



Applying the Transtheoretical Model of Change to exercise in young Chinese people

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Objectives. The objective of the present study was to test the application of the Transtheoretical Model of Change (TTM) in relation to exercise behaviour of 298 Hong Kong Chinese undergraduates.

Design and methods. A cross-sectional design was used. Respondents completed measures of stages of change, self-efficacy, processes of change, decisional balance, exercise and demographic data.

Results. Significant effects for stage of change were found for self-efficacy, pros, exercise and nine of the 10 processes of change. In general, scores on these variables were found to increase across the stages although *post hoc* tests revealed slightly different patterns of significant differences. Cons were not found to differ significantly across stages of change. The relationship between self-efficacy and processes of change was dependent on stage of change.

Conclusions. The results support some of the assumptions of the TTM but raise questions about the predicted relationships between stages of change and processes of change and between self-efficacy and processes of change at each stage of change. The practical implications of the findings for the development of interventions to improve young people's exercise levels are discussed.

In Hong Kong the leading causes of death are malignant neoplasms (159.6/100,000), heart disease (75.5/100,000) and respiratory disease (55.1/100,000) (Hong Kong Census and Statistics Department, 2000). A significant proportion of the mortality from these disorders may be due to modifiable behaviour patterns (Stroebe & Stroebe, 1995). People can affect their own health and well-being by avoiding behaviours that

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endanger their health (e.g. smoking cigarettes) and adopting behaviours that enhance their health (e.g. regular exercise) (Conner & Norman, 1996).

The effect of exercise on health

Exercise of at least 20 minutes, duration, three times per week improves the functioning of the cardiovascular, respiratory, endocrine and nervous systems, as well as reducing the risk of cardiovascular disease, total mortality, and some malignancies, such as colon cancer (Pate *et al.*, 1995). In addition, exercise may improve psychological health (Weyerer & Kupfer, 1994) and cognitive functioning (Van Sickle, Hersen, Simco, Melton, & Van Hasselt, 1996). However, few people exercise at levels reported to offset health problems, or significantly improve health status (Booth *et al.*, 1993; UK Health Education Authority and UK Sports Council, 1992; US Department of Health and Human Services, 2000). In particular, the exercise and fitness levels of young people in Hong Kong are reportedly low and less than similar groups in other countries. Whereas only 12% report exercising 3–4 times per week, over half (55%) report their exercise frequency as never, seldom or a few times per month (Lindner, 1998). This trend appears to continue into adulthood (Callaghan, Ma, & Fung, 1997; Family Planning Association of Hong Kong, 1993; Twinn & Kan, 1994). Habitually low levels of regular exercise have been reported to jeopardize the long-term health of young people (Pate, Baranowski, Dowda, & Trost, 1996). Identifying the predictors of young peoples' exercise behaviour may contribute to efforts to improve young peoples' exercise levels (O'Connor, 1994) and is an important public health initiative (US Department of Health and Human Services, 2000; US Surgeon General, 1996; World Health Organization, 1999).

Explaining exercise behaviour with social cognition models

There are two broad classes of social cognition models that have been used to explain health behaviour, namely continuum and stage models (Weinstein, Rothman, & Sutton, 1998). Continuum models such as the Theory of Reasoned Action (TRA; Fishbein & Ajzen, 1975) and the Theory of Planned Behaviour (TPB; Ajzen & Madden, 1986) attempt to identify the psychological determinants of action and then combine these determinants in a single prediction equation. Thus each individual can be placed along a single continuum representing the likelihood of action. In contrast, stage models suggest that individuals pass through qualitatively different stages as they move from inaction to action. While many studies have investigated the TRA and TPB for exercise (see Hausenblas, Carron, & Mack, 1997), there is less research using stage models. This paper focuses on the stage model most commonly applied to health-related behaviour, namely the Transtheoretical Model of Change (Prochaska & Marcus, 1994).

Transtheoretical Model of Change (TTM)

The TTM (Prochaska & Marcus, 1994) incorporates four related concepts considered central to behavioural change, namely stage of change, self-efficacy, decisional balance and the processes of change. Stage of change reflects the temporal dimension in which attempts to change behaviour occur. The model proposes that individuals progress

through a series of stages before they achieve a sustained change in the behaviour. For exercise, the five stages are:

1. Precontemplation — not even thinking about participating in exercise;
2. Contemplation — seriously considering starting to exercise;
3. Preparation — beginning a limited programme of exercise;
4. Action — regularly exercising at the recommended level for six months or less; and
5. Maintenance — exercising at the recommended level for more than six months.

Progression through the stages should be linked to differences in self-efficacy, decisional balance and the processes of change (Prochaska & Marcus, 1994).

Self-efficacy refers to the confidence individuals have in their ability to perform a behaviour. Thus individuals with high self-efficacy would feel confident that they could exercise even when faced with barriers such as tiredness, time pressure or a bad mood. Exercise self-efficacy should increase as individuals move through the stages towards maintenance (Marcus, Selby, Niaura, & Rossi, 1992). Decisional balance is a measure of the balance between positive (Pros) and negative (Cons) belief about the consequences of exercise. Pros are consequences such as feeling 'less stressed', whereas Cons refer to negative outcomes such as 'feeling too exhausted'. Typically individuals who exercise have a positive decisional balance in that the positive beliefs about exercise outweigh the negative beliefs. In contrast, the decisional balance of sedentary individuals is generally negative (Marcus, Rossi, Selby, Niaura, & Abrams, 1992; Marcus, Eaton, Rossi, & Harlow, 1994). In addition, as individuals progress through the stages, a systematic shift in decisional balance should occur (Prochaska, Redding, Harlow, Rossi, & Velicer, 1994). Specifically, Pros should increase when individuals move from Precontemplation to Contemplation. In contrast, Cons should decline progressively in the move from Contemplation to Action and Maintenance.

While self-efficacy and decisional balance represent beliefs about behaviour that are common to many social cognition models, the TTM also includes processes of change. Prochaska and DiClemente (1984) define a process of change as a 'type of activity that is initiated or experienced by an individual in modifying affect, behaviour, cognition, or relationships' (Prochaska & DiClemente, 1984, p. 7). Ten different processes of change have been identified that are thought to determine movement through the stages. Table 1 presents a description of these processes of change for exercise with exemplars of each process.

These 10 processes can be categorized into two broad classes, namely experiential and behavioural. Experiential processes cover individuals' awareness of how exercise may help them, and their feelings about exercising. Behavioural processes are things that individuals do to help them exercise such as rewarding themselves when they exercise, having friends who encourage them to exercise and placing things around the house that will remind them to exercise. Prochaska and DiClemente (1984) present evidence that suggests people generally use different processes during particular stages. For example, individuals in the 'lower' stages, namely Precontemplation, Contemplation and Preparation, generally use more experiential and fewer behavioural processes than people in the more active stages, namely Action and Maintenance. In contrast those in Action and Maintenance generally use more behavioural and fewer experiential processes.

In general, research thus far on the TTM for exercise has been supportive of the model. Hence, there is a progressive increase in self-efficacy levels from Precontemplation to Action (Booth *et al.*, 1993; Marcus & Owen, 1992; Marcus, Rossi, Selby, Niaura, &

Table 1. Descriptions, sample items and Cronbach's alphas of processes of change for exercise

Process	Type of process	Description	Sample item	Alpha
1. Consciousness raising	Experiential	Increasing knowledge about the benefits of exercise	I recall information people have personally given me on the benefits of exercise	0.75
2. Dramatic relief	Experiential	Reacting to warnings about the risks of not exercising	I react emotionally to warnings about an inactive lifestyle	0.79
3. Environmental re-evaluation	Experiential	Caring about consequences to others of not exercising	I feel I would be a better role model for others if I exercised regularly	0.71
4. Self-re-evaluation	Experiential	Comprehending benefits the benefits of exercise	I am considering the idea that regular exercise would make me a healthier, happier person	0.78
5. Social liberation	Experiential	Increasing healthy opportunities to exercise	I am aware of more and more people encouraging me to exercise these days	0.58
6. Self-liberation	Behavioural	Committing yourself to exercise	I tell myself that I am able to keep exercising if I want to	0.75
7. Helping relationships	Behavioural	Enlisting social support to help you exercise more	I have a healthy friend who encourages me to exercise when I don't feel like it	0.75
8. Counter-conditioning	Behavioural	Substituting alternatives: exercising as an alternative to not exercising	Instead of remaining inactive I engage in some physical activity	0.74
9. Reinforcement management	Behavioural	Rewarding yourself when you exercise	I reward myself when I exercise	0.66
10. Stimulus control	Behavioural	Reminding yourself to exercise	I put things around the house to remind me to exercise	0.72

Abrams, 1992; Marcus *et al.*, 1994; Nigg & Courneya, 1998). Further, individuals at the Action and Maintenance stages emphasize more positive and fewer negative beliefs about exercise (Clarke & Eves, 1997; Gorely & Gordon, 1995; Marcus & Owen, 1992; Marcus, Rakowski, & Rossi, 1992; Marcus *et al.*, 1994; Nigg & Courneya, 1998), and exercise more than individuals at the lower stages (Lee, 1993). While stage of change, self-efficacy and decisional balance for exercise have been extensively researched, studies employing the processes of change are less plentiful. Typically, individuals in the lowest stage — Precontemplation — use processes of change less than individuals in the other stages, though the effects are more consistent for experiential than behavioural processes (Gorely & Gordon, 1995; Marcus, Rossi, Selby, Niaura, & Abrams, 1992; Nigg & Courneya, 1998). Further, individuals in Action and Maintenance use more processes of change than individuals in the lower stages (Gorely & Gordon, 1995; Marcus, Rossi, Selby, Niaura, & Abrams, 1992; Nigg & Courneya, 1998). While Marcus, Rossi, Selby, Niaura, and Abrams (1992) found that experiential processes peaked in the Action stage, Nigg and Courneya (1998) with an equivalent sized sample did not replicate this finding; generally differences between the Action and Maintenance stages of exercise for process use are rare.

In a review of the TTM and HIV prevention and other health-related behaviours Prochaska *et al.* (1994) report that self-efficacy and processes of change correlate, with the direction of the association dependent upon stage of change. Thus higher self-efficacy scores among Precontemplators and Contemplators correlated with greater process use, whereas for those in Action and Maintenance, higher self-efficacy scores were associated with less process use (Prochaska *et al.*, 1994). While this finding was reported for use of the TTM with cessation behaviours (e.g. smoking cessation), the possible association between process of change and self-efficacy for adoption behaviours such as exercise has not been studied. Thus replication of the differential association between self-efficacy and process use for the stages would broaden the validity of the model. As exercise must be repeatedly performed in the Action and Maintenance stages, it is possible that negative correlations between self-efficacy may not occur for an adoption behaviour. Self-efficacy for exercise is operationalized as confidence in overcoming barriers to participation (Marcus, Selby, Niaura, & Rossi, 1992), and it may be that processes of change, particularly behavioural processes, may be required to maintain both high levels of self-efficacy and exercise behaviour when faced with potential barriers.

Despite this support for the model, there remain several limitations to the research that has been conducted to date. Almost all studies test only the stages of change model and not the other aspects of the TTM. For example, most studies compare differences on various outcomes such as physical activity, decision-making processes, and knowledge about exercise between people at each stage of change. In contrast, relatively few published studies have investigated the processes of change which purport to underpin movement between stages (Dunn *et al.*, 1997; Gorely & Gordon, 1995; Marcus, Rossi, Selby, Niaura, & Abrams, 1992; Marcus, Simkin, Rossi, & Pinto, 1996; Nigg & Courneya, 1998). Also, no studies have examined the correlation between self-efficacy and processes of change across stages of change for exercise.

Concerning the generality of the model, there is some evidence of cross-cultural validity for the TTM in that similar results have been reported for Australia, the UK and North America. Nonetheless, Marcus and Owen (1992) suggest that cultural differences may influence the relationships between the variables of the TTM as they reported differences between Americans and Australians at different stages of change on

self-efficacy and decisional balance. To date, there are no published studies evaluating the TTM in largely non-Caucasian societies. Further, studies testing the TTM with exercise (as opposed to the Stages of Change Model) have largely sampled middle-aged and older adults. One exception is Nigg and Courneya (1998) who tested the TTM with 819 community high school students, aged 13–19, living in Canada. These authors reported that all TTM variables differed significantly across the Stages of Change for exercise. Further studies with adolescents are needed to confirm these findings.

The present study

In his latest policy address the Hong Kong Chief Executive stressed the importance of improving young peoples' fitness levels (Hong Kong Government, 1999). Improving young peoples' exercise levels will contribute to improvements in their fitness levels. In Hong Kong, 98% of whose population is Chinese, there is a need for empirical investigation of the factors that may influence the exercise levels of young people and the utility of the TTM to explain exercise in Chinese people has not been tested. Studies testing the TTM with non-Caucasians could also shed light on the cross-cultural validity of the model thus giving the present study practical and theoretical significance. The aim of this study was therefore to test the TTM in relation to exercise behaviour in young Chinese people.

Method

Sample

A total of 298 Chinese undergraduate students (general education, $N = 167$; nursing, $N = 122$; and psychology, $N = 9$) attending classes in the nursing and psychology departments at the Chinese University of Hong Kong participated in the study. The mean age of the sample was 20 years ($SD = 1.42$, range = 18–23). Two hundred and five (68.8%) were female, 90 (30.2%) were male, 3 (1%) did not report their gender.

Measures

Data were collected by a questionnaire incorporating the following measures of the TTM.

Stages of change ladder

Developed by Marcus and Owen (1992), each participant was instructed to select a rung that best described their current regular exercise behaviour. Regular exercise was defined as three or more times per week of exercise of at least 25 minutes' duration.¹

Rungs corresponded to the following stages of change: rung 0 = Precontemplation ('I currently do not exercise, and I do not intend to start exercising in the next 6 months'); rungs 1–2 = Contemplation ('I currently do not exercise, but I am thinking about starting to exercise in the next 6 months'); rungs 3–5 = Preparation ('I currently exercise some, but not regularly'); rungs 6–8 = Action (I currently exercise regularly and have been exercising

¹ Due to an oversight, the duration of each session was specified as 25 minutes rather than the more conventional 20-minute prescription.

at the recommended level for 6 months or less'); and rungs 9–10 = Maintenance ('I currently exercise regularly and have done so for longer than 6 months').

Self-efficacy Questionnaire (SEQ)

Used by Gorely and Gordon (1995) this 5-item scale measures participants' confidence in their ability to sustain exercising in various situations. Participants responded to a 5-point Likert scale from 1, not at all confident, to 5, very confident to each item, e.g. 'I am confident I can participate in regular exercise when: I am tired, I am in a bad mood . . .'. Item 5 of the original SEQ used by Marcus, Selby, Niaura, and Rossi (1992), namely 'It is raining, or snowing' was changed to 'when it is raining, cold, or very hot' to reflect the weather conditions of Hong Kong following a similar change by Gorely and Gordon (1995). Test–retest of the SEQ over a two-week period was 0.90 (Marcus, Selby, Niaura, & Rossi, 1992), internal consistency scores ranged from 0.80 to 0.85 in two separate studies using the SEQ (Marcus & Owen, 1992). In the present study item 4, 'I am on holiday/vacation', was excluded as it correlated poorly with the other items. Cronbach's alpha for the 4-item SEQ was 0.64, a value somewhat lower than that reported by Marcus and Owen (1992).

Decisional Balance (Pros and Cons) Questionnaire (DBQ)

Developed by Marcus, Rakowski, and Rossi (1992), this 16-item scale consists of two subscales, representing the positive (Pros; $N=10$ items) and negative aspects of exercise (Cons; $N=6$ items). Participants rated the importance of each item in their decision to exercise on a 5-point Likert scale from 1, not at all important, to 5, extremely important. Item 7 of the Cons, 'I would find it difficult to find an exercise I enjoy that is not affected by bad weather', was not included as it correlated poorly with the other items. Cronbach's alphas were 0.88 and 0.70 for the Pros and Cons subscales respectively, values similar to those reported by Marcus, Rakowski, and Rossi (1992).

Processes of Change Questionnaire (PCQ)

Developed by Marcus, Rossi, Selby, Niaura, and Abrams (1992), this scale has 39 items and consists of 10 subscales measuring 10 processes of change. Participants were instructed to respond on a 5-point Likert scale (1, never, to 5, always) to the following statement. 'The following experiences can affect the exercise habits of some people. Think of any similar experiences you may be currently having or have had during the past month. Then rate how frequently the event occurs'. Following pilot work, the anchor on the Likert scale 'always' was substituted for the original anchor 'repeatedly' to improve the participants' understanding. Internal consistency for the PCQ reported by Marcus *et al.* ranges from 0.62 to 0.89 for each subscale ($M=0.81$). Cronbach's alphas for each subscale of the PCQ in the present study are shown in Table 1. These ranged from 0.58 to 0.79 (median = 0.74). The fourth item of the self-liberation subscale (item 27 of the overall PCQ) was deleted as it correlated poorly with the other items of this subscale.

As social liberation ($\alpha=0.58$) and reinforcement management ($\alpha=0.66$) have lower reliabilities than is conventionally acceptable, results for these two processes of change should be treated with caution.

Demographic data

Data were gathered on students' age, sex and study major.

Exercise behaviour

This was measured by four items asking respondents to (1) state on how many days per week they exercised; (2) how many minutes, approximately, they exercised each time; (3) how long they had been exercising at this level; and (4) what exercise activities they did, after Marcus, Rossi, Selby, Niaura, and Abrams (1992). The total minutes of exercise per week were computed as the number days per week multiplied by the average time per day. As the resultant variable was positively skewed, a logarithmic transformation was performed prior to analysis to improve the distribution.

Procedure

A pilot study among a small group of students who did not participate in the main study suggested minor changes to the instructions of the questionnaire. In the main study students completed the measures at a time in the class suitable to them and their teacher. The researcher distributing the questionnaire assured the students that their participation was voluntary; their involvement would not confer special benefits; that their refusal to participate would not penalize them in any way; that they may withdraw their participation at any time and their responses would be anonymous. Completed measures were taken as consent to participate.

Results**Response rate**

For the main study 350 questionnaires were distributed, 298 were returned (response rate = 85%).

Descriptive analyses**Stages of change**

Based on self-report, the number of students at each stage of change was as follows: Precontemplation: 10 (3.4%); Contemplation: 32 (10.7%); Preparation: 163 (54.7%); Action: 61 (20.5%) and Maintenance: 26 (8.7%). Six (2%) students did not answer the question. As can be seen the largest group within the sample reported that they were in preparation. Due to changes in the staging algorithm when applied to exercise, the size of the Preparation group can be misleading (Clarke & Eves, 1997). Participants choose a single mutually exclusive category and, hence, anyone engaging in some exercise cannot be in Precontemplation or Contemplation. However, the Action and Maintenance stages require participation on a regular basis at a specified level, in this case three or more sessions of 25 minutes each. Thus the Preparation category can include both those who are genuinely in Preparation and those who perform certain amounts of exercise less than the specified criterion for regular exercise but have no intention of changing their behaviour. To circumvent this problem, participants who indicated that they were in Preparation but had intention scores of three or less were excluded from the analysis ($N = 60$) as it was reasoned that these individuals did not intend to increase

Table 2. Mean scores $\pm$ standard deviation and Tukey's results by stage of change for decisional balance, self-efficacy and exercise

Variable	Stage of change					Tukey's HSD $p < .01$	η^2 s
	Precontemplation (N = 10)	Contemplation (N = 32)	Preparation (N = 103)	Action (N = 61)	Maintenance (N = 26)		
Self-efficacy Pros	1.90 $\pm$ 0.66	2.50 $\pm$ 0.71	2.68 $\pm$ 0.51	2.97 $\pm$ 0.50	3.31 $\pm$ 0.53	17.14 PC < C = P < A = M	0.23
	2.12 $\pm$ 0.82	3.17 $\pm$ 0.68	3.41 $\pm$ 0.62	3.63 $\pm$ 0.53	3.85 $\pm$ 0.58	14.83 PC < C = P PC = C < A = M P < M	0.22
Cons Exercise behaviour	2.90 $\pm$ 0.95	3.09 $\pm$ 0.71	2.81 $\pm$ 0.58	2.85 $\pm$ 0.68	2.72 $\pm$ 0.71	1.34 n.s.	0.02
	0.00 $\pm$ 0.00	2.92 $\pm$ 1.86	3.75 $\pm$ 1.45	4.65 $\pm$ 0.94	5.35 $\pm$ 0.63	30.12 PC < C = P < A = M	0.38

Table 3. Mean scores $\pm$ standard deviation and Tukey's results by stage of change for processes of change across stage of change

Process	Stage of change						η^2 s
	Precontemplation (N = 10)	Contemplation (N = 32)	Preparation (N = 103)	Action (N = 61)	Maintenance (N = 26)	F ratio	
Experiential processes							
Consciousness raising	1.80 $\pm$ 0.69	2.16 $\pm$ 0.71	2.57 $\pm$ 0.68	2.69 $\pm$ 0.73	2.90 $\pm$ 0.75	7.43	0.11
Dramatic relief	1.47 $\pm$ 0.50	1.96 $\pm$ 0.65	2.02 $\pm$ 0.53	2.22 $\pm$ 0.63	2.02 $\pm$ 0.68	3.86	0.06
Environmental re-evaluation	2.00 $\pm$ 0.57	2.39 $\pm$ 0.69	2.83 $\pm$ 0.73	2.97 $\pm$ 0.66	3.02 $\pm$ 0.68	7.59	0.11
Self-re-evaluation	2.00 $\pm$ 0.75	2.97 $\pm$ 0.86	3.22 $\pm$ 0.72	3.56 $\pm$ 0.74	3.60 $\pm$ 0.70	12.19	0.17
Social liberation	2.05 $\pm$ 0.88	2.27 $\pm$ 0.62	2.55 $\pm$ 0.66	2.60 $\pm$ 0.59	2.65 $\pm$ 0.74	2.96	0.05
Behavioural processes							
Self-liberation	1.96 $\pm$ 0.53	2.45 $\pm$ 0.84	3.07 $\pm$ 0.60	3.40 $\pm$ 0.83	3.56 $\pm$ 0.86	17.23	0.23
Helping relationships	1.82 $\pm$ 0.80	2.07 $\pm$ 0.74	2.31 $\pm$ 0.74	2.36 $\pm$ 0.66	2.67 $\pm$ 0.95	3.36	0.05
Counter-conditioning	2.12 $\pm$ 0.60	2.47 $\pm$ 0.58	2.93 $\pm$ 0.66	3.36 $\pm$ 0.71	3.87 $\pm$ 0.58	25.53	0.31
Reinforcement management	1.85 $\pm$ 0.64	2.58 $\pm$ 0.68	2.92 $\pm$ 0.62	3.21 $\pm$ 0.62	3.39 $\pm$ 0.64	15.58	0.21
Stimulus control	1.72 $\pm$ 0.50	1.89 $\pm$ 0.53	2.27 $\pm$ 0.60	2.44 $\pm$ 0.64	2.43 $\pm$ 0.85	6.14	0.09
							C < P

their exercise levels. Consequently, the number of students at each stage of change for the analyses were as follows: Precontemplation: 10 (4.3%); Contemplation: 32 (13.8%); Preparation: 163 (44.3%); Action: 61 (26.3%) and Maintenance: 26 (11.2%).

Multivariate analysis

Discriminating between stages of change

Multivariate analysis of variance (MANOVA) revealed a main effect for stage of change (Wilks' $\lambda = 0.782$, approximate $F(4,216) = 3.45$, $p < .001$) and an interaction between stage and variable (Wilks' $\lambda = 0.614$, approximate $F(12,471) = 7.94$, $p < .001$). Tables 2 and 3 show the mean scores, and summarize the univariate ANOVAs and the Tukey HSD follow-up tests by stage of change for each of the TTM variables.

Table 2 shows the stages were significantly different for self-efficacy, Pros and frequency of exercise behaviour. In general, scores increased across stages though slightly different patterns of significant differences were observed. In contrast, there was no significant differences in negative consequences of exercising (Cons) across the different stages. In general, the effect size for stage of change was large by Cohen's (1992) estimate with effect sizes (η^2 s) ranging from 0.02 to 0.38 (median = 0.225).

In relation to the processes of change, significant effects of stage were found for all except one process (see Table 3). As the single non-significant effect, namely social liberation, was associated with the lowest Cronbach's alpha (0.58), results for this variable may reflect the unreliability of the measure in this sample. In general, process use increased across stages, with once again slightly different patterns of significant effects observed. The steeper gradient across the stages for behavioural processes is reflected in the larger effect sizes for behavioural processes (median = 0.21, range = 0.05–0.31) than experiential processes (median = 0.11, range = 0.05–0.17).

Correlational analysis

It was expected that self-efficacy among participants in the early stages would correlate positively with process, use whereas self-efficacy scores among participants in the later stages would correlate negatively with use of the processes of change (Prochaska *et al.*, 1994). The results of the correlation analyses for each stage are presented in Table 4.

Two points are evident from Table 4. First, the data provide little support for a negative association between self-efficacy and process use in the later stages; there were no significant negative correlations between self-efficacy and any process. Rather, where correlations were significant for the later stages, the direction of the association was positive. Nonetheless, there was some evidence of differential association between self-efficacy and the different stage groups.

Averaging across the five experiential processes and then computing the correlations with self-efficacy revealed the following. For the experiential processes the correlations for each stage were Precontemplation $r = .30$, n.s., Contemplation $r = .35$, $p < .05$, Preparation $r = .28$, $p < .01$, Action $r = .17$, n.s., and Maintenance $r = -.01$, n.s. For the behavioural processes the correlations for each stage were Precontemplation $r = .44$, n.s., Contemplation $r = .26$, n.s., Preparation $r = .41$, $p < .001$, Action $r = .36$, $p < .01$ and Maintenance $r = .17$, n.s. These results suggest lower associations between self-efficacy and process use in the Maintenance stage.

Table 4. Pearson's product moment correlation coefficients between self-efficacy and processes of change at each stage of change

Stage of change	Experiential processes					Behavioural processes				
	CR	DR	ER	SR	SO	SL	HR	CC	RM	SC
Precontemplation (N = 10)	– 0.02	0.28	0.49	0.45	0.24	0.59	0.39	0.28	0.29	0.44
Contemplation (N = 31)	0.41*	0.26	0.25	0.22	0.15	0.27	– 0.08	0.23	0.11	0.43**
Preparation (N = 98)	0.19	0.13	0.33***	0.19	0.23*	0.26***	0.34***	0.41***	0.20*	0.27***
Action (N = 59)	0.22	– 0.04	– 0.003	0.16	0.21	0.23	0.004	0.41***	0.27	0.33**
Maintenance (N = 25)	– 0.09	– 0.07	0.009	0.007	0.12	0.27	0.13	0.16	– 0.09	0.04

* $p < .05$, ** $p < .01$, *** $p < .001$ otherwise not significant.

Key, CR = Consciousness raising, DR = Dramatic relief, ER = Environmental re-evaluation, SR = Self-re-evaluation, SO = Social liberation, SL = Self-liberation, HR = Helping relationships, CC = Counter-conditioning, RM = Reinforcement management, SC = Stimulus control.

Discussion

The aim of the present study was to test the TTM in relation to exercise behaviour in young Chinese people. The majority (55%) of Hong Kong students reported that they were in Preparation. This can be contrasted with the mean population prevalence of the stages of exercise behaviour change taken from 12 previous studies in Australia, USA and the UK. Buxton, Wyse, and Mercer (1996) concluded that most (43%) people were 'Active' (i.e. in Action and Maintenance), 29% were in Preparation and 28% were 'Inactive' (i.e. in Precontemplation and Contemplation). The percentage of students who reported being 'Active' (29.2%) in the present study was lower than that reported for British students (43%) (Buxton *et al.*, 1996; Naylor & McKenna, 1994; Naylor, McKenna, Barnes, & Christopher, 1995) and Canadian high school students (65% Nigg & Courneya, 1998). This confirms reports that young Hong Kong Chinese people's level of regular exercise is consistently less than their counterparts in other countries (Lindner, 1998). There are several reasons for this (Mulley, 1997). The culture and environment of Hong Kong is not conducive to exercise. Further, exercise is often seen as play and considered less important than studying hard. In addition, few schools have a comprehensive physical education programme, a fact relating the low priority given to physical activity in educational policy.

It was expected that self-efficacy and exercise behaviour would increase across the stages of change from Precontemplation to Maintenance and the present study confirmed this finding.

For decisional balance, students in the later stages of change placed more emphasis generally on the benefits of exercise than students in the early stages, a finding consistent with earlier work (Gorely & Gordon, 1995; Marcus & Owen, 1992; Marcus *et al.*, 1994). In contrast, the slight bias for the early stages of change to place more emphasis on the barriers to exercising than students in the later stages was not significant.

For the processes of change for exercise, previous studies indicate that individuals in the early stages use processes less than individuals in the later stages, though the effects are more consistent for experimental than behavioural processes (Gorely & Gordon, 1995; Marcus *et al.*, 1992; Nigg & Courneya, 1998). Our results were generally in line with these findings. Thus use of all processes by participants in the early stages was generally lower than in the later stages. Further, two of the behavioural processes, namely helping relationships and counter-conditioning, were higher in Maintenance than Action, whereas none of the experiential processes differed between these two stages. It should also be noted that no evidence of a peak for experiential processes in the Action stage was found. While it is intuitively reasonable that process use may be less important for individuals with self-sustaining exercise behaviour, i.e. those in Maintenance, evidence consistent with this suggestion is lacking. Clearly more research is needed to investigate this issue.

It is possible that our failure to find differences in process use between some of the stages is due to how preparation was defined. We defined preparation as *exercising some, but not regularly* (Marcus & Owen, 1992). A potential problem with this definition is that it does not differentiate between people exercising irregularly with no intention of advancing towards regular exercise, from those exercising irregularly, but with active intentions to begin exercising regularly within 30 days. The latter is a truer definition of preparation according to Prochaska and Velicer (1997).

For possible relationships between self-efficacy and process use, Prochaska *et al.*

(1994) suggested the relationship would be dependent on stage such that a positive association in the early stages would be contrasted with a negative correlation in the later stages of change. This suggestion was not supported in the present study. Rather a low correlation between self-efficacy and process use was found for those in Maintenance. Part of the discrepancy between our results and previous studies (see Prochaska *et al.*, 1994) may be due to real differences between cessation and adoption behaviours. Our results, however, would be consistent with a looser linkage between the separate components of the TTM for individuals in Maintenance.

Our sample was generally younger (excepting Nigg & Courneya, 1998), and from a different cultural background than participants in previous studies testing the TTM with exercise. Indeed reliability of the measures was slightly lower than previously reported, with the exception of decisional balance. For self-efficacy the lower alphas may reflect a cultural difference. For example, barriers to exercise that are the basis of self-efficacy in the TTM may come from parental and authority figures who consider exercise as leisure, and thus, an impediment to hard work and getting on in life. For the processes, however, our alphas are in line with those reported by Nigg and Courneya (1998) and these may reflect lower alphas in adolescents rather than cultural differences. In spite of these factors, the results were generally consistent with previous cross-sectional studies of the TTM and exercise. Thus there was an increase in self-efficacy, Pros and frequency of reported exercise behaviour across the stages of change and process use also increased consistent with the model. The only variable that did not fit was negative consequences of exercise (Cons), an effect that could not be attributed to lower reliability of the measure in a Chinese sample. As the results of previous research derive largely from studies of middle-aged and elderly adults, the robustness of the cross-sectional effects despite a relatively young and culturally distinct sample is notable.

Our results are important for several reasons. We have provided evidence for the validity of aspects of the TTM to young Chinese people and hence broaden the empirical support for the model. Our inclusion of the processes of change has allowed us to test the relationship between stage of change and processes of change for exercise behaviour in young people. Regarding interventions that might help the young people in this study improve their exercise levels, our results suggest that these young adults may respond to interventions that emphasize the benefits of exercise. Consistent with this suggestion, individuals in Preparation had higher scores for consciousness raising and environmental re-evaluation than those in Contemplation. Of the behavioural processes of change, students in Preparation reported more use of stimulus control, and counter-conditioning than those in Contemplation, suggesting two relatively simple behavioural techniques of prompting and substitution of behaviours may prove useful. Whilst this study provides some support for the TTM and exercise in young Chinese people it also highlights several issues for further research. Further, longitudinal studies will allow researchers to trace students' movements between the stages, investigate how these movements occur, and better understand the role of TTM variables in stage transitions.

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