Exercise Behavior Among New Zealand Adolescents: A Test of the Transtheoretical Model

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The purpose of this study was to examine whether variables in the Transtheoretical Model (TTM) acted more as predictors than as consequences of exercise behavior (stage of change). Students from 13 New Zealand high schools (N = 1,434) completed questionnaires corresponding to variables in the TTM (i.e., stage of exercise change, processes of change, self-efficacy, and decisional balance) at two time periods separated by 6 months. Reciprocal relationships were found between exercise behavior and the TTM variables. The TTM might be a useful framework for understanding longitudinal exercise behavior in the adolescent population.

The benefits of regular physical activity for both adults (41) and younger people (36) are numerous. With respect to youth, evidence-based data are strong for beneficial effects of physical activity to musculoskeletal health, cardiovascular health, and adiposity in the overweight (36). There is adequate research evidence supporting the beneficial effects of physical activity on lipids and adiposity in normal-weight children and adolescents, cardiovascular variables, psychological factors, and academic performance (36).

Despite these documented benefits, many do not participate in regular physical activity or exercise. Physical activity survey data from Australia, Canada, England, New Zealand, and the United States indicate that over one-third of the population (including those over the age of 50) can be described as inactive—they take part in less than 2.5 hrs of leisure time physical activity per week (24,35,42). It is not surprising then that understanding the underlying motives for adopting and maintaining exercise and physical activity has received a great deal of research attention in both clinical and nonclinical populations.

Social cognitive models of health behavior have driven most of this research, including: the Health Belief Model (34); Protection Motivation Theory (20); Theory of Reasoned Action (12); Theory of Planned Behavior (2); Self-Efficacy Theory (5); and the Transtheoretical Model (31). Of these, the Transtheoretical Model (TTM) is unique because of its multistage approach. The TTM is also an integrative model of behavior change, in which key constructs from other theories are incorporated. Hence, the TTM has the potential to provide a complete picture of exercise stage...
change, as well as allow conclusions to be drawn about what constructs or variables might be important in understanding behavior change.

Over the past 15 years, the TTM has been embraced by behavioral psychologists who, across a wide range of populations and settings, have demonstrated relationships between the constructs of the TTM and exercise behavior. These studies can be classified into one of the following four categories: a) studies that validate the stage of exercise readiness with physical indices (i.e., VO2max and self-reported exercise (8,14,19); b) cross-section studies and longitudinal studies that examine whether the TTM constructs of self-efficacy, decisional balance, and processes of change can discriminate stage of exercise readiness (13,15,22,23,33) and stage transition (15,29); c) studies that combine the stages of change with variables in other social-cognitive models (9,10,17); and d) interventions to enhance a physically active lifestyle based on the constructs of the model (11,39).

A limitation of this literature is that most of these studies have used primarily adult (middle-aged) samples. There is a dearth of empirical literature examining the TTM in adolescents (25,26,30). This is unfortunate given the trend toward a gradual decrease in the amount of physical activity seen from childhood to adulthood (particularly during adolescence) and the obvious health consequences of such a trend (18,35,38). Understanding the factors that affect this decrease in physical activity might be valuable in designing interventions to increase exercise participation amongst this population. This in turn might have positive effects on future physical activity practices as individuals move toward adulthood.

Studies examining the TTM model in adolescents have shown that self-efficacy, decisional balance (i.e., pros), and processes of change (i.e., self-liberation, counter-conditioning, self-reevaluation, consciousness raising, and reinforcement management) were the strongest discriminators of exercise stage readiness (26,30).

The TTM has also been used to predict exercise stage transition in both adults (29) and adolescents (30). Plotnikoff (29) reported that self-efficacy and decisional balance were able to predict stage transition (i.e., those that progressed, regressed, or stayed the same), however, only minimal support for processes of change predicting stage transition was found. In a recent study, Prapavessis, Maddison, and Brading (30) showed that all TTM constructs significantly predicted exercise stage transition. Large effects were found for self-efficacy, decisional balance, and two behavioral processes (i.e., counterconditioning and self-liberation).

Although the two studies described above provide support for the TTM’s internal validity and ability to predict exercise stage transition, they do not shed light on whether the variables in the TTM act more as determinants or as consequences of behavior (stage of change). The TTM has been conceptualized in terms of several major dimensions. The stages of change are core constructs around which the other dimensions are organized. Transitions between the stages of change are effected by the processes of change with a series of intervening variables, including decisional balance (pros and cons of change) and self-efficacy. Little is known, however, about whether the stages of change (perception of physical activity level) influence the TTM variables or rather the TTM variables affect stage of change as proposed in the model.

To the best of our knowledge, a study by Nigg (25) is the only one that has specifically examined this issue in an adolescent population. Using cross-lag
panel-analysis techniques, Nigg (25) found that exercise behavior led to self-efficacy, pros, and cons, but these social-cognitive variables did not lead to exercise behavior. The processes-of-change variables did not significantly lead to the stages of exercise, nor did the stages of exercise significantly lead to the processes-of-change variables.

Although the Nigg (25) findings advanced knowledge, they are nevertheless inconclusive and are likely the product of three methodological issues specific to the study’s design and data. First, Nigg reexamined his population 3 years after the initial testing. Exercise staging is typically defined within a 6-month time frame (22); hence, the time period used by Nigg might not have provided the strongest representation of exercise behavior patterns. Indeed, adolescents’ exercise patterns may bear little resemblance to their reference point after 3 years have elapsed. Examining the TTM model within a 6-month time period is more consistent with the model and might provide stronger results, especially with respect to the influence that variables like self-efficacy, pros, and cons have on exercise behavior.

Second, closer inspection of Nigg’s data revealed that stage distributions for both time periods were skewed toward the more active stages (i.e., preparation and maintenance). This might have contributed to the lack of effect seen with the processes of change as well. For example, experiential processes and cons have been shown to have the greatest influence in the early stages of exercise behavior (13,22,26). Hence, with a more even stage distribution, the strength of these variables might have been greater.

Third, and finally, prior to data analyses, Nigg grouped the five experiential processes and the five behavioral processes together. This approach might well have masked the potency of the individual processes. For example, evidence exists supporting the importance of counterconditioning and self-liberation in determining stage of exercise readiness and stage transition in adolescents (26,30).

With the above points in mind, the purpose of this study was to employ a more ecologically valid longitudinal cross-lagged panel design to investigate whether the TTM variables act more as determinants or consequences of exercise behavior (stages of change).

**Method**

**Participants and General Procedure**

A total of 3,972 students \((N = 2,121 \text{ females and } N = 1,851 \text{ males})\) from 13 Auckland community high schools made up the initial sample (Time 1). Participants ranged in age from 14 to 19 years (mean 16.5 years \(SD 0.76\)) and had a mean body mass index (BMI) of 22.05 (based on self-report of height and weight). Of the students who participated, 40% were New Zealand (NZ) European, 5% NZ Maori, 8% Pacific Islander, 24% Asian, 8% Fijian Indian, and 15% other. A second data collection took place 6 months later (Time 2). A total of 1,434 students (625 males and 809 females) participated in the second (Time 2) data collection. The demographics were almost identical to the first with a mean age of 16.41 years \(SD 0.71\). A modest response for Time 2 occurred because many of the students had either left school or were on examination leave. The same data collection procedure as
Time 1 was used at Time 2. Analysis of all Time 2 completers showed no difference from noncompleters on all demographic and TTM construct variables at Time 1.

**Measures**

**Stages of Exercise Change Questionnaire (SECQ).** The SECQ was adapted by Marcus and colleagues (22) from the literature on smoking. Consistent with previous research (22,26,30), the stage of change questionnaire was used as a proxy measure of exercise behavior. Five statements were presented (one based on each stage of change) and the participant was asked to tick the statement that best described their current exercise status (e.g., “I do not currently exercise and am not seriously thinking about changing in the next 6 months” — precontemplation). The Kappa index of reliability for the SECQ, taken over a 2-week period, was 0.78 (22). Recently, Lee, Nigg, DiClemente, and Courneya (19) provided evidence supporting the relationship between stage of exercise readiness and self-reported exercise behavior among adolescents. All statements pertained to leisure time physical activity outside of school. Leisure time physical activity was defined as exercising at least 3 times per week for 30 min or more at a moderate intensity or higher (at least some light sweating: for example, fast walking, swimming, cycling, hockey, soccer, and aerobics).

**Self-Efficacy Questionnaire (SEQ).** This instrument was designed to assess confidence in the ability to persist with exercising in various situations (26). Items represented areas that have been shown to be important by exercise researchers: negative affect, resisting relapse, and making time for exercise (21). A 5-point Likert-type scale from 1 (not at all confident) to 5 (very confident) was used for scoring the SEQ. Test–retest reliability for the SEQ over a 2-week period was .90 \((n = 20; 40)\). In the present study, Cronbach’s alpha values for the self-efficacy scores were acceptable \((\alpha = .74 \text{ at Times 1 and 2})\).

**Decisional Balance Questionnaire (DBQ).** The DBQ developed by Marcus, Rakowski, and Rossi (22) asked participants to indicate on a 5-point Likert-type scale how important each statement was with respect to the decision to exercise or not. Marcus et al. (22) reported adequate internal reliability values for the 10-item pros scale (.95) and for the 6-item cons scale (.75). An example of a pro item is, “Exercise would help me relieve tension,” and an example of a con item is, “I would have less time for my family and friends if I exercised regularly.” In the present study, Cronbach’s alpha values at both time points were acceptable (pros \(\alpha = .89\), and cons \(\alpha = .78\)).

**Processes of Change Questionnaire (PCQ).** The PCQ (23) assesses 5 experiential processes (consciousness raising, dramatic relief, environmental reevaluation, self-reevaluation, and social liberation) and 5 behavioral processes (counterconditioning, helping relations, reinforcement management, self-liberation, and stimulus control). Participants were asked to recall the previous months and rate the frequency of occurrence of each of the 39 items on a 5-point Likert-type scale \((1: \text{never occurs} \text{ to } 5: \text{repeatedly occurs})\). As previously mentioned, evidence exists supporting the importance of counterconditioning and self-liberation in
determining stage of exercise readiness in adolescents (26,30), hence only these 2 processes of change were examined.1 Acceptable Cronbach’s alpha values for the present study were obtained for these subscales (ranging from .68 – .78 for Time 1 and .69 – .72 at Time 2).

Procedure
At Time 1, the principal investigator contacted the principals of the local high schools to obtain permission to conduct the study. Classroom teachers were then approached, and they distributed an information sheet, consent form, and TTM questionnaire to all home-room class participants. The TTM questionnaire was completed in class (approximately 20 min) and then returned to the teacher, who in turn contacted one of the investigators to collect them. Participants under 15 years of age were required to provide written consent from a parent or guardian in order to participate in the study. Participation in the study was voluntary. Identical data collection took place 6 months later (Time 2).

Treatment of the Data
To address the primary research question, cross-lagged panel correlations with structural equation modeling (3) were used. A two-wave cross-lagged panel design with a 6-month time lag was performed on the variables of interest. All variables in the TTM model were analyzed individually. As highlighted above, however, only self-efficacy, decisional balance, counterconditioning, and self-liberation were examined and presented here. Evaluation focused on the standardized beta weights of the diagonal paths between TTM variables and stage readiness (exercise behavior) to determine whether these variables acted more as determinants or consequences of behavior. The panels also consisted of longitudinal (within construct) pathways, which represented stability coefficients. A hypothesized model consisted of 4 observed variables (see Figure 2).

Maximum likelihood estimation was used for all structural equation modeling analyses. Evaluation of model fit was based on recommended indices (16). Specifically, expected values were as follows: a nonsignificant chi-square ($\chi^2$), goodness-of-fit index (GFI) $> 0.90$, root mean square error of approximation (RMSEA) $\leq 0.05$, and comparative fit index (CFI) $> 0.90$. It must be acknowledged, however, that the power of the chi-square test to detect an underlying disagreement between the theory and the data is controlled largely by the size of the sample (6). Hence, in very large samples (such as the one used in the present study), departures from the null hypothesis are almost certain, and all models under consideration would be rejected on statistical grounds. Because of this we believe that good approximate fit, as indicated by other fit tests (eg., GFI, CFI, and RMSEA), should be considered, and that a significant chi-square is not a reason by itself to modify the model.

Results
Descriptive data for all the variables of interest are presented in Table 1. To ensure normal distribution of all data, statistical transformations were performed on all skewed data according to recommendations by Tabachnick and Fidell (37). As
can be seen in Table 1, all the TTM cognitive constructs remained stable across time. Stage of exercise readiness distributions for Times 1 and 2 are illustrated in Figure 1. As can be seen, patterns of exercise stage of readiness were also stable across time.

Cross-Lagged Panel Analyses

Panel analyses are presented in Figures 2 to 6. All panels fit the data satisfactorily ($M \chi^2 = 76.50; M \text{ GFI} = 0.95; M \text{ CFI} = 0.94; M \text{ RMSEA} = 0.02$). The stability coefficients from baseline to follow-up on the same variables were significant and stronger than the cross lags in all panels. As highlighted by Nigg (25), these autoregressive paths explained most of the follow-up variance, which needs to be considered in interpretation of the results.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Descriptive Statistics for the Variables of Interest.</th>
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<tbody>
<tr>
<td></td>
<td>Time 1</td>
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<tr>
<td></td>
<td>Mean</td>
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<tr>
<td>Self-efficacy</td>
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<td>Pros</td>
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<tr>
<td>Cons</td>
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<tr>
<td>Counterconditioning</td>
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<tr>
<td>Self-liberation</td>
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**Figure 1** — Stages of change distribution at Time 1 (baseline) and Time 2 (6 months later).
As can be seen in Figure 2, the association of self-efficacy at Time 1 to exercise readiness (behavior) at Time 2 was significant ($p < .01$) and identical in strength to that of exercise behavior at Time 1 to self-efficacy at Time 2. Approximately 35% of the variance of exercise behavior and self-efficacy at Time 2 was explained respectively by the model. Figure 3 presents the relationship between pros and exercise behavior (stage readiness). As can be seen, the associations between pros and behavior are significant ($p < .01$). The magnitude of the relations between

\[ N = 1,434; \chi^2 (1) = 112.93, p < .001, \text{GFI} = .94, \text{CFI} = .93, \text{RMSEA} = 0.03. \]

**Figure 2** — Panel analyses for self-efficacy and exercise behavior (stages of change). *$p < .01$; **$p < .001$.  

\[ N = 1,434; \chi^2 (1) = 77.02, p < .001, \text{GFI} = .95, \text{CFI} = .94, \text{RMSEA} = 0.02. \]

**Figure 3** — Panel analyses for pros and exercise behavior (stages of change). *$p < .01$; **$p < .001$.  

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exercise behavior at Time 1 and pros at Time 2 is slightly larger than that of pros at Time 1 to stage readiness at Time 2. Approximately 34% variance of behavior and cognition (pros), respectively, was explained by the model at Time 2.

As can be seen in Figure 4, the relationship between cons at Time 1 and exercise behavior at Time 2 was slightly less than the relationship between exercise behavior at Time 1 and cons at Time 2. These relationships were nonsignificant ($p > .05$). The model explained 33% variance of behavior and 12% of cognition (cons) at Time 2. As can be seen in Figure 5, relations between counterconditioning (Time 1) and exercise behavior (Time 2) were slightly greater than for exercise

**Figure 4** — Panel analyses for cons and exercise behavior (stages of change). $^*p < .01; ^{**}p < .001$.

**Figure 5** — Panel analyses for counterconditioning and exercise behavior (stages of change). $^*p < .01; ^{**}p < .001$. 
behavior (Time 1) and counterconditioning at Time 2. Both path coefficients were significant (p < .01). The model explained 34% variance of behavior and 26% of counterconditioning at Time 2. Finally, as can be seen in Figure 6, relations between self-liberation at Time 1 and exercise behavior at Time 2 and between exercise behavior at Time 1 and self-liberation at Time 2 were significant (p < .01) and similar in strength. Approximately 34% of behavior and 25% variance of self-liberation at Time 2 were explained.

**Discussion**

The purpose of the present study was to determine whether the TTM variables act more as determinants or as consequences of exercise behavior (stage readiness). Results generally support a reciprocal type relationship for most of the variables examined. Beyond this general observation, specific results need highlighting.

First, exercise stage readiness and the TTM constructs (i.e., self-efficacy; decisional balance, pros and cons; and two behavioral processes, counterconditioning and self-liberation) remained stable from baseline (Time 1) to 6 months later (Time 2). These findings are in contrast to those reported by Nigg (25) who used a 3-year follow-up period.

Second, a reciprocal relationship between self-efficacy and exercise behavior (stage readiness) was evident in this study. This longitudinal evidence suggests that self-efficacy is an important determinant and consequence of exercise. Moreover, these results suggest that stage of readiness and self-efficacy are intertwined. For example, a person with greater self-efficacy to overcome barriers to exercise is more likely to be active, and greater activity is, in turn, associated with greater self-efficacy. The determinant component of this relationship is consistent with the exercise literature that has shown self-efficacy to be a strong determinant
of physical activity (28). With respect to behavior affecting self-efficacy, this relationship is consistent with Nigg’s (25) results: He reported a similar strength relationship between exercise behavior and self-efficacy, which supports existing theory. According to self-efficacy theory, the strongest source of self-efficacious beliefs is previous mastery accomplishment (4). Therefore, those with a stable pattern of activity (or those preparing to be active) should feel confident to perform at a similar level and overcome barriers and obstacles, etc., and therefore they are more likely to perform the behavior.

Third, our results supported reciprocal relations between the decisional balance variable (pros) and exercise behavior. The magnitudes of the relations were similar, albeit slightly less than those reported by Nigg (25), and might be related to the different approach used to assess exercise behavior. For cons, the size of the cross-lagged path coefficients suggests that exercise stage readiness influenced cons more than cons influenced exercise stage readiness. A possible explanation for this might be found in the stage distribution data. As can be seen in Figure 1, the majority of adolescents were in the preparation phase “making small change—I will stage.” Research evidence has generally shown that cons are most salient in the precontemplation and contemplation stages (13,22,26).

Fourth, results showed reciprocal relations between the two behavioral processes, counterconditioning and self-liberation, and exercise stage readiness. Once again, the stage distribution data may offer a possible explanation for these findings. Because a large number of participants were in the preparation to maintenance stage of exercise readiness (Figure 1), and behavioral processes have been shown to influence these latter stages (21,26), it is not surprising that variables like counterconditioning and self-liberation acted both as determinants and consequences of exercise stage readiness. The approach of separating specific processes of change appears to be a more potent method for delineating the effect of these variables on exercise behavior compared with collapsing these variables into a group approach (experiential versus behavioral).

According to the TTM model, counterconditioning refers to the learning of healthier behaviors that can substitute for problem behaviors. For adolescents, this approach might have a significant impact when developing interventions. It is possible that teaching and exposing young people to a spectrum of healthy behaviors might have a positive health impact. With respect to self-liberation, which is both the belief that one can change and the commitment and recommitment to act on that belief, an intervention might target the school environment to foster commitment to exercise.

Fifth, overall these cross-lag panel analyses suggest that previous cognition and behavior are strong determinants of subsequent cognition and behavior, respectively. Previous research has highlighted the importance of past cognition and behavior on theoretical model constructs (27,32).

Sixth, there are several limitations to the present study that need to be considered when interpreting the data. Specifically, the stage-of-change questionnaire was used as a proxy measure of exercise status. From a public health perspective, there is a need to link the constructs in the TTM with objective measures of exercise behavior. The voluntary nature of the sample, the self-reported nature of the measures used, and the modest response rate at Time 2 might have biased the results. In addition, administrative variables such as teacher distribution of questionnaires might have also biased the results.
Seventh, future longitudinal studies are needed that incorporate time-lag assessment periods that are consistent with TTM theory (i.e., 6 months). The magnitude and pattern of relation differences noted between our findings and those reported by Nigg (25) are attributable, in part, to the differences in the time frames of assessment used in the respective studies. Furthermore, it is important to acknowledge that research examining gender differences within the TTM is limited and warrants further attention. Lastly, despite recent concerns for stage-matched interventions to increase physical activity (1,7), future studies should consider the application of “tailored” interventions focused on the enhancement of specific behavioral processes, self-efficacy, and decisional balance variables to achieve maximal adoption and maintenance of exercise behavior. If this approach is fruitful, then the health-related implications and benefits would be evident.

References


**Note**

1. Cross-lag panel analysis was performed for all the experiential and behavioral variables. Results generally showed reciprocal relations between the TTM variables and stages of change (behavior). The exceptions to these result was stimulus control (SC) and dramatic relief (DR). Specifically, relations between SC (Time 1) and behavior (Time 2) was greater (beta = 0.14) than behavior (Time 1) to SC (Time 2; beta = 0.09). No significant relations existed between DR and behavior.