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Reconceptualizing Decisional Balance In an Adolescent Sun Protection Intervention: Mediating Effects and Theoretical Interpretations

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Abstract

The Transtheoretical model (TTM) integrates principles of operant learning, such as stimulus control and reinforcement, and psychological factors, such as decisional balance. Understanding interrelationships between decisions, behavior, and consequences from multiple theoretical perspectives can advance theory and inform development of more effective interventions. This analysis examined the mediating effects of a special case of the decisional balance construct where the pros of competing behaviors (i.e. sun protection vs. exposure) were measured rather than the pros and cons of the same behavior. Participants included 819 adolescents (10-16 yrs old, 53.5% girls, 58.4% Caucasian) randomized to a 24-month expert system intervention (Sunsmart) or a physical activity and nutrition comparison group. Self-report measures included sun protection behaviors, pros for protection, and pros for exposure. Mediation analysis using latent growth curve models found both the treatment-to-mediator and mediator-to-behavior paths significant for decisional balance, producing an indirect effect of .323 ($p < .01$) and good model fit (CFI=.973, RMSEA=.055). Multiple strategies for conceptualizing and measuring decisional balance appear to be valid. Results are interpreted from the TTM and operant perspectives.

MESH Keywords

theoretical model; expert systems; behavior analysis; outcome expectancy

Introduction

Skin cancer is one of the most prevalent cancers, representing nearly half of all cancers in the U.S. In 2007, over 62,480 incident cases of melanoma were estimated in the U.S., and over

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one million adults developed nonmelanoma cancer (American Cancer Society, 2008). Preventing all skin cancers is an important public health goal which is possible by performing sun protective behaviors such as avoiding the midday sun, wearing protective clothing, and applying sunscreen. A review of sun safety interventions for children noted that only about a third of studies explicitly stated a guiding theory behind their interventions and fewer measured or tested theoretical mediators for changing sun safety behaviors (Buller & Borland, 1999).

Baranowski et al. highlighted the importance of identifying mediators to the evolution of health behavior theory (Baranowski, Klesges, Cullen, & Himes, 2004). Mediators are the hypothesized causal mechanisms of an intervention. They are constructs that the intervention works through to affect change in behavior. Examining the function of theoretical variables can lead to elimination of poor explanatory mechanisms. Advances may be made from critical tests of the assumptions of theories, comparison of the predictive ability of two or more theories, and the identification of new variables to extend current models (Baranowski et al., 2004; Nigg, Allegrante, & Ory, 2002).

The Transtheoretical Model (TTM) proposes that pros, cons, decisional balance (pros minus cons), along with self-efficacy mediate changes in health behaviors, including sun avoidance and protective behaviors (Prochaska et al., 2005). Cross-sectional studies of TTM constructs applied to sun protection have been conducted (Herrick, Stone, & Mettler, 1997; Kristjansson, Branstrom, Ullen, & Helgason, 2003), but only a few TTM-guided prospective studies of sun protection have been reported (Pagoto, McChargue, & Fuqua, 2003; Weinstock, Rossi, Redding, & Maddock, 2002), and none of these studies prospectively tested TTM mediating constructs. Cross-sectional studies of TTM theoretical mediators do not discriminate the temporal order of interventions and causal variables necessary to test the theoretical mediators (Resnick & Nigg, 2003). Prospective evidence that TTM constructs mediate interventions for any type of behavior change is limited. Fahrenwald et al. reported that changes in TTM based constructs over 8 weeks did not mediate physical activity behavior among low income women (Fahrenwald, Atwood, & Johnson, 2005). Taylor et al. (2006) failed to show relationships between theoretical mediators and both quality of life and physical activity of cancer patients over 12 months (Taylor et al., 2006). Pinto et al. reported that TTM constructs mediated exercise change at 6-weeks, one construct mediated at 8-weeks, and none mediated at 8-months (Pinto, Lynn, Marcus, Depue, & Goldstein, 2001).

Some experts have questioned the ability of rational decision-making models to influence behavior change and suggest more emphasis on evaluating treatment length, contingent consequence systems, and operant behavioral principles such as reinforcement (Hovell, Wahlgren, & Gehrman, 2002; Jeffery, 2004). The Transtheoretical Model and Social Cognitive Theory have adopted many principles of applied behavior analysis, and these principles are also featured in recent ecological models of behavior change (Hovell et al., 2002; Sallis & Owen, 1999; Sallis & Owen, 2002). How well constructs are operationalized and measured determines their ability to explain behavior (Rovniak, Hovell, Wojcik, Winett, & Martinez-Donate, 2005).

For example, the decisional balance construct was derived from Janis and Mann's decision-making model (Janis & Mann, 1977), which is based on competing consequences people evaluate as comparative gains (benefits) and losses (costs) (Mann, 1972). According to Janis and Mann, the competition among consequences is comparative, meaning “not the absolute amount of gain and loss … but the amount relative to a comparison level, based on the amount of reward or punishment the person has obtained in the past or has seen other people obtaining” (Janis et al., 1977). Through principal components analyses, Velicer and colleagues (1985) derived two comparative components related to cigarette smoking; pros of behavior and cons of behavior (Velicer, Prochaska, DiClemente, & Brandenburg, 1985); these constructs have been applied to multiple health behaviors. According to the TTM, when perceived pros for sun protection increase and cons for protection decrease, a person decides to avoid the sun through protective behavior.

The pros and cons constructs in Janis and Mann's comparative gain and loss model deal with the function of social consequences for behavior. The motivating relationships of consequences such as contingent reinforcement and punishment were codified by B.F. Skinner (Skinner, 1953). Applied Behavior Analysis (ABA) emerged from Skinner's operant learning principles that identify contingencies between behaviors and their consequences as the most important independent variables to target in applied research as either main effects or mediating variables. Antecedents and consequences change the probability of the target behavior, such as sun protection, over alternative behaviors such as sun exposure. ABA also postulates that sun exposure behaviors, while not mutually exclusive from sun protection behaviors, are conceptualized to have their own reinforcing and punishing consequences. These behavior-specific consequences can compete, and depending on their *balance* can result in different patterns of changes in sun protection behaviors.

We hypothesized that the way in which the decisional balance construct is defined and measured by researchers using the TTM model is underspecified. That is, the construct's empirically derived measures of pros and cons of change do not typically assess the full range of consequences or qualities of consequences relevant to the behavior change process. In this study we conducted mediator analyses to test a special case of the decisional balance construct where the pros of competing behaviors (i.e., sun protection and sun exposure) were measured rather than the pros and cons of the same behavior. We interpreted results from both the Transtheoretical Model and Behavior-Analytic perspectives to assess how well predictions from these two models explain observed results.

Methods

Participants

The sample consisted of 819 adolescents, 10 to 16 years old. Participants were recruited through 45 primary care providers from six private clinic sites in San Diego County. The sample consisted of 53.5% girls and multiple racial/ethnic groups: 58.4% White, 3.2% Asian/Pacific Islander, 6.6% Black, 13.1% Hispanic, 14.5% multiracial, and 3.5% “Other.” Parental written consent and adolescent assent were obtained prior to study entry. The study was approved by the participating healthcare organizations and university institutional review boards.

Design

The study design and main outcomes of the interventions have been reported in detail elsewhere (Norman et al., 2007). Briefly, participants were randomized to either a 24-month sun protection intervention or a physical activity and diet intervention. Adolescents randomized to the sun protection intervention received an adapted version of the Sun Smart expert-system computer program based on the Transtheoretical Model that was previously shown to be effective (Prochaska & Velicer, 1997; Velicer et al., 1993; Weinstock & Rossi, 1998). Sun Smart was adapted for delivery through primary health care in the present study. The expert system consisted of an interactive tailored computer session that assessed self-reported stage of change, decisional balance, self-efficacy, and processes of change, and also generated tailored feedback reports. Adolescents interacted with the expert system in the physician's office twice; at the start of the intervention and at 12-months. At 3, 6, 15, and 18 months after baseline, adolescents were phoned by a health counselor. Participants completed the expert system assessments during the telephone interview and were mailed a feedback report along with tip-sheets on various sun protection topics and a 3-ounce bottle of sunscreen. Adolescents received $10, $15, $20, and $40 for completing the baseline, 6-, 12-, and 24-month measures, respectively. Both groups also received tickets for small cash prizes ($10-50) in drawings conducted every 6 months contingent on completing scheduled measurement visits and phone calls.

The comparison group received a physical activity and diet intervention promoting physical activity and healthy eating behaviors (Patrick et al., 2006). The intervention had similar components as the sun protection intervention and consisted of a computerized expert system kiosk at the primary care provider's office, monthly stage-matched phone calls, a printed manual, and mail contact for 24 months. The nutrition and physical activity intervention was based on Social Cognitive Theory (Bandura, 1986) and the Transtheoretical Model (Prochaska et al., 1997). The intervention targeted physical activity, sedentary behavior, total fat intake, and servings of fruits and vegetables per day.

The Sun Smart intervention produced favorable changes in sun protection behaviors for the intervention group relative to the comparison group. Between group differences at 24 months were found for staying the shade in the mid-day hours, limiting exposure, and using sunscreen (Norman et al., 2007).

Measures

Sun protection behavior scale—Adolescents were asked to rate how often they practiced seven recommended sun protection behaviors on a 5-point Likert scale with anchors of 1 ‘Never’ to 5 ‘Always’ (Weinstock et al., 2000). Items included: How often did you wear a shirt?; How often did you stay in the shade?; How often did you avoid the sun during the mid-day hours?; How often did you limit your exposure to the sun during the mid-day hours?; Use a sunscreen?; Use a sunscreen with SPF of 15 or more on your face?; Use a sunscreen with SPF of 15 or more on all your sun exposed areas? Thirty three adolescents were retested one week later on average. Internal consistency (alpha =.78) and test-retest reliability (ICC = .70) were good.

Pros for Sun Protection—The pros for protection scale was adopted from previous studies (Weinstock et al., 1998; Rossi and Balis, 1991, Prochaska et al., 1994). Adolescents were asked to rate the importance of four potential gains for sun protective behaviors on a 5-point scale with anchors of 1 ‘Not very important’ to 5 ‘Extremely important.’ The items included: My skin won't age so fast if I reduce my sun exposure.; Protecting myself from the sun reduces my risk of skin cancer.; Using sunscreens allow me to enjoy the outdoors with less worry.; Reducing sun exposure is an easy way to protect my health. Internal consistency for the scale at baseline was very good (alpha = .86).

Pros for Sun Exposure—Adolescents also rated the importance of four potential gains for sun exposure behaviors using the same response scale as pros for sun protection. This scale was adopted from the same previous studies (Weinstock et al., 1998; Rossi and Balis, 1991, Prochaska et al., 1994). Originally, these four questions were labeled “Cons for Sun Protection,” but after examination of the question content and comparison to the original operational definition of Cons (as losses) (Velicer et al., 1985), these questions were better conceptualized as Pros for Sun Exposure. The items included: Getting a tan makes me feel good.; My friends think I look better when I have a tan.; Spending time in the sun is relaxing.; I look better when I have a tan. Internal consistency for the scale at baseline was very good (alpha = .81).

Decisional Balance—To compute decisional balance, we subtracted the scale score of Pros for Sun Exposure from the scale score of the Pros of Sun Protection. The maximum score for

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each scale was 20 points (4 questions times 5 possible points), so decisional balance could range from -20 to +20 points. Participants with negative decisional balance scores reported higher gains for sun exposure than protection. Positive decisional balance scores indicated participants reported greater gains for protection than exposure. Correlations between the pros of protection and the pros of exposure ranged from .07 to .20 across the four assessment points. Calculation of the reliability of the difference score using these correlation coefficients and the internal consistency coefficients of the pros of protection and pros of exposure resulted in high reliability coefficients (.79 to .82) for the decisional balance difference score at each assessment point (Ragosa, Brandt, Zimowski, 1982).

Internal and external validity for the decisional balance scale using the 8-item inventory has been previously demonstrated. Prochaska and colleagues used the measure to examine the pattern of pros and cons across stages of change for 12 problem behaviors among adults (Prochaska et al., 1994). Hoeppner et al. (2006) explored the decisional balance items in a sample of over 1,000 adolescents. Both studies found two factors, which they labeled pros and cons of sun protection, and these factors correlated with stages of change as expected; pros of sun protective behavior increased while the cons decreased across stages of change.

For the current study, we conducted a principal components analysis with varimax rotation on the eight item correlation matrix. Parallel analysis and Minimum Average Partial (MAP) methods both identified two components, *which we labeled pros for protection and pros for exposure*. Items loaded on components as expected, and average loadings for the pros for protection and pros for exposure were 0.82 and 0.77, respectively. The two components accounted for 69% of the total variance. Further, a confirmatory factor invariance model was specified in Mplus 4.2 (Muthen & Muthen, Los Angeles, CA, 2001) to test if the pattern of loadings for the two-factor measurement structure of decisional balance varied for adolescents with different skin vulnerability levels. A multiple group confirmatory factor analysis for the three sun vulnerability groups holding the factor loadings equal across groups resulted in good model fit (CFI = .971, RMSEA = .064) indicating similar covariation and internal validity for the decisional balance items across levels of sun vulnerability.

Statistical Analyses

Sample means and standard deviations were computed for each variable. Latent growth curve modeling (LGCM) was used to test whether decisional balance constructs (i.e., pros of protection, pros of exposure, decisional balance) mediated the relationship between the intervention and sun protection (Cheong, MacKinnon, Khoo, 2003). LGCM is able to model individual growth trajectories for observed variables over time by specifying latent intercept and slope variables for each construct of interest (Duncan, Duncan, Stryker, 2007). Scores from baseline, 6, 12, and 24 -month assessments were used as observed variables. For each model, the intercept was centered relative to scores at baseline so that the intercept represented the initial status of the growth curve. The linear slope represents the functional form of the growth trajectory across the time-points.

A series of models were tested in the following sequence. First, to determine the growth trajectories, unconditional linear growth models were fit to each variable (i.e. sun protection behavior, pros for protection, pros for exposure, decisional balance). Second, conditional linear growth models were tested to determine whether each growth trajectory's latent intercept and slope was a function of treatment group status. Third, parallel process models were tested to evaluate the correlations among the growth parameters of sun protection behavior with each decisional balance construct. Fourth, based on these initial models, a full mediation model was specified if it was established that treatment group status was related to the latent slope of the measured construct, and that the slope of the construct was related to the slope of sun protection behavior. The magnitude of the indirect effect from the treatment group through the construct slope to the sun protection slope was the indicator of mediation.

The outlined LGCM testing process followed the basic steps for testing mediation described by Baron and Kenny (1986) and MacKinnon, Fairchild, and Fritz (2007). LGCM has the advantage of using all the available data across the four assessment points to model individual change trajectories rather than using mediation testing approaches that rely on change scores or residualized scores, which both have limitations (Ragosa, Brandt, Zimowski, 1982; Cohen, Cohen, West, and Aiken, 2003).

All models were estimated using Mplus 4.2 software (Muthén & Muthén, Los Angeles, CA, 2001). Model fit to the data was determined from the Comparative Fit Index (CFI; Bentler, 1990), with values greater than .90 indicating reasonable model fit, and the Root Mean Square Error of Approximation (RMSEA; Steiger, 1990), with values less than .08 indicating reasonable model fit. For all models, the maximum likelihood missing data procedure in MPlus 4.2 was used. This maximum likelihood procedure uses all available data from each participant and assumes that data are missing at random.

Results

Five hundred and seventy two participants had complete data at all four time-points, two participants had missing data at all time points, and 245 participants had some missing data. Having complete data was not associated with baseline sun protection score, sex, age, race/ethnicity, or sun sensitivity. Adolescents without complete data were significantly more likely to be in the treatment group (SunSmart 34.2% versus Comparison 26.4%).

Means and standard deviations for sun protection and decisional balance variables at each assessment are presented in Table 1. The unconditional growth models for sun protection behavior, pros of protection, pros of exposure, and decisional balance (pros of protection minus pros of exposure) all fit the data well as indicated by CFI values exceeding .98 and RMSEA values below .08 (models not shown). All four unconditional models had latent intercept and slope means that were different from zero ($p < .01$) and significant variation between individuals ($p < .01$). For all of the unconditional models, except pros of exposure, item loadings on the latent slope variable were fixed at 0, 1, and 2 for baseline, 6-months, and 12-months, respectively. The loading for the 24-month item was not fixed and was estimated to reflect the decrease in the average values observed at 24-months. The loadings for the pros of exposure were fixed at 0, 0, 1, 2 at baseline, 6, 12, and 24-months, respectively, to reflect the observed pattern of means. These latent slope loadings were specified in all subsequent models tested. Since latent intercept and slope parameters for these models were the same as those estimated in the conditional growth models the latter values are not presented.

Table 2 presents summary information from the conditional growth models, which added treatment group to the unconditional growth models. In these models, the latent intercept and slope variables are regressed on treatment group. As can be seen in Table 2, the latent slopes for sun protection behavior and decisional balance were related to the treatment group with more positive increases in these variables found for adolescents in the SunSmart intervention in relation to the comparison group. These regression models established ‘treatment to outcome’ and ‘treatment to mediator’ path relationships. Treatment group status was not related to the latent slopes for the pros of protection or pros of exposure. All of the conditional growth models fit the data well except for the pros of exposure model where model fit decreased compared to the unconditional growth model (CFI = .885, RMSEA = .174).

Table 3 presents the summary information from the three parallel process LGC models that estimated correlations between the latent intercept and slope parameters for the sun protection growth trajectory with either the pros of protection, pros of exposure, or decisional balance growth trajectories. All three models demonstrated good model fit as indicated by the CFI and RMSEA values. Significant positive correlations between latent slope parameters were found for in the pros of protection [r = .746] and decisional balance [r = .805] models. These correlations indicated that changes in sun protection behavior were related to changes in the pros of protection and decisional balance establishing ‘mediator to behavior’ relationships for two of the three variables.

Since significant ‘treatment to mediator’ and ‘mediator to behavior’ paths were not found for the pros of exposure in the conditional growth model and parallel process model, respectively, testing a full mediation model for this construct was not necessary. For the pros of protection a ‘treatment to mediator’ path was not found in the conditional growth model but a significant ‘mediator to behavior’ path was found in the parallel process model. Based on these findings, a significant indirect mediation effect of ‘treatment to mediator to behavior’ was not expected and was not found in the mediation model.

The mediation model for decisional balance is presented in Figure 1. This model demonstrated good model fit with CFI = .973 and RMSEA = .055 ($\chi^2_{(26)} = 90.0$, $p < .001$). The ‘treatment to mediator’ and ‘mediator to behavior’ paths were both significant resulting in a significant indirect effect of .323 ($p < .01$) and a R^2 for the sun behavior latent slope of .437. The ‘treatment to behavior’ path was not significant in the mediation model (compared to the sun behavior conditional growth model where the path was significant) suggesting the treatment effect on behavior worked through changes in decisional balance to influence sun protection behavior.

Discussion

The main finding of the present study was that change in decisional balance between alternative behaviors (exposure versus protection behaviors) mediated the effects of the Sun Smart intervention on sun protection behaviors of adolescents. This is a rare finding of theoretically-based mediation of a health behavior change intervention. The results support Transethoretical Model propositions that decisional balance is an important mediator of intervention effects (Prochaska, Redding, & Evers, 1997). It is notable that the component ratings of pros for sun protection and pros for sun exposure did not mediate the intervention, but their combination did. The current paper is evidence that adolescents make choices about sun protection based on the anticipated consequences of alternative behaviors.

The measurement instruments and current construct findings can be interpreted from multiple perspectives. A critical conceptual analysis of mediators may provide new insight to the function of constructs and their future usefulness.

Transtheoretical Model Perspective

According to the Transtheoretical model, the increase in pros for sun protection followed by a decrease in cons for protection should lead to a crossover in decisional balance which tends to occur close in time to “action” or initiation of consistently engaging in a healthy behavior (Prochaska et al., 1994). This crossover of pros and cons is hypothesized to signify a cognitive shift in the importance of factors considered relevant to making a behavior change. The shift is in the direction of the positive aspects of a behavior change out-weighing the negative aspects of change. The change in decisional balance is believed to be the mechanism of behavior change. However, are pros and cons for the unhealthy alternative also important?

Since it is possible to have pros for sun protection and pros for exposure, the relative change in competing pros should produce behavior change, as should competing cons. This conceptualization of decisional balance is not explicitly hypothesized by Prochaska and colleagues (1994), but is consistent with Janis and Mann's (1977) conceptualization of decisional balance that includes the pros and cons of both changing and not changing. The current mediation analysis provides empirical support for considering and measuring competing pros (and possibly cons) and suggests the operationalization of decisional balance may benefit from including the pros and cons for both the unhealthy behavior and for the alternative healthy behaviors.

Applied Behavior Analysis Perspective

This logical extension of competing pros (and cons) is adapted from the behavior-analytic perspective. From the behavior-analytic prospective, pros and cons of a behavior may be conceptualized as proxy measures of reinforcement and punishment contingencies. The behavioral-analytic perspective highlights the key role of two competing behavioral classes related to skin cancer prevention; protection and exposure. For each of these behavior classes, the theory hypothesizes competing response-contingent consequences such as reinforcement and punishment. Moreover, each consequence can be immediate or delayed, with immediate consequences generally having stronger control over behavior (Chance, 2003). Thus, timing of consequences becomes a moderator of the reinforcing or punishing effects (Laraway, Snycerski, Michael, & Poling, 2003). These behavior-specific consequences can compete, and depending on their *balance* can result in different patterns of sun protection behaviors. Current behavior-analytic public health theories promote measurement of and intervention through just such competing consequences (Biglan et al., 1995; Hovell et al., 2002). Notably, Janis and Mann's (1977) comparative gain and loss model, which was the basis of pros and cons, relies on the function of competing consequences. However, from a behavioral-analytic perspective the Prochaska model omits the pros and cons of a competing behavior and does not emphasize latency as a factor determining degree of reinforcing or punishing function.

A functional analysis of the contingency balance of natural immediate and delayed consequences of sun exposure *and* protection is necessary to understand why people expose themselves to the sun. For sun exposure, immediate potentially reinforcing consequences may include warmth, positive social comments, or an attractive tan. Immediate potential punishers for exposure may be excessive heat, sweating, critical social comments, or sunburns. Delayed potential punishing consequences for exposure may include sunspots, wrinkles, aged skin, or skin cancer. Few delayed potential reinforcing consequences are likely, but may include bone health.

For protective behaviors, naturally occurring immediate potentially reinforcing consequences may include an attentive parent's approval or avoidance of a parent's criticism. Immediate potential punishers for protection are many and can include a greasy feeling from sunscreen, decreased time outdoors, or the unpleasant social attention for protective clothing. Delayed potential reinforcers such as healthy skin, protected health or absence of cancer are cumulative and unlikely to appear until an adolescent is much older. Delayed potential punishers for protection are less likely but might include criticism for pale color or lacking a bronze tan.

The concept of assessing contingencies for competing behaviors can be extended to other health behaviors. Many examples can be provided: cooking at home versus going to fast food restaurants; consuming alcoholic versus nonalcoholic beverages at parties; having sex while wearing versus not wearing a condom. The concept can also be generalized to entire behavioral classes. For example, physical activity and sedentary behaviors can be conceptualized as alternative behavioral classes. Both classes include a number of distinct behaviors. For example, physical activity may include walking for transportation, dumbbell press, yoga, etc. The sedentary class may include watching TV, using the computer, reading a book, eating a meal, etc. For each behavioral class, multiple immediate and delayed consequences can be identified that can function as pros (reinforcers) and cons (punishers). This produces four possible types of consequences for each behavioral class (i.e., immediate reinforcement, immediate punishment, delayed reinforcement, delayed punishment). This reconceptualization expands the theoretical consequences from two to eight factors, and multiplies the complexity of “balancing” these factors by individual or environmental changes. Ultimately, this approach needs to be tested to see if it adds to current methods of assessing decisional balance of a target behavior and justifies the additional measurement burden. It may be the case that this approach generalizes well to some behaviors but not as well to others.

For the current study, the sun protection behavior and Transtheoretical model construct scales for Pros and Cons for sun protection were adopted from the Rhode Island Sun Smart Project (Weinstock et al., 1998). After careful review of these existing scales (Weinstock et al., 1998; Rossi and Balis, 1991, Prochaska et al., 1994) our team noticed that the cons scale for sun protection asked participants about gains for exposure. Since the original Transtheoretical definition of cons is disapproval or instrumental losses, we redefined this scale as pros for exposure but did not change the number of items or scoring. The original questions are provided in the measures section. An example includes, “I look better when I have a tan.” This reconceptualization improves the match to the original definition of decisional balance – thus improving the theoretical fidelity of the scale -- and provides a less confounded test of the construct (Rovniak et al., 2005).

After the scale was redefined, another dimension of the scale emerged. Compared to the pros for exposure scale, the pros for protection scale tended to measure gains from cumulative behaviors and/or extremely delayed gains. For example, participants were asked to rate the following gain, ”Reducing sun exposure is an easy way to protect my health.” Such a gain (i.e. protection of health) is a result of cumulative instances of different protective behaviors and is unlikely to be realized until adolescents are much older. On the other hand, the gains measured in questions about pros for exposure are more immediate and more specific to each instance of exposure. The confounding influence of the latency of consequence would be true even if the scale was considered a loss scale. The scales may function better if both components of decision balance scales were balanced by immediacy of anticipated gains and losses. Future studies should attempt to measure consequences that are immediate and delayed for both pros and cons scales. Such an application may illuminate different change profiles and possibly a reinterpretation of the current cross-sectional evidence for these two constructs.

The application of a behavior analytic perspective to the development or evaluation of cognitive measures could improve the clarity of scales and improve performance of decisional balance measures. If it can be determined that the framing of information or arguments related to more immediate consequences are more effective than information on more delayed consequences of behavior, then interventions may be more made more efficient and effective.

Study strengths and limitations

Many analyses of Transtheoretical model constructs have been cross-sectional studies examining pros and cons, stage of change, self efficacy, or process of change (Kristjansson et al., 2003; Prochaska et al., 1994). The current study is the first to test Transtheoretical construct mediation of sun protection behaviors in the context of a randomized controlled trial. Moreover, this analysis examined change in protective behaviors and constructs over two years in a large and diverse sample of adolescents.

This analysis is limited by self-reported measures of behavior change and theoretical constructs. We also did not measure cons of sun protection, so a comparison of the mediating influence of decisional balance using pros vs. cons of sun protection compared to pros of protection vs. pros of exposure was not possible. A future direction would be to test the predictive ability of combinations of competing pros and cons for both unhealthy and healthy behaviors while designing questions that control for immediate and delayed consequences.

We operationalized decisional balance as the difference between the pros of protection and the pros of exposure. This approach is consistent with previous studies that have operationalized decisional balance as the difference between the pros and cons constructs (Velicer, Prochaska, DiClemente, & Brandenburg, 1985; Rakowski et al., 1992; Marcus, Rakowski, & Rossi, 1992; Share, McCrady, & Epstein, 2002; Semaan, Lauby, O'Connell, & Cohen, 2003; Norman et al., 2004; Cardinal, 2005). This strategy allowed us to examine whether the combined effect of decisional balance was theoretically more important than either the pros of protection or the pros of exposure variables. However, analysis of all three variables may be considered redundant testing, since the decisional balance difference score is a linear function of the other two variables. While decisional balance strongly correlated with its components, we demonstrated that the composite variable functioned differently than either of its separate components.

The longitudinal growth trajectories of the pros constructs are ‘underspecified’ by existing theory. Without adequate *a priori* models to guide us, we followed established model building procedures (e.g., see Singer & Willett, 2003) to determine models that adequately depicted the growth patterns of the constructs observed in the data. This involved fitting the model to the data (within reason) rather than specifying models with *a priori* growth trajectories. While we acknowledge that this aspect of our model building was not hypothesis driven, we believe these analyses contribute to developing better specified theoretical hypotheses. Further studies will be needed to fully determine the robustness and generalizability of these models beyond the data.

This analysis was also limited by not being able to address moderating variables, such as motivating operations (Laraway, Snycerski, Michael, & Poling, 2003) or reinforcement schedules, that could alter the power of the reinforcement contingencies for either sun exposure or protection behaviors. Moreover, people from certain ethnic/racial groups or with certain skin sensitivity may value the sun differently. This analysis was restricted to adolescents and sun protection behaviors. Thus, the competing nature of pros for healthy and unhealthy behaviors needs to be examined for other populations and behaviors, taking into account pros and cons for both protective and risk practices and doing so in the context of latency and reinforcement schedule effects.

The current analysis critically examined the role of Transtheoretical model constructs in the context of an intervention to promote sun protection among adolescents. We suggest that a more comprehensive assessment of pros, cons, and decisional balance of alternative or competing behaviors may improve behavioral predictions. Interpreting results from multiple theoretical perspectives may lead to theoretical, measurement, and intervention advancements.

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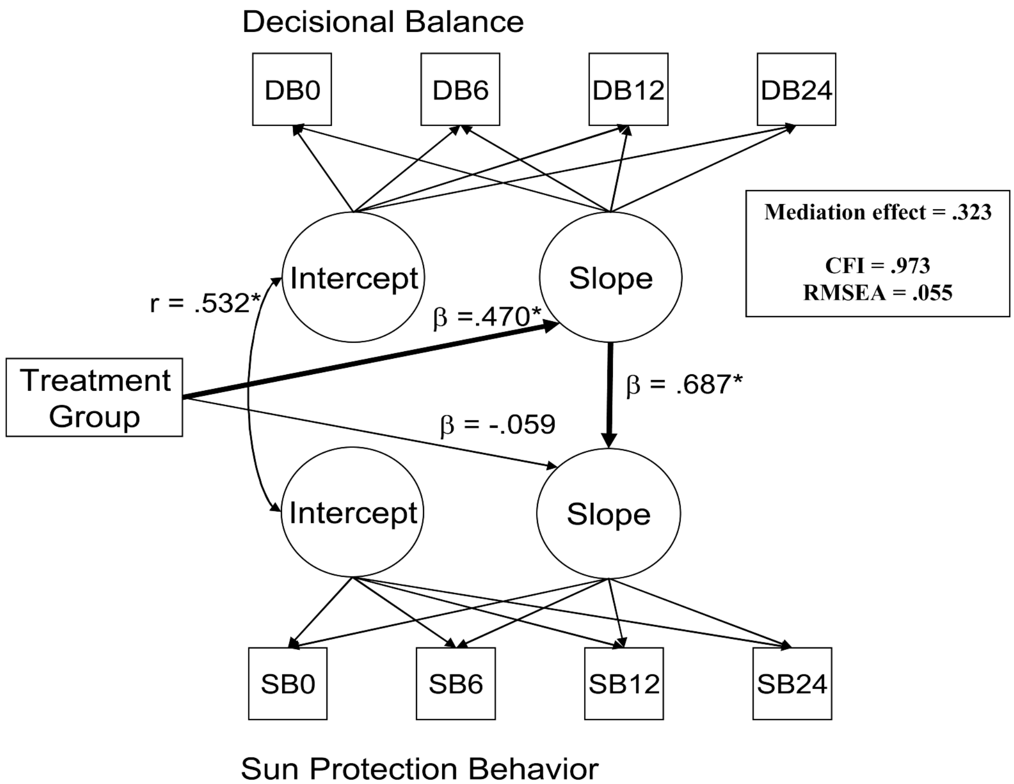

Figure 1.
Latent growth curve model of decisional balance mediating the relationship between the treatment group and sun protection behavior.

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Table 1

SunSmart and comparison group sample mean values of measured variables over time.

	BL		6 Months		12 Months		24 Months	
Variable	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Sun protection behavior								
SunSmart	22.51	4.51	24.32	4.63	24.46	4.92	24.90	5.04
Comparison	22.51	5.48	23.24	5.22	23.04	5.63	23.04	5.86
Pros of protection								
SunSmart	15.04	3.12	15.80	2.97	16.33	3.22	16.16	3.85
Comparison	13.86	4.14	14.90	4.23	15.06	4.45	15.13	4.41
Pros of exposure								
SunSmart	10.16	4.14	8.16	3.59	8.52	3.77	9.68	4.60
Comparison	8.13	5.00	9.72	4.54	9.72	4.61	10.06	4.72
Decisional balance								
SunSmart	4.88	5.15	7.64	4.90	7.81	5.11	6.48	5.83
Comparison	5.73	5.58	5.18	5.50	5.34	5.78	5.08	5.70

Sample sizes, BL SunSmart (371), Comparison (419); 6mo SunSmart (373), Comparison (378); 12mo SunSmart (337), Comparison (361); 24mo SunSmart (273), Comparison (320).

Table 2

Summary information from conditional growth models for sun protection behavior, pros of protection, pros of exposure and decisional balance.

Model	Latent Means (SE)		Tests of Model Fit			Treatment Effects	
	Intercept	Slope	$\chi^2_{(df)}$	CFI	RMSEA	Intercept	Slope
Model 1: Sun protection behavior	22.68*	.269*	24.84 (6)	.980	.062	B = .127	B = .635*
	(.233)	(.127)	p = .0004			β = .019	β = .288
						R^2 = 0.0	R^2 = .083
Model 2: Pros of protection	14.03*	.547*	18.75 (6)	.987	.051	B = 1.06*	B = .063
	(.173)	(.099)	p = .0026			β = .197	β = .028
						R^2 = .039	R^2 = .001
Model 3: Pros of exposure	9.07*	.326*	128.99 (5)	.885	.174	B = -.235	B = .142
	(.188)	(.107)	p < .0001			β = -.041	β = .048
						R^2 = .002	R^2 = .002
Model 4: Decisional balance	5.50*	-.197	50.41 (6)	.962	.085	B = -.073	B = 1.55*
	(.244)	(.133)	p < .0001			β = -.010	β = .585
						R^2 = 0.0	R^2 = .342

Note. SE = standard error, CFI = comparative fit index, RMSEA = root mean square error of approximation, B = unstandardized regression weight, β = standardized regression weight, R^2 = proportion of explained variance. Treatment coded as 1 = sunsmart, 0 = control.

* $p < .05$.

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Table 3

Summary information from latent growth parallel process models of pros of protection, pros of exposure, and decisional balance with sun protection behavior.

Model	Model Estimated Correlations				Tests of Model Fit		
	Sun protection behavior I1 with S1	Construct measure I2 with S2	Intercepts I1 with I2	Slopes S1 with S2	$\chi^2_{(df)}$ p-value	CFI	RMSEA
Model 2: Pros of protection	.056	-.117	.593*	.746*	59.51 (18) p < .0001	.982	.053
Model 3: Pros of exposure	.236	-.070	-.238*	-.103	41.67 (19) p < .0001	.988	.038
Model 4: Decisional balance	.112	.096	.595*	.805*	51.37 (18) p < .0001	.986	.048

Note. I1 = sun protection behavior latent intercept, S1 = sun protection behavior latent slope, I2 = construct measure latent intercept, S2 = construct measure latent slope, CFI = comparative fit index, RMSEA = root mean square error of approximation. I to S cross-correlations between sun protection behavior and construct measures (i.e, I1 with S2 and I2 with S1) were non-significant in all models and are not shown in table.

* $p < .05$.