Evaluation of Decisional Balance in Change of Effective Stress Management Behavior among Chinese University Participants Using Item Response Theory

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The transtheoretical model defines behavior change as progression through five stages: precontemplation (not ready), contemplation (getting ready), preparation (readiness), action, and maintenance. Decisional balance (i.e., the relative weight of the pros and cons of making a change) is assumed to mediate stage progression. As one progresses through the stages, the model predicts that the balance of pros increases while that of cons decreases. Previous studies have confirmed this; these results may be attributed to differing response patterns to each item of the decisional balance measure across the stages. This study examines the relationship between decisional balance and the stages of change related to effective stress management behavior (i.e., any healthy activity to manage stress) using a decisional balance measure based on item response theory. The participants were 447 male and 602 female college students. A six-item scale of decisional balance was developed. The balance of pros was significantly higher in later stages such as action and maintenance stages relative to earlier stages such as precontemplation and contemplation stages, while the opposite held for the cons. These results provide strong evidence that the correspondence between decisional balance and the stage of change can be applied to stress management behavior.

Keywords: Effective Stress Management Behavior; Decisional Balance; Stage of Change; Item Response Theory

Introduction

Stress is an increasing problem in the youth (Darling, McWey, Howard, & Olmsted, 2007). Participants enter university in their late teens, an age at which many psychological disorders develop, making them particularly vulnerable (Kessler, 2007; Greenberg, 2010). This is supported by research suggesting that participants experience increased levels of mental illness and stress (Darling et al., 2007; Li, Bray, & Kehle, 2005; Eisenberg, Gollust, Golberstein, & Hefner, 2007).

In China, 42% university participants do not practice effective stress management behavior measures (defined as any form of activity practiced for at least 20 minutes and that reduces perceived stress, such as regular relaxation, physical activity, talking with others, and engaging in a social activity) (Deng, Tsuda, Horiuchi, Kim, & Wu, 2012). Thus, the importance of using a behavioral science model has been emphasized to understand how university participants manage daily stress (Horiuchi, 2013). However, there remains a lack of population-based stress management behavior research in China based on a behavioral science model.

Transtheoretical model (TTM) based intervention studies have been successful in guiding populations to initiate and maintain stress management behavior (Evers, Prochaska, Johnson, Mauriello, Padula, & Prochaska, 2006; Prochaska, Butterworth, Redding, Burden, Perrin, Leo, Flaherty-Robb, & Prochaska, 2008). TTM proposes that individual stress management behaviors progress through five stages: precontemplation, contemplation, preparation, action, and maintenance.

Transition through the stages is driven by changes in decisional balance, which involves evaluating the pros and cons of a target behavior. In addition, TTM posits that the balance of pros and cons varies over time and is dependent on the stage of change (Prochaska, DiClemente, & Norcross, 1992). According to Hall and Rossi (2008), cons are more salient than pros in the precontemplation stage. However, the relative weight of pros and cons reverses between the contemplation and preparation stages; that is, pros are more highly weighed in the contemplation stage than in the precontemplation stage. In the preparation stage, the cons are less important than they were in earlier stages.

Four reliable and valid measures of decisional balance for stress management behavior have been reported (Fava, Norman, Levesque, Redding, Johnson, Evers, & Reich, 1998; Evers et al., 2006; Mauriello et al., 2007; Horiuchi, 2012). In these studies, reliability was confirmed using classical test theory (CTT) and validity was confirmed by theoretically predicting the relationships between the stages of change. CTT, however, presents some limitations in analyzing test items and interpreting data; for instance, it generates a single reliability estimate for an entire scale and sample dependent score interpretation (Embretson & Reise, 2000). Therefore, this study uses

item response theory (IRT) to test an alternative to CTT.

IRT is popular in the fields of educational measurement and psychometrics. Its procedures provide distinct advantages over those of CTT for item analysis, score interpretation, and reliability estimates. Within the CTT model, item parameters are sample dependent, meaning that an individual's score may be higher if the items are easy or may be lower if the items are difficult, and the difficulty of the items may vary depending on the abilities of individuals completing them. Furthermore, when using CTT to measure abilities or attitudes of multiple groups, it is difficult to make comparisons across groups unless the same instrument is used, because scoring is relative to specific tests and groups of respondents (Embretson & Reise, 2000). For example, the score for cons is lower in the precontemplation stage than in the action stage. However, in CTT, it is difficult to determine if there is a difference between the cons in the precontemplation and action stages and to distinguish whether an item among the cons matches the situation and abilities of the subject.

Therefore, the results of previous studies could be attributable to varying response patterns in each item across the stages. To rule out this possibility, it is necessary to develop a decisional balance scale that examines the relationship between decisional balance and each stage of change and more rigorously apply TTM.

In this study, effective stress management behavior is defined as a form of healthful activity practiced for at least 20 minutes such as exercising, meditating, relaxing, and seeking social support. Unhealthful activities include consuming alcohol and drugs, overeating, or smoking. This definition is applied from the stage-based manual for adopting stress management behavior (Pro-Change Behavior Systems, Inc., 2003). The minimum length of time (20 minutes) was specified to provide participants with a helpful time frame. One could argue that a more constrained definition should be used here. The authors believe, nevertheless, that it is suitable to use a flexible definition when focusing on daily self-care activities from a primary prevention focus, since there is a wide variation in the types of activities people use to manage stress (Horiuchi, Tsuda, Kim, Hong, Park, & Kim, 2010). Furthermore, Horiuchi et al. (2010) reported that college participants who effectively manage stress for more than six months are less stressed than those who do not, supporting the validity of this definition.

The potential effect of decisional balance on stress management behavior makes it important to promote accurate estimates of participants' abilities. An appropriate first step in this process is to develop a measure of decisional balance that provides ample evidence for a reliable and valid interpretation of participants' scores. The current study is unique in that IRT was used for scaling or establishing the relationship between participants' item responses and their current stage of decisional balance. This study uses IRT to develop a measure of decisional balance and to examine the relationships between decisional balance and the stages of change in effective stress management behavior.

Method

Participants

Participants included 1049 Chinese college freshmen, of whom 52.3% were female. The mean age was 19.40, with a standard deviation (SD) of 1.56 years. We recruited participants during or after lectures. Only those who agreed to participate in this study completed questionnaires.

Measures

Stage of Change

Stage of change was assessed using the Chinese language version of Pro-Change staging algorithm (Deng et al., 2012). First, the definition of effective stress management behavior was provided to the participants. Then, participants were asked if they experienced stress; only those who answered affirmatively were asked to respond to the change stage algorithm. The participants were asked whether they practiced stress management behavior everyday and were requested to select one of the following five items representing their stage of change: 1) "No. I have no intention to begin in the next six months." (precontemplation); 2) "No. But I intend to begin in the next six months." (contemplation); 3) "No. But I intend to begin in the next month." (preparation); 4) "Yes. I have been practicing but for less than six months." (action); or 5) "Yes. I have been practicing for at least six months." (maintenance). 27 female and 25 male participants reported they were not stressed and were excluded from the following analyses. Individuals' stages of change could vary to some extent depending on situational factors such as stressful daily events, so it was expected that the temporal stability of the stage of change would be moderate. A two-week test-retest revealed moderate reliability (κ = .40). Construct validity was confirmed by demonstrating that correlations to decisional balance were consistent with the TTM predictions (Horiuchi, Tsuda, Kobayashi, & Deng, 2009).

Decisional Balance

Decisional balance for stress management behavior was assessed using the Pro-Change decisional balance measure (Evers et al., 2006), comprising 12 items which are divided into two subscales: pros and cons. Each subscale includes six items. An example of an item from the pros is "If I used healthy strategies to effectively manage my stress, I would be healthier." An example of item for the cons is "if I used healthy strategies to effectively manage my stress, it would take too much time." Each item was rated according to the importance of each statement on a five-point Likert scale (1 = not important to 5 = extremely important). The total scores of each of the six items were calculated as scores for the pros and cons, respectively.

Statistical Analyses

Evaluation of Model Assumptions

An exploratory factor analysis was performed using the maximum-likelihood method with Varimax rotation. Using the results, we confirmed that each item loaded mainly on the expected factor. It was expected that odd-numbered items would load more highly on pros, while the even-number items would do so on the cons.

For the comparative fitness index (CFI), values above .90 generally indicate models with an acceptable fit. A root mean square error of approximation (RMSEA) below .08 usually indicates a reasonable fit, with a threshold of .05 providing a strict criterion of quality of fit.

Item Response Theory and the Graded Response Model

The graded response model (GRM; Samejima, 1969) is an

IRT model specifically designed for K-ordered polytomous responses. In this study, there are five (K = 5) ordered genotype categories for each item, which are the following: Y = 1 (not important), Y = 2 (slightly important), Y = 3 (moderately important), Y = 4 (very important), and Y = 5 (extremely important). We use θ, a continuous latent variable, to denote the general level of an individual for decisional balance. Mathematically, GRM is specified by the following decisional balance response function:

$$P(Y_i \geq k \mid \theta) = \frac{\exp(a_i \theta - b_{ik})}{1 + \exp(a_i(\theta) - b_{ik})} \qquad (1)$$

In this study, θ represented the probability of giving a particular response given a specific level of pros or cons; k equaled the observed participant response to a Likert-type item; a_i equaled the item's ability to discriminate between those with high or low levels of pros or cons; and b_{ik} equaled the difficulty in moving from a response in a lower category (k − 1) to the next higher category (k) for item j.

In this formula, a_i and b_{ik}, respectively, are the discrimination and category-specific parameters of decisional balance i, and P($Y_i \geq k \mid$) denotes the cumulative probability of genotype categories k or higher for the ith decisional balance. Because GRM requires $b_{i1} < b_{i2} < \cdots < b_{ik}$, the probability of each genotype category is given by the following formula:

$$P(Y_i = k \mid \theta) = P(Y \geq k) - P(Y_i \geq k+1) \qquad (2)$$

Parameter Estimation

Parameter estimation was completed with EasyGRM (Kumatani, 2003). The participants' response patterns to the pros or cons items were analyzed using the maximum-likelihood estimation procedures to approximate the four-step difficulty parameters (−4 < b < 4) and one discrimination parameter (a > .75) for each item (Ironson, Smith, Brannick, Gibson, & Paul, 1989), along with an information function, which provided evidence of reliability. Following item parameter estimation, the expected posteriori scoring procedure estimated one latent trait value (pros or cons) for each participant.

Reliability Evidence

In IRT models, reliability is judged by the amount of information provided by the individual items as well as by the entire test or scale. In polytomous IRT models, the information functions from each response category for an item are combined to arrive at the information provided by the item (Dodd, de Ayala, & Koch, 1995). Items that are more discriminating provide more information about the latent trait than less-discriminating items (Embretson & Reise, 2000).

A review of test information functions showed the amount of information that each subscale collectively provided at all levels of decisional balance. The information function was also used to calculate the standard error of measurement for each level of decisional balance. Smaller standard errors indicated more precise measurements (Embretson & Reise, 2000).

External Validity

External validity was evaluated through the examination of the relationship between decisional balance and the stage of change related to stress management. Relationships between the stage of change and decisional balance were compared with the patterns observed across previous stress management behavior studies (Riley & Fava, 2003; Evers et al., 2006; Mauriello et al., 2007; Horiuchi et al., 2012).

To confirm that the decisional balance score differed across the stages of change, we examined the differences in mean values for the decisional balance for stress management behavior across the stages using a two-way multiple analysis of variance (MANOVA). According Mauriello et al. (2007), women reported significantly high rating for pros. Thus, we included gender as well as the stage of change as one of the independent variables.

Results

Factor Structure Analyses

As expected, the two exploratory factor analyses showed two statistically identifiable and interpretable factors: pros and cons (**Figure 1**).

Confirmatory factor analysis showed that CFI and RMSEA fulfilled the criteria (CFI = .931 and RMSEA = .063) (**Figure 1**). The inter-factor correlation between the pros and cons was .13. Thus, these results confirm the two factors uncovered by the study.
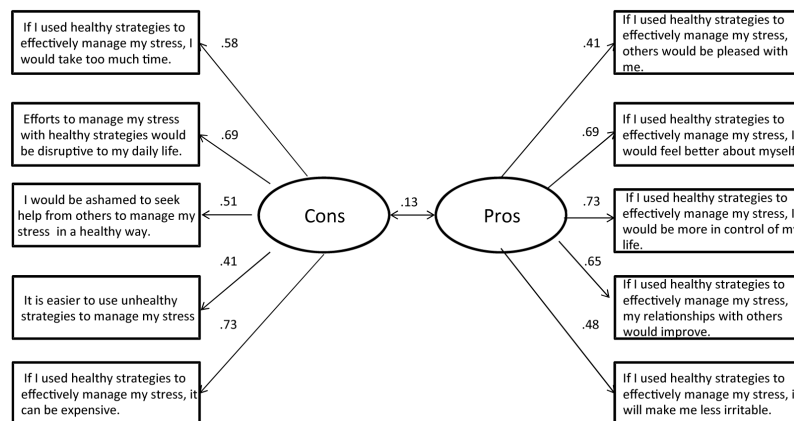
Figure 1.
Two-factor decisional balance measurement model.

Parameter Estimation

Parameter estimates for all subscale items are presented in **Table 1**. Slope parameters greater than .75 were considered acceptable as recommended (Ironson et al., 1989). The participants' response patterns to the decisional balance items were used in the marginal maximum likelihood and expectation maximization estimation procedures to approximate the four difficulty parameters and one discrimination parameter for each item, along with an information function, which provided reliability evidence. Following item parameter estimation, the expected posteriori scoring procedure estimated one latent decisional balance value for each participant.

Reliability Evidence

Test information functions for the items showed that the subscale for the pros provided the most precise information, with low standard error when participants estimated pros' levels ranging from −2.5 to +.5 (**Figure 2**). On the other hand, the subscale for the cons provided the most precise measurement between cons levels of −1 and +2.5 (**Figure 3**). As previously mentioned, this represents a significant difference between the results of IRT and CTT scaling. While IRT procedures revealed a difference in the precision of measurement between the various levels of decisional balance, CTT procedures did not. Cronbach's alpha, the typical CTT measure of reliability, was .78 and .70 for the pros and cons subscales, respectively.

External Validity (Decisional Balance by Stage of Change)

The participants' stage of change distribution was as follows: precontemplation = 11%, contemplation = 15%, preparation = 15%, action = 38%, and maintenance = 20%.

ANOVAs indicated that within the stages, there were significant differences between pros [$F(4, 866) = 5.83$, $p < .05$, η2 = .04] and cons [$F(4, 866) = 3.07$, $p < .05$, η2 = .01]. The pros were significantly higher in the preparation, action, and maintenance stages than in the precontemplation stage, and higher in maintenance than in contemplation. Cons were significantly higher in the precontemplation stage than in the contemplation, action, and maintenance stages. The pros showed a maximum average difference of .7 SD units and the cons showed a maximum average difference of .4 SD units between the precontemplation and maintenance stages (**Table 2** and **Figure 4**).

Discussion

To the best of our knowledge, this is the first study to apply decisional balance to effective stress management behavior among Chinese university participants. To do so, this research has generated internally and externally valid measurements of the pros and cons of practicing effective stress management behaviors. These measures can serve as the foundation for the future development of interventional measures. These results demonstrated good construct validity for the TTM scale, measuring decisional balance in a large sample of Chinese university participants. In addition, decisional balance demonstrates validity with stages of effective stress management behavior.

The selection of 12 items by using IRT resulted in decisional balance scale as 6 items developed. The main reason for removing the six items was that the low level of discrimination that is not reflected much in answer to an item led to a difference in decisional balance of the subject. Items that exceed −4 (b) denote that most participants would answer "not important" to deflection by floor effect. And shows a ceiling effect that would answer "extremely important" for items that are more than 4 (b) in reverse. Standard errors of the six items that have been adopted for this study have a very low value; however, there was no problem with the accuracy of the estimation. The

Table 1.

Item parameter estimates for pro and con items[*].

No.	Pros items	b1	b2	b3	b4	Slope
5	If I used healthy strategies to effectively manage my stress, I would feel better about myself	−2.95	−2.34	−1.11	.28	1.3
7	If I used healthy strategies to effectively manage my stress, I would be more in control of my life	−3.43	−2.32	−1.05	.18	1.46
9	If I used healthy strategies to effectively manage my stress, my relationships with others would improve	−2.93	−2.08	−0.69	.64	1.12
No.	Cons items	b1	b2	b3	b4	Slope
2	If I used healthy strategies to effectively manage my stress, I would take too much time	−1.33	.00	1.64	3.23	.85
4	Efforts to manage my stress with healthy strategies would be disruptive to my daily life	−.90	.42	1.56	2.59	1.12
12	If I used healthy strategies to effectively manage my stress, it can be expensive	−.81	.39	1.62	2.60	1.36

Note: [*]© 2004 Pro Change Behavior Systems, Inc., all rights reserved.

Table 2.

Summary of raw scores on pros and cons.

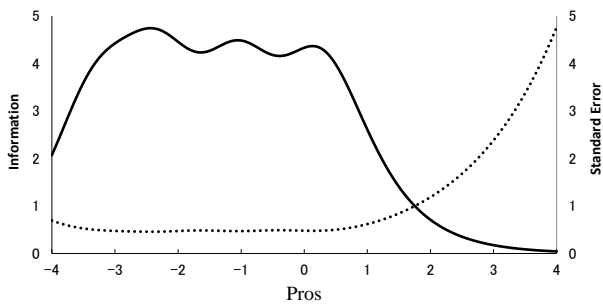|		Pros		Cons	
Stage	N	Mean	SD	Mean	SD
Precontemplation	92	45.79	11.30	52.84	10.63
Contemplation	134	49.26	9.93	50.24	8.74
Preparation	142	50.41	9.79	49.08	9.36
Action	332	50.91	9.61	49.30	9.83
Maintenance	171	52.88	8.13	48.85	10.37

Figure 2.
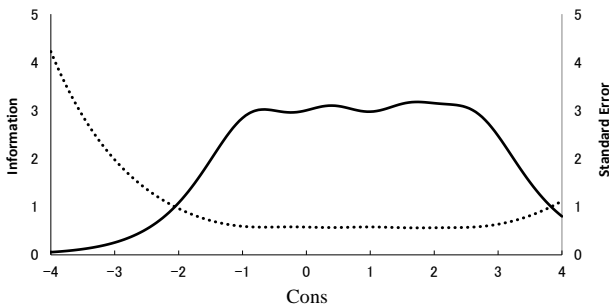Information and standard error for pro subscale.

Figure 3.
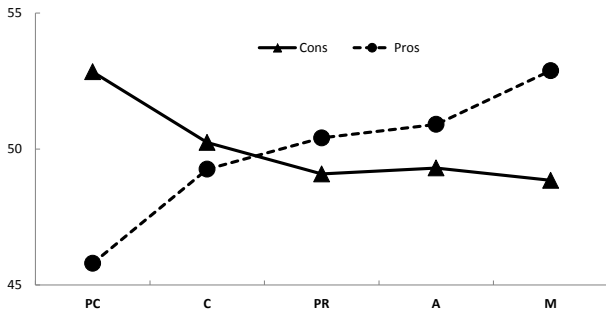Information and standard error for con subscale.

Figure 4.
Pros and cons across the stages of change for effective stress management. PC = Precontemplation, C = Contemplation, PR = Preparation, A = Action, and M = Maintenance.

test information curve showed information at −2.5 to .5 level of pros characteristic values and −1 to 2.5 of cons characteristic values reached a peak for most people.

The results of IRT showed that the IRT model can be fitted to decisional balance data and item information, test information, and standard error can be helpful in determining item characteristics. We used an IRT model to analyze the decisional balance data because its reliability can be compromised by the various factors that might influence an individual's response to any single indicator measure. If all indicators are considered together, the effect of this kind of variation for any single measure is reduced, improving the reliability of our assessment of decisional balance. IRT provides a solution to measuring decisional balance across stage of change

Through confirmatory factor analyses, we developed a six-item Chinese language version of the decisional balance with two factors: the pros of effective stress management behaviors

and the cons of doing so. Two-factor decisional balance measures have been found across stress management behavior (Riley & Fava, 2003; Evers et al., 2006; Mauriello, Rossi, Fava, Redding, Robbins, Prochasa, & Meier, 2007; Horiuchi et al., 2012). This study, like prior studies, showed the same factor structure.

The relative weights of pros and cons varied between participants in the precontemplation stage and those in the action and maintenance stages. We also observed a characteristic cross-over in the relative importance of pros and cons between the precontemplation stage and the action and maintenance stages. As noted above, similar patterns have been observed in a wide array of other behaviors. Moreover, the current study refines its findings using IRT to develop a more accurate evaluation of the decisional balance scale than seen in prior studies.

The specific progression through the stages of change in the weighting of pros and cons related to stress management behavior was consistent with findings for other behaviors. Previous investigations of change across multiple behaviors predicted a 2:1 ratio of variation in pros to that in cons, with pros being an average of 1.0 SD units higher in preparation and post-action stages than in the precontemplation and contemplation stages, and cons being an average of .5 SD units lower in the preparation and contemplation stages than in the preparation and post-action stages. In this study, pros showed a smaller difference between stages than expected (.7 SD unites), and cons displayed a greater difference between stages than expected (.4 SD units).

These findings lend themselves to a number of possible interpretations. First, the results support the theme of cross-behavior consistency in the construct of decisional balance.

Second, assuming that the 7:4 ratio of variation in pros to that in cons can be replicated across other cross-sectional and longitudinal studies, this suggests that pros may be more important for the action and maintenance stages of stress management behavior than for the other samples and countries. These findings are particularly interesting given that previous research shows that a 7:4 ratio is different from that found in decisional balance studies of routine medical behaviors.

Limitations and Future Directions

This study has two limitations. First, the findings are based on cross-sectional comparisons of individuals in each stage of change. Although previous studies with other behaviors have shown that cross-sectional patterns may be longitudinally replicated, follow-up studies evaluating individual changes over time would be important. The second limitation of this study is that the participants only consisted of college participants. Therefore, it is unknown whether the six-item Chinese version of the PDSM would be appropriate for different populations. In future studies, it will be necessary to examine whether the developed measure is suitable for different participants from different demographics.

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