequent time points, however, high baseline Behavioral Processes predict higher 12-month Cons (see Figure C8). Behavioral Processes at 6-months also predicted increased Sunscreen Use at 12-months (Figure C11). While expected to be act as independent variables, the Behavioral Processes were significantly predicted by Pros, Confidence (Figure 9), and Sunscreen Use.

Pros were predicted to act as a mediator between Experiential Processes and behavior, with Experiential Processes predicting Pros, which would then predict behavior. As discussed above, Experiential Processes were found to predict increases in the Pros of behavior change at subsequent time points. The relationship between Pros and behavior is less clear. High levels of Pros at baseline predict higher 6-month Avoidance (Figure C14) along with high levels of Pros at 6-months predicting increases in Sunscreen Use at 12-months (Figure C15). However, baseline Avoidance and Sunscreen Use also predict Pros at 6-months. Additional relationships were also found with the Pros of behavior change. Overall, high levels of Pros at baseline

significantly predict high levels of Behavioral Processes and low levels of Cons (Figure C12) at 6-months. In addition, high Pros were predicted by high levels of Behavioral Processes, Confidence (Figure C13) and lower Cons.

Behavior predicting decreases in the level of Cons was the only hypothesized relationship for the Cons. As expected, high levels of Avoidance at baseline and 6-months significantly predict lower levels of Cons at subsequent time points (Figure C17). However, a complex relationship where higher levels of Sunscreen Use are predicted by higher levels of baseline Cons and lower levels of Cons at 6-months was not expected (Figure C18). The only other relationships between Cons and other constructs included high endorsement of Cons at baseline predicting lower Pros and Confidence (Figure C16) at 6-months.

There were no specific hypotheses related to the Confidence construct. Despite this, several relationships were significant. Overall, high levels of baseline Confidence were found to predict high levels of 6-month Behavioral Processes, Pros, Avoidance (Figure C19), Sunscreen Use and 12-month Sunscreen Use (Figure C20). Baseline Confidence is also negatively related to 6-month Cons. Additionally, high levels of Confidence at 6-months predict high levels of both Avoidance and Sunscreen Use and low levels of Cons at 12-months. High 6-month Confidence levels were predicted by high Experiential Processes, Avoidance, and Sunscreen Use and lower levels of Cons. Despite the lack of hypothesized relationships, Confidence appears to predict and be predicted by several TTM constructs.

The behavior subscales were analyzed separately with each TTM construct. Overall, higher levels of baseline Avoidance behavior predict higher levels of Pros and

Confidence and lower levels of Cons at 6-months. Six month Avoidance only significantly predicts decreases in 12-month Cons. Additionally, high levels of baseline Sunscreen Use predict increases in Experiential Processes, Pros, Confidence, and Avoidance (Figure C21) at 6-months. Finally, 6-month Sunscreen Use predicts increases in both Experiential and Behavioral Processes at 6-months.

Contemplation. Non-significant paths were again removed from each combination of pairwise cross-lagged constructs. Tables C2a and C2b present the fit indices and Chi-squared difference for all pairwise models. Almost all reduced models in this sample show non-significant Chi-squared difference tests, indicating that those parameters that were removed are not necessary for the fit of the model. The reduced model for Confidence shows a slightly significant ($p < .05$) Chi-squared difference. However, all the paths removed from this model were all non-significant.

Experiential Processes were expected to act as independent variables, specifically predicting Pros and behavior. Baseline Experiential Processes did significantly predict increases in both Pros (Figure C23) and Sunscreen Use (Figure C27) at 6-months. Experiential Processes did not significantly predict any other constructs (see Figures C22, C24, and C26). However, high 12-month Experiential Processes were significantly predicted by high 6-month Pros and Sunscreen use along with high Baseline Confidence (Figure C25).

Behavioral Processes were also expected to predict Pros and behavior, acting as independent variables. These predictions were confirmed with higher Behavioral Processes predicting higher levels of Pros (Figure C28) and Avoidance behavior

(Figure C31) at subsequent time points. In addition, 6-month Behavioral Processes were predicted by Cons (Figure C29), with higher Cons predicting increased levels of Behavioral Processes. There were no significant relationships between Behavioral Processes and either Confidence (Figure C30) or Sunscreen Use (Figure C32).

The Pros of behavior change were hypothesized to be influenced by both Experiential and Behavioral Processes as well as to influence behavior. As discussed above, Experiential and Behavioral Processes were found to be significant predictors of Pros. In addition, increases in 6-month Pros were predicted by lower Cons (Figure C33) and higher Confidence (Figure C34). High baseline Pros only significantly predict lower Cons at 6-months. However, high Pros at the 6-month time point significantly predict increases in Experiential Processes, Avoidance (Figure C35), and Sunscreen Use (Figure C36). Thus, all predictions for Pros were at least partially supported in this sample.

The Cons of behavior change were expected to be predicted by behavior. Increases in Avoidance at both baseline and 6-months significantly predict subsequent decreases in Cons (Figure C38). There are no significant relationships between Sunscreen Use and Cons (Figure C39). As discussed above, high baseline Pros also predicted lower Cons of behavior change. In addition, high baseline Cons significantly predict lower Behavioral Processes, Pros, and Avoidance at 6-months along with all follow-up time points of Confidence (Figure C37). Six month Cons are also negatively related to Confidence at 12-months. While more constructs were significantly related to Cons than expected, all significant relationships were in an anticipated direction.

There were no hypotheses made for Confidence, however several empirical relationships were found. High baseline Confidence levels significantly predict higher Pros at 6-months and Experiential Processes at 12-months. Additionally, high Confidence predicts increases in Avoidance behavior at subsequent time points (Figure C40). Conversely, higher baseline Sunscreen Use behavior predicts lower levels of Confidence at 6-months (Figure C41). Cons and Confidence show a complex relationship. High levels of Cons at baseline predict lower Confidence at both follow-up time points. However, high levels of Cons at 6-months significantly predict higher levels of Confidence at 12-months.

The behavior constructs were predicted to influence the Cons of behavior change. Behavior was also expected to be influenced by Experiential and Behavioral Processes along with the Pros of behavior change.

For Avoidance, these predictions were at least partially supported. Avoidance negatively predicts Cons at subsequent time points. Also as predicted, high Behavioral Processes predict higher Avoidance behavior at subsequent time points. Additionally, higher 6-month Pros influence higher Avoidance at 12-months. Experiential Processes do not show significant predictive relationships with Avoidance. While there were no specific predictions between behavior and Confidence, Confidence was a strong predictor of Avoidance at adjacent times. Additionally, baseline Cons and Sunscreen Use (Figure C42) were negatively related to Avoidance at 6-months.

Only two of the expected relationships were partially supported for the Sunscreen Use behavior subscale. High baseline Experiential Processes predicted

higher levels of Sunscreen Use at 6-months. However, high levels of Sunscreen Use at 6-months significantly predicted higher Experiential Processes at 12-months. The only relationship between Pros and Sunscreen Use was that higher Pros at 6 months influenced higher Sunscreen Use at 12-months. Sunscreen Use did not show any predictive relationship with the Cons of behavior change, nor was it predicted by Behavioral Processes. While not predicted, high levels of Sunscreen Use at baseline predicted lower levels of Confidence and Avoidance behavior.

Preparation. As in the previous two samples, non-significant paths were removed from each combination of cross-lagged constructs. All reduced models show non-significant Chi-squared difference tests, indicating that the parameters that were removed are not necessary for the fit of the model. These values and fit indices are presented in Tables C3a and C3b.

Experiential Processes were not expected to play a large role in this sample. Accordingly, only Pros and Cons showed significant relationships with Experiential Processes. Higher Experiential Processes at baseline were strongly related to higher Pros at 6-months (Figure C44). The relationship with Cons is a bit more complex, where lower Cons at 12-months were significantly predicted by lower Experiential Processes at baseline and higher Experiential Processes at 6-months (Figure C45). All other constructs did not show significant relationships with Experiential Processes (see Figures C43, C46, C47, and C48)

As opposed to Experiential Processes, Behavioral Processes are expected to be more involved in this stage sample, specifically, predicting behavior. While there are

no significant predictive relationships between Behavioral Processes and Sunscreen Use (Figure C53), this anticipated relationship was found for Avoidance. Higher reported use of Behavioral Processes predicted more Avoidance behavior at all subsequent time points (Figure C52). However, Behavioral Processes at 6-months were also predicted by baseline Avoidance. In addition to this relationship with behavior, Behavioral Processes were also found to relate to several of the other TTM constructs. The only cross-lagged path not significant between Behavioral Processes and Pros was that from Behavioral Processes at 6-months to 12-month Pros (Figure C49). High endorsement of Behavioral Processes was significantly related to lower Cons reported at later time points (Figure C50). Additionally, high baseline Cons significantly predicted less endorsement of Behavioral Processes at 6-months. Finally, higher Confidence at baseline predicted higher endorsement of Behavioral Processes at 6-months, which showed a positive predictive relationship with Confidence at 12-months (Figure C51).

Behavior was expected to predict the Pros of behavior change. However, there were no significant cross-lagged paths between either of the behavior subscales and Pros (see Figures C56 and C57). Despite this lack of expected relationships, all other TTM constructs did show predictive relationships with the Pros. As discussed above, Pros both predicted and were predicted by Experiential and Behavioral Processes of Change. Additionally, low levels of Cons at baseline predicted higher levels of Pros at both 6- and 12-month time points (Figure C54). Finally, high levels of Confidence at baseline were also related to higher levels of Pros at 6-months (Figure C55).

Similar to the Pros, the Cons of behavior change were expected to be predicted by the behavior scales. While both Avoidance and Sunscreen Use predicted Cons, there were differing relationships. With Avoidance, all adjacent time point cross-lagged paths were significant, indicating that while increases in Avoidance predicted decreases in Cons, so to did increases in Cons predict decreases in Avoidance (Figure C59). However, only increases in baseline Sunscreen Use predicted higher levels of Cons at both follow-up time points (Figure C60). Confidence also was negatively related to Cons at subsequent time points (Figure C58). Additionally, high levels of Cons at baseline predicted lower levels of Confidence at 6-months. As discussed above, Cons were also predicted by Experiential and Behavioral Processes and also predicted Behavioral Processes and Pros.

While no explicit hypotheses were made for Confidence, it was expected that they would influence the behavior constructs. Higher levels of Confidence were found to be related to both higher Avoidance at all time points (Figure C61) and higher Sunscreen Use at 6-months only (Figure C62). Additionally, higher levels of Avoidance at 6-months significantly predicted higher levels of Confidence at 12-months. As discussed above Confidence also predicted Behavioral Processes, Pros, and Cons, and was predicted by Cons of behavior change.

Behavior was expected to be predicted by Behavioral Processes and to predict both the Pros and Cons of behavior Change. Behavioral Processes did significantly predict later levels of Avoidance behavior, however, they did not predict future Sunscreen Use. Additionally, both Avoidance and Sunscreen Use predicted the Cons of behavior change, as discussed above, however, neither showed any significant

predictive relationships with the Pros of behavior change. In addition to these relationships, both behavior subscales were also predicted by Confidence, as discussed above. When examined together, baseline Avoidance significantly predicted 6-month Sunscreen Use while 6-month Sunscreen Use predicted 12-month Avoidance (Figure C63).

Table C1a. Step 3: Fit Indices for Precontemplation Models – Experiential and Behavioral Processes

	χ^2	df	CFI	AASR	RMSEA	$\Delta \chi^2$ Δdf
<u>Experiential Processes with:</u>						
Behavioral Processes	220.6 0	107	.983	.026	.043	9.04 (5) n.s.
Pros	282.6 0	106	.974	.025	.053	2.60 (4) n.s.
Cons	141.3 5	107	.995	.024	.023	5.19 (5) n.s.
Confidence	233.9 2	107	.980	.045	.045	12.21 (6) n.s.
Avoidance	189.9 7	105	.989	.028	.037	3.09 (3) n.s.
Sunscreen Use	190.4 9	104	.990	.026	.038	3.55 (2) n.s.
<u>Behavioral Processes with:</u>						
Pros	189.1 2	105	.984	.027	.037	2.89 (3) n.s.
Cons	195.9 6	105	.984	.048	.038	2.92 (3) n.s.
Confidence	253.0 3	107	.973	.040	.048	2.98 (5) n.s.
Avoidance	285.6 0	106	.973	.049	.054	1.96 (4) n.s.
Sunscreen Use	164.1 6	107	.992	.029	.030	6.69 (5) n.s.

Table C1b. Step 3: Fit Indices for Precontemplation Models – Pros, Cons, Confidence, and Behavior

	χ^2	df	CFI	AASR	RMSEA	$\Delta \chi^2$ Δdf
<u>Pros with:</u>						
Cons	235.36	106	.978	.036	.046	5.30 (4) n.s.
Confidence	266.41	107	.969	.045	.050	5.48 (5) n.s.
Avoidance	190.87	106	.987	.031	.037	7.24 (4) n.s.
Sunscreen Use	171.23	106	.991	.026	.032	4.32 (4) n.s.
<u>Cons with:</u>						
Confidence	134.77	105	.995	.031	.022	2.90 (3) n.s.
Avoidance	171.77	106	.991	.042	.033	7.46 (4) n.s.
Sunscreen Use	154.60	106	.994	.028	.028	3.96 (4) n.s.
<u>Confidence with:</u>						
Avoidance	282.86	105	.975	.032	.054	2.01 (3) n.s.
Sunscreen Use	580.43	104	.939	.055	.085	1.64 (2) n.s.
<u>Avoidance with:</u>						
Sunscreen Use	244.46	107	.984	.042	.047	12.29 (5) p < .05

Table C2a. Step 3: Fit Indices for Contemplation Models – Experiential and Behavioral Processes

	χ^2	df	CFI	AASR	RMSEA	$\Delta \chi^2$ Δdf
<u>Experiential Processes with:</u> Behavioral Processes						
Pros	251.54	106	.958	.035	.060	1.44 (4) n.s.
Cons	150.56	108	.990	.034	.032	2.60 (6) n.s.
Confidence	246.81	107	.954	.052	.058	1.16 (5) n.s.
Avoidance	164.04	108	.969	.036	.037	12.42 (6) n.s.
Sunscreen Use	185.99	106	.984	.040	.046	2.26 (4) n.s.
<u>Behavioral Processes with:</u>						
Pros	184.29	106	.969	.038	.044	3.75 (4) n.s.
Cons	207.23	107	.971	.062	.049	3.18 (5) n.s.
Confidence	271.40	108	.935	.052	.063	13.04 (6) p < .05
Avoidance	229.15	106	.964	.056	.055	3.54 (4) n.s.
Sunscreen Use	192.49	108	.981	.055	.045	4.78 (6) n.s.

Table C2b. Step 3: Fit Indices for Contemplation Models – Pros, Cons, Confidence, and Behavior

	χ^2	df	CFI	AASR	RMSEA	$\Delta \chi^2$ Δdf
<u>Pros with:</u>						
Cons	172.81	106	.980	.035	.040	6.54 (4) n.s.
Confidence	193.46	107	.962	.045	.046	5.82 (5) n.s.
Avoidance	198.12	107	.972	.046	.047	8.58 (5) n.s.
Sunscreen Use	171.01	107	.985	.036	.039	2.53 (5) n.s.
<u>Cons with:</u>						
Confidence	158.95	105	.983	.051	.036	6.82 (3) n.s.
Avoidance	151.15	105	.989	.037	.034	3.41 (3) n.s.
Sunscreen Use	173.71	108	.988	.039	.040	3.37 (6) n.s.
<u>Confidence with:</u>						
Avoidance	273.85	106	.951	.053	.064	3.64 (4) n.s.
Sunscreen Use	597.59	107	.894	.110	.109	2.34 (5) n.s.
<u>Avoidance with:</u>						
Sunscreen Use	184.83	107	.985	.044	.043	5.37 (5) n.s.

Table C3a. Step 3: Fit Indices for Preparation Models – Experiential and Behavioral Processes

	χ^2	df	CFI	AASR	RMSEA	$\Delta \chi^2$ Δdf
<u>Experiential Processes with:</u> Behavioral Processes						
Pros	280.36	106	.977	.022	.045	6.69 (4) n.s.
Cons	138.95	106	.996	.021	.019	3.67 (4) n.s.
Confidence	336.39	108	.967	.046	.051	5.70 (6) n.s.
Avoidance	158.79	108	.994	.025	.024	5.94 (6) n.s.
Sunscreen Use	247.19	108	.987	.025	.039	5.01 (6) n.s.
<u>Behavioral Processes with:</u> Pros						
Pros	252.28	103	.973	.033	.042	0.08 (1) n.s.
Cons	201.07	105	.985	.040	.033	1.79 (3) n.s.
Confidence	375.39	106	.954	.048	.055	1.56 (4) n.s.
Avoidance	306.15	105	.973	.041	.048	3.17 (3) n.s.
Sunscreen Use	331.19	108	.976	.050	.050	9.44 (6) n.s.

Table C3b. Step 3: Fit Indices for Preparation Models – Pros, Cons, Confidence, and Behavior

	χ^2	df	CFI	AASR	RMSEA	$\frac{\Delta \chi^2}{\Delta df}$
<u>Pros with:</u>						
Cons	200.66	106	.985	.027	.033	6.44 (4) n.s.
Confidence	352.64	107	.953	.051	.053	3.92 (5) n.s.
Avoidance	205.67	108	.986	.032	.033	5.96 (6) n.s.
Sunscreen Use	214.67	108	.988	.029	.035	7.60 (6) n.s.
<u>Cons with:</u>						
Confidence	236.16	105	.979	.042	.039	2.86 (3) n.s.
Avoidance	187.46	104	.990	.031	.031	0.96 (2) n.s.
Sunscreen Use	203.34	106	.991	.026	.033	2.95 (4) n.s.
<u>Confidence with:</u>						
Avoidance	603.87	104	.938	.064	.076	1.85 (2) n.s.
Sunscreen Use	1207.69	107	.892	.108	.112	8.12 (5) n.s.
<u>Avoidance with:</u>						
Sunscreen Use	364.13	106	.978	.042	.054	4.91 (4) n.s.

Figure C1. Step 3: Precontemplation – Experiential Processes and Behavioral Processes

Figure C2. Step 3: Precontemplation – Experiential Processes and Pros

Figure C3. Step 3: Precontemplation – Experiential Processes and Cons

Figure C4. Step 3: Precontemplation – Experiential Processes and Confidence

Figure C5. Step 3: Precontemplation – Experiential Processes and Avoidance

Figure C6. Step 3: Precontemplation – Experiential Processes and Sunscreen Use

Figure C7. Step 3: Precontemplation – Behavioral Processes and Pros

Figure C8. Step 3: Precontemplation – Behavioral Processes and Cons

Figure C9. Step 3: Precontemplation – Behavioral Processes and Confidence

Figure C10. Step 3: Precontemplation – Behavioral Processes and Avoidance

Figure C11. Step 3: Precontemplation – Behavioral Processes and Sunscreen Use

Figure C12. Step 3: Precontemplation – Pros and Cons

Figure C13. Step 3: Precontemplation – Pros and Confidence

Figure C14. Step 3: Precontemplation – Pros and Avoidance

Figure C15. Step 3: Precontemplation – Pros and Sunscreen Use

Figure C16. Step 3: Precontemplation – Cons and Confidence

Figure C17. Step 3: Precontemplation – Cons and Avoidance

Figure C18, Step 3: Precontemplation – Cons and Sunscreen Use

Figure C19. Step 3: Precontemplation – Confidence and Avoidance

Figure C20. Step 3: Precontemplation – Confidence and Sunscreen Use

Figure C21. Step 3: Precontemplation – Avoidance and Sunscreen Use

Figure C22. Step 3: Contemplation – Experiential Processes and Behavioral Processes

Figure C23. Step 3: Contemplation – Experiential Processes and Pros

Figure C24. Step 3: Contemplation – Experiential Processes and Cons

Figure C25. Step 3: Contemplation – Experiential Processes and Confidence

Figure C26. Step 3: Contemplation – Experiential Processes and Avoidance

Figure C27. Step 3: Contemplation – Experiential Processes and Sunscreen Use

Figure C28. Step 3: Contemplation – Behavioral Processes and Pros

Figure C29. Step 3: Contemplation – Behavioral Processes and Cons

Figure C30. Step 3: Contemplation – Behavioral Processes and Confidence

Figure C31. Step 3: Contemplation – Behavioral Processes and Avoidance

Figure C32. Step 3: Contemplation – Behavioral Processes and Sunscreen Use

Figure C33. Step 3: Contemplation – Pros and Cons

Figure C34. Step 3: Contemplation – Pros and Confidence

Figure C35. Step 3: Contemplation – Pros and Avoidance

Figure C36. Step 3: Contemplation – Pros and Sunscreen Use

Figure C37. Step 3: Contemplation – Cons and Confidence

Figure C38. Step 3: Contemplation – Cons and Avoidance

Figure C39. Step 3: Contemplation – Cons and Sunscreen Use

Figure C40. Step 3: Contemplation – Confidence and Avoidance

Figure C41. Step 3: Contemplation – Confidence and Sunscreen Use

Figure C42. Step 3: Contemplation – Avoidance and Sunscreen Use

Figure C43. Step 3: Preparation – Experiential Processes and Behavioral Processes

Figure C44. Step 3: Preparation – Experiential Processes and Pros

Figure C45. Step 3: Preparation – Experiential Processes and Cons

Figure C46. Step 3: Preparation – Experiential Processes and Confidence

Figure C47. Step 3: Preparation – Experiential Processes and Avoidance

Figure C48. Step 3: Preparation – Experiential Processes and Sunscreen Use

Figure C49. Step 3: Preparation – Behavioral Processes and Pros

Figure C50. Step 3: Preparation – Behavioral Processes and Cons

Figure C51. Step 3: Preparation – Behavioral Processes and Confidence

Figure C52. Step 3: Preparation – Behavioral Processes and Avoidance

Figure C53. Step 3: Preparation – Behavioral Processes and Sunscreen Use

Figure C54. Step 3: Preparation – Pros and Cons

Figure C55. Step 3: Preparation – Pros and Confidence

Figure C56. Step 3: Preparation – Pros and Avoidance

Figure C57. Step 3: Preparation – Pros and Sunscreen Use

Figure C58. Step 3: Preparation – Cons and Confidence

Figure C59. Step 3: Preparation – Cons and Avoidance

Figure C60. Step 3: Preparation – Cons and Sunscreen Use

Figure C61. Step 3: Preparation – Confidence and Avoidance

Figure C62. Step 3: Preparation – Confidence and Sunscreen Use

Figure C63. Step 3: Preparation – Avoidance and Sunscreen Use

Appendix D – Survey Measures

Processes of Change

The following feelings, thoughts, and experiences can affect the summer sun exposure habits of some people. We would like to know how often you may have had similar feelings, thoughts, and experiences during the past summer using the following scale:

1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Always

Consciousness Raising

- 2. I look for information about the risks of getting too much sun.
- 17. I think about what I've seen on TV or in magazines about the health risks of sun exposure.

Dramatic Relief

- 3. It bothers me when I see someone whose skin has been damaged by the sun.
- 18. I get upset when I see someone aged by too much tanning.

Self Reevaluation

- 13. I think about the damage to my appearance that will result from too much sun.
- 28. I worry that too much sun will make my skin look bad.

Stimulus Control

- 8. I avoid social situations where I could get too much sun.
- 9. I cover up when I know I will be out in the sun for awhile.

Reinforcement Management

- 10. I reward myself when I avoid the sun.
- 25. I am rewarded by others for reducing my sun exposure.

Self Liberation

- 12. I make commitments to reduce my sun exposure.
- 27. I tell myself that if I try hard enough I can avoid the risk from sun exposure.

Decisional Balance

Next are opinions some people may have about protecting themselves from summer sun. Please rate how important each opinion is to you in deciding whether or not to protect yourself from too much sun exposure, using the following scale:

1 = Not Important, 2 = Slightly Important, 3 = Moderately Important,
4 = Very Important, 5 = Extremely Important

Cons

1. The sun feels good on my skin.
3. I feel healthy when I have a nice tan.
5. Having to avoid the sun takes the fun out of being outdoors.
7. I look better when I have a tan.

Pros

2. Reducing sun exposure is an easy way to protect my health.
4. Using sunscreens allows me to enjoy the outdoors with less worry.
6. The health risks from sun exposure are serious.
8. My skin won't age so fast if I reduce my sun exposure.

Confidence

Next are situations in which some people might choose not to protect themselves from too much summer sun. Please rate how confident you are that you would use sun protection in each situation, using the following scale:

1 = Not at all Confident, 2 = Not Very Confident,
3 = Moderately Confident, 4 = Very Confident, 5 = Extremely Confident

How confident are you that you would...

Sunscreen Use

1. Use sunscreen whenever you are out in the summer sun for more than 15 minutes.
4. Use sunscreen when no one else you are with is using sunscreen.
7. Use sunscreen even if you don't like how it feels.

Avoidance

2. Stay in the shade when all your friends are enjoying themselves in the sun.
3. Cover up with protective clothing even when it is hot outside.
5. Avoid going outside in the summer sun during the midday hours.
6. Wear a hat with a wide brim even if you don't like how it looks.

Behavior

During the summer, when you are in the sun for more than about 15 minutes, how often do you do each of the following? Please use the following 5 point scale:

1= Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Always

Avoidance

1. Wear a shirt
2. Stay in the shade
3. Avoid the sun during the mid-day hours
4. Limit exposure to the sun during the mid-day hours

Sunscreen Use

5. Use sunscreen
6. Use a sunscreen with SPF of 15 or more on your face
7. Use a sunscreen with SPF or more on all sun exposed skin areas

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