Predicting Physical Exercise in Cardiac Rehabilitation: The Role of Phase-Specific Self-Efficacy Beliefs

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During the process of health behavior change, individuals pass different phases characterized by different demands and challenges that have to be mastered. To overcome these demands successfully, phase-specific self-efficacy beliefs are important. The present study distinguishes between task self-efficacy, maintenance self-efficacy, and recovery self-efficacy. These phase-specific beliefs were studied in a sample of 484 cardiac patients during rehabilitation treatment and at follow-up 2 and 4 months after discharge to predict physical exercise at 4 and 12 months follow-up. The three phase-specific self-efficacies showed sufficient discriminant validity and allowed for differential predictions of intentions and behavior. Persons in the maintenance phase benefited more from maintenance self-efficacy in terms of physical exercise than persons not in the maintenance phase. Those who had to resume their physical exercise after a health related break profited more from recovery self-efficacy in terms of physical exercise than persons who were continuously active. Implications for possible interventions are discussed.

Key Words: maintenance, relapse, prevention

Physical activity is a core factor in the prevention and rehabilitation of coronary heart disease (CHD) (Grundy, Pasternak, Greenland, Smith, & Fuster, 1999). There is broad evidence that regular physical exercise is related to lower mortality, lower relapse rates, and reduced symptoms after the manifestation of CHD (cf. Thompson, Buchner, Piña, et al., 2003). For example, Jolliffe and colleagues (2003) reported in a meta-analysis that exercise interventions led to a 31% reduction of total cardiac mortality in CHD patients who underwent a long-term supervised exercise training program. Thus, coronary rehabilitation patients are advised to engage in regular vigorous exercise to reduce their risk status and support the rehabilitation process (Smith, Blair, Bonow, et al., 2001). Most CHD patients, however, fail to follow the recommended exercise regimen. For example, a study with CHD patients who underwent supervised exercise training in the rehabilitation center showed that only 25% of them had adopted a vigorous exercise program at 1-year follow-up.

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Predicting Health Behavior Change

According to prevailing theories of health behavior change, such as the Theory of Reasoned Action (Fishbein & Ajzen, 1980), the Theory of Planned Behavior (Ajzen, 1991), and Protection Motivation Theory (Maddux & Rogers, 1983), intentions are the most important predictor of behavior. Recent meta-analyses have shown, however, that intentions are not sufficient to gain a satisfactory prediction of behavioral change (e.g., Sheeran, 2002), resulting in a phenomenon termed “intention-behavior gap” (Sheeran, 2002). This gap might be overcome by taking postintentional variables into account. The Health Action Process Approach (HAPA; Schwarzer, 1992) provides a theoretical framework for identifying important preintentional and postintentional factors for health behavior change. The HAPA distinguishes between a motivational phase, in which individuals form an intention to act, and a subsequent volitional phase, in which they strive to execute the intention.

Within this volitional phase, different tasks must be mastered, such as initiating a novel or difficult behavior, maintaining it, and recovering from possible lapses. Self-efficacy, defined as one’s perceived ability to master arising demands and tasks successfully (Bandura, 1997), is hypothesized as being crucial in all phases of behavior change, whereas other variables may play a role in certain phases only.

Since individuals have to deal with phase-specific demands, different phase-specific self-efficacy beliefs are distinguished that address the respective challenges. Task self-efficacy is an optimistic self-belief that is supposed to be most important in the initial motivational phase. It refers to one’s perceived ability to implement a difficult or novel behavior. A person who lacks confidence in being able to implement the behavior is less likely to form a behavioral intention. Risk awareness, outcome expectancies, and task self-efficacy are considered to be joint predictors of behavioral intentions. After having formed an intention, a person enters the volitional phase to initiate and subsequently maintain the behavior and recover from possible lapses.

For the initiation of a behavior, action planning is assumed to play an important role. It refers to concrete plans about when, where, and how to implement the intended behavior (Gollwitzer, 1999; Leventhal, Singer, & Jones, 1965) and has proven to be a useful strategy in health behavior change (Lippke, Ziegelmann, & Schwarzer, 2004; Milne, Orbell, & Sheeran, 2002; Sniehotta, Scholz, & Schwarzer, in press). In order to successfully maintain a behavior, however, maintenance self-efficacy is assumed to be crucial. It is defined as the perceived ability of maintaining a health behavior in the face of barriers and obstacles. Moreover, when lapses occur, recovery self-efficacy comes into play. It refers to one’s confidence in his or her ability to return to regular physical activity after having lapsed to old habits.

Phase-Specific Self-Efficacy Beliefs

The role of self-efficacy beliefs has been a target of several studies concerned with health behavior change in cardiac rehabilitation. In cardiac samples, it has been found that greater exercise self-efficacy is related to higher compliance with exercise programs (Ewart, 1995). Moreover, several studies address the change of a specific
self-efficacy during rehabilitation and its relationships to subsequent outcomes, such as exercise or dieting behavior (Cheng & Boey, 2002; Evan & Burns, 2004). The results indicate that self-efficacy increases over the course of the rehabilitation and that this is positively associated with subsequent health behavior change. Applying a cross-lagged design, Evan and Burns (2004) found implications for a causal effect of exercise self-efficacy on increase in subsequent exercise behavior.

The results of these studies have been acknowledged by the American Association of Cardiovascular and Pulmonary Rehabilitation (2004), which includes self-efficacy beliefs in its guidelines for cardiac rehabilitation as a crucial pathway in the promotion of behavior change. However, there are also studies that did not find any relationship between exercise self-efficacy and attendance at cardiac rehabilitation programs, intentions to exercise (Bray & Cowan, 2004), or exercise adherence in cardiac rehabilitation patients (Jeng & Braun, 1997). Most of the studies on the role of self-efficacy beliefs in cardiac rehabilitation, however, have only investigated one kind of exercise self-efficacy in predicting health behavior change.

The rationale for the distinction between several phase-specific self-efficacy beliefs, as is done in the HAPA model, is that during the course of health behavior change, different tasks must be mastered and it takes different self-efficacy beliefs to master them successfully. For example, a person might be confident in his or her ability to be physically active in general (i.e., high task self-efficacy), but not very confident about maintaining physical activity on a long-term basis (low maintenance self-efficacy). In the case of a lapse, it is most important to be confident about one’s ability to return to the intended physical activity (i.e., high recovery self-efficacy).

The concept of phase-specific self-efficacy has been put forth by Marlatt, Baer, and Quigley (1995) in the domain of addictive behaviors. They distinguished between three phase-specific self-efficacy beliefs: action self-efficacy, coping self-efficacy, and recovery self-efficacy. These correspond closely to task self-efficacy, maintenance self-efficacy, and recovery self-efficacy of the present study. For the present study, however, we chose the terminology of the HAPA model. This distinction between the three phase-specific self-efficacy beliefs has proven useful in the domain of addictive behavior change (cf. Marlatt et al., 1995). A similar distinction between phase-specific self-efficacy beliefs was introduced by Rodgers and colleagues (Rodgers & Sullivan, 2001; Rodgers, Hall, Blanchard, McAuley, & Munroe, 2002). These researchers also found evidence for distinguishing between three different self-efficacy beliefs in the domain of exercise behavior: task self-efficacy, coping self-efficacy, and scheduling self-efficacy.

Likewise, Blanchard, Rodgers, Courneya, Daub, and Knapi (2002) distinguished between task self-efficacy and barrier self-efficacy. Both of these self-efficacy beliefs resulted in different prediction patterns for exercise adherence during and after cardiac rehabilitation. In studies applying the HAPA model, task self-efficacy and maintenance self-efficacy differed in their effects on preventive nutrition (eating a low-fat and high-fiber diet) and on corresponding intentions (Schwarzer & Renner, 2000). Task self-efficacy emerged as a significant predictor of intentions, whereas maintenance self-efficacy contributed to the prediction of eating a low-fat and high-fiber diet. In a study on breast self-examination, Luszczynska and Schwarzer (2003) found task self-efficacy to be predictive of intentions and action planning, whereas maintenance self-efficacy and recovery self-efficacy
beliefs were predictive of breast self-examination 3 months later. Similar results were found for physical exercise. Task self-efficacy was predictive of intentions while maintenance self-efficacy predicted action planning and physical exercise (Sniehotta, Scholz, & Schwarzer, in press). Overall, research on phase-specific self-efficacy beliefs underlines the usefulness of the distinctions made.

**Purpose of the Present Study**

Previous research focused on the main effects of phase-specific self-efficacy beliefs on intentions and behavior. Former studies assumed implicitly that all persons were in the same phase of the behavior change process. The HAPA suggests, however, that we also need to take the phases of behavioral change into account. The effects of phase-specific self-efficacy beliefs are assumed to be moderated by the phase that individuals are in. For example, in the case of cardiac rehabilitation patients, some of them might still have to initiate their regular physical exercise whereas others have already been regularly active for a longer period and thus face the problems specific to maintaining their exercise program. Likewise, persons who had to take a break from their usual exercise regimen due to health constraints face the problems of returning to regular physical exercise, and thus have to cope with different challenges than those who were exercising continuously.

Phase-specific self-efficacy beliefs are needed to master these different challenges successfully. A person who is confident about being able to maintain a behavior (high maintenance self-efficacy), but has not yet initiated the behavior, might not profit as much from this high maintenance self-efficacy in terms of his or her behavioral change. Likewise, high recovery self-efficacy is most beneficial for someone who has to resume a behavior after a lapse or a break, but not for someone who successfully maintains the behavior.

The purpose of the present study was to examine the role of phase-specific self-efficacy beliefs on change in physical exercise by taking into account the moderating role of the different phases individuals are in during their health behavior change. The hypotheses are:

1. Task self-efficacy, risk awareness, and outcome expectancies jointly predict intentions. Furthermore, comparing task self-efficacy to maintenance self-efficacy and recovery self-efficacy, it is hypothesized that task self-efficacy is the strongest predictor of intentions but will have no effect on behavior change.

2. Maintenance self-efficacy assessed during rehabilitation is more predictive for persons who have already been physically active prior to the CHD treatment, and can thus be seen as maintainers, than for formerly inactive persons. Two months after discharge, most patients are assumed to be in the maintenance phase regardless of their exercise levels prior to treatment. Thus it is hypothesized that the effect of maintenance self-efficacy on changes in exercise is no longer dependent on past physical exercise.

3. Recovery self-efficacy plays a major role in a later stage when lapses occur. Therefore it is hypothesized that recovery self-efficacy, assessed at 4 months after discharge, is an important predictor of physical exercise 12 months after discharge. This effect is assumed to be especially strong for patients who had interrupted their physical exercise for a certain period of time during the first 4 months after discharge due to health constraints, and thus are about to resume their exercise program.
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Method

Sample and Procedure

Participants of the present study were 484 CHD patients who participated in a 3-week in-patient rehabilitation program in one of three rehabilitation centers. Patients entered this kind of in-patient rehabilitation program directly after being hospitalized for acute coronary care. The German cardiac in-patient rehabilitation is a comprehensive somatic and psychoeducational treatment that aims at restoring and subsequently maintaining the physical and mental health of the patients (Dietz & Rauch, 2003). The treatment includes, for example, exercise courses 5 days a week, educational courses on preventing risk factors for CHD, stress management courses, and support regarding occupational rehabilitation.

All participants of the present study had the medical recommendation for regular exercise. Each one signed an informed consent form and was given a personal code to match the data of the questionnaires so as to ensure anonymity. Participants were assured that all personal data would be kept confidential and were informed that participation in the study was voluntary and unpaid.

All participants filled out the first questionnaire during the 2nd week of their 3-week stay in the rehabilitation center. Follow-up questionnaires were sent to them 2 and 4 months after discharge. The Time 2 follow-up questionnaire was returned by 395 (81.6%) participants; the Time 3 questionnaire was completed and returned by 354 (73.1%) participants. Afterward, participants were asked whether they would be willing to complete another questionnaire 12 months after discharge (Time 4). Of the 354 participants, 246 (69.5%) agreed, and of those, 211 (85.8%) completed and returned the Time 4 questionnaire.

Mean age of the participants was 59 years (SD = 10.02), with the youngest person being 31 years of age and the oldest being 86 years. Of the initial 484 patients, 382 participants (78.9%) were men. The majority of participants were married or living with a partner (371 = 76.7%), 44 persons (9.1%) were divorced, 36 (7.4%) were single, 24 (5.0%) were widowed, and 9 persons (1.9%) did not indicate their marital status. Most of the participants reported a maximum of 9 years of school education (n = 149; 30.8%), 96 participants (19.8%) had 10 years of schooling, 115 (23.8%) had 12 years, 100 (20.7%) had 13 years of schooling, and 24 persons (5%) did not report their years of schooling. Approximately half of the sample was currently employed (n = 246; 50.8%).

Dropout analyses revealed that there were significant differences on baseline measures between dropouts and persons who completed all four questionnaires. Dropouts reported lower intentions at T1, F(1, 482) = 7.38, p < .05; lower task self-efficacy, F(1, 482) = 6.25, p < .05; and lower action planning, F(1, 482) = 5.99, p < .05. Furthermore, we tested whether there were differential effects for the three rehabilitation clinics. No significant differences on the relevant variables emerged at any measurement point in time between patients of the three rehabilitation centers.

Measures

At Time 1 the baseline measures of all constructs were assessed. At Time 2, maintenance self-efficacy along with action planning were assessed. At Time 3, recovery self-efficacy and physical exercise were assessed as well as whether or
not participants had to take a health related break from their physical exercise. At Time 4, physical exercise was assessed again. All item examples below are translations from German. Unless otherwise stated, all measures were assessed using the same instruments as Sniehotta, Scholz, and Schwarzer (in press), and all items had a response range from 1 = “not at all true” to 4 = “exactly true.”

Risk Awareness. Risk awareness was measured at T1 by three items assessing vulnerability to coronary health problems with the stem “If I keep my lifestyle the way it was prior to the acute treatment….” followed by three statements concerning probable future coronary events and coronary health problems, such as, “I will suffer from coronary health problems.” The sample mean was 3.09 (SD = .83) with an internal consistency of Cronbach’s α = .79.

Outcome Expectancies. Outcome expectancies regarding behavior change were assessed at T1 with eight items. All items had the stem “If I will exercise on a regular basis…” followed by positive consequences such as “then I will feel balanced in my daily life,” or “it will be good for my blood pressure.” The sample mean was 3.48 (SD = .45) with an internal consistency of Cronbach’s α = .92.

Task Self-Efficacy. Task self-efficacy was assessed by three items, for example, “I am confident that I can adjust my life to a physically active lifestyle,” or “I am confident that I can be physically active at least three times a week for 30 minutes.” Cronbach’s α of task self-efficacy was .75. The sample mean was 3.23 (SD = .65).

Behavioral Intentions. Behavioral intentions were measured by six items at T1 for the time after discharge from the rehabilitation center. The stem “I intend to…” was followed by the recommended activities, for example, “be physically active on a regular basis for a minimum of 20 minutes at least three times a week.” The sample mean of behavioral intentions was 3.40 (SD = .55) and Cronbach’s α = .82.

Action Planning. Action planning was assessed at T1 and T2 by four items. The item stem “I have made a detailed plan regarding…” was followed by the items (a) “when to do my physical exercise,” (b) “where to exercise,” (c) “how to do my physical exercise,” and (d) “how often to do my physical exercise.” Time 1 action planning had a sample mean of 3.06 (SD = .97) and Cronbach’s α = .92. Time 2 action planning had a sample mean of 3.21 (SD = .89) and an internal consistency of Cronbach’s α = .94.

Maintenance Self-Efficacy. Maintenance self-efficacy was assessed at T1 and T2 with the following introduction: “After having started engaging in physical activity, it is important to maintain this behavior on a long-term basis. How confident are you that you will succeed in doing so?” The item stem “I am confident to engage in physical activity regularly on a long-term basis…” was followed by four items concerning typical barriers that may hamper the maintenance of the behavior, such as, “even if I cannot see any positive changes immediately,” or “even if I am together with friends and relatives who are not physically active.” Time 1 maintenance self-efficacy had a sample mean of 3.06 (SD = .66) and Cronbach’s α = .73. Time 2 maintenance self-efficacy had a sample mean of 3.08 (SD = .64) and Cronbach’s α = .75.

Recovery Self-Efficacy. Recovery self-efficacy was assessed at baseline and at Time 3, as it is assumed that recovering from lapses occurs later in the health behavior change process. Items were measured in accordance with Luszczynska
and Schwarzer (2003): “Despite the best intentions, minor or major setbacks may occur. Please imagine, you had taken a break from being physically active. How confident are you that you can return to being physically active on a regular basis after having taken a break?” The item stem “I am confident that I can return to a physically active lifestyle...” was followed by three items concerning the ability to resume the behavior after taking a break, such as, “even if I have relapsed several times,” or “even if I have relapsed for several weeks.” Time 1 recovery self-efficacy had a sample mean of 3.07 (SD = .81) and Cronbach’s α = .85. Time 3 recovery self-efficacy had a sample mean of 3.14 (SD = .88) and an internal consistency of Cronbach’s α = .93.

A Health-Related Break From Physical Exercise. Having to take a health related break from physical exercise was the indicator for being in the recovery phase. It was assessed at Time 3 and operationalized by two questions. First, participants were asked if they had to take a break from their regular physical exercise due to health related problems. The response format was dichotomous (0 = no, 1 = yes). A “yes” answer was validated by asking participants the specific reason for their break and how many days it lasted. Only the responses of those who gave a reason and a time period were rated as valid. Overall, 33% of the participants reported that at some point between discharge and Time 3 measurement they had to take a health related break from exercise.

Past Physical Exercise. Past physical exercise was the indicator for maintaining physical exercise at Time 1, because formerly active patients did not have to go through the process of initiating a physical exercise program after discharge from the rehabilitation center, but instead could continue with their regular physical exercise. For assessment of past exercise behavior, participants were asked how often per week, prior to their CHD event, they had engaged in (a) vigorous exercise (e.g., swimming), (b) fitness activities (e.g., gymnastics), or (c) moderate exercise to train muscle strength. These frequencies were aggregated to a sum score. Overall, only 24.6% of participants had been active at least once a week before their acute CHD event. The sample mean for past physical exercise was .49 (SD = .85).

Assessment of Current Physical Exercise. For assessment of current physical exercise at Time 3 and Time 4, participants were asked how often per week during the past 4 weeks they engaged on average in (a) vigorous exercise (e.g., swimming), (b) fitness activities (e.g., gymnastics), (c) moderate exercise to train muscle strength, or (d) activities that equaled the exertion of their rehabilitation exercise program. These frequencies were aggregated to a sum score. The sample mean of current physical exercise at Time 3 was 1.59 (SD = 1.28). At Time 4 the mean was 1.49 (SD = 1.34).

Data Analyses

In most longitudinal studies there occurs the problem of missing data. Complete deletion of persons with missing values is only appropriate when the missing pattern meets the assumption of missing completely at random (MCAR) (Little & Rubin, 2002). Missing completely at random means the dropout is a random subsample of the study sample without any systematic association between missing values and observed values. Since dropout analyses of the present study have shown that the missing pattern is missing at random (MAR), which means the probability of missing values depends on the observed values, listwise deletion would not be
the appropriate way to handle missing data. Therefore, missing values were estimated using the Multiple Imputations method (Schafer & Graham, 2002) employing NORM 2.03 (Schafer, 1999). Multiple imputation (MI) is a Monte Carlo technique that takes the missing-data uncertainty into account by generating multiple values for one missing observation in the form of generating multiple datasets. Each data set is analyzed separately. Results are then integrated following a method suggested by Rubin (1987) to obtain overall estimates and standard errors. Unlike alternative single imputation methods, multiple imputation has the advantage of reflecting the uncertainty of missing data by the between-imputation variance (Schafer & Graham, 2002). For the present study we generated five data bases.

To examine the factor structure of the three phase-specific self-efficacy beliefs, we conducted confirmatory factor analysis using Amos 5 (Arbuckle & Wothke, 1999). The model fit was assessed by examining the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the Tucker Lewis Index (TLI). A satisfactory model fit is indicated by high CFI and TLI (>.90) and low RMSEA (<.08; Tabachnick & Fidell, 2001). Another minimum sample discrepancy function, the \( \chi^2/df \) ratio, is suggested as being a useful criterion. Bollen and Long (1993) suggest a \( \chi^2 \) not larger than 2.5 times the degrees of freedom as a criterion for acceptable fit. To test whether a one-factor structure fitted the data better than the hypothesized three-factor model, we employed a nested-model comparison (Maruyama, 1998). Both models were compared by the \( \chi^2 \) difference test, whereby a significant \( \chi^2 \) difference indicates that the more restricted model (in this case the one-factor model) should not represent the data better than the less restricted model (i.e., the three-factor model).

For testing interaction effects, we employed multiple regression analyses. To avoid problems with multicollinearity, we centered the variables that built the interaction term (Aiken & West, 1991). The dichotomous moderator, taking a health related break from activity, remained uncentered. To display the interaction effects, we applied the method of simple slope analysis (Aiken & West, 1991). Low and high values of past physical exercise as the continuous moderator were generated by adding or subtracting one standard deviation from the centered mean of the moderator. The low and high values of the dichotomous moderator were 0 and 1.

Results

Descriptive Findings

Intentions at Time 1 were high \( M = 3.4, SD = .55 \), on a scale ranging from 1 to 4, with 90.7% of the participants having a mean score of intentions above 2.5. This shows that the majority of participants indeed intended to become physically active after discharge and is in line with previous research (e.g., Blanchard, Corneya, Rodgers, Daub, & Knapik, 2002).

In terms of physical exercise, only 24.6% of participants had been active at least once a week before their acute CHD event, whereas 4 months after discharge 77.27% had been active at least once a week, and 12 months after discharge 72.36% had been active at least once a week. This demonstrates that after discharge from rehabilitation, the majority engaged in physical exercise at least once a week.

A confirmatory factor analysis was conducted using Amos 5 (Arbuckle & Wothke, 1999) to examine the factor structure of the three phase-specific self-efficacy beliefs at Time 1. The fit of this three-factor model was satisfactory: TLI = .93,
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CFI = .95, RMSEA = .076, $\chi^2/df = 2.08$, $\chi^2 = 121.97$, $df = 33$, $p < .001$. Additionally, a model comparison was specified to test whether a one-factor structure fitted the data better than the hypothesized three-factor model. The result of this model comparison speaks clearly in favor of the three-factor model ($\Delta \chi^2 = 501.47$, $df = 3$, $p < .001$). Thus the three-factor structure can be assumed to represent the data appropriately. Furthermore, the latent correlations between the three phase-specific self-efficacies were medium, indicating a moderate overlap. Task self-efficacy at T1 correlated with maintenance self-efficacy at T1 with $r = .46$, $p < .001$, and with recovery self-efficacy at T1 with $r = .38$, $p < .001$. Maintenance self-efficacy at T1 correlated with recovery self-efficacy at T1 with $r = .41$, $p < .001$. Thus there is discriminant validity among the three concepts.

Predicting Intentions

To examine whether task self-efficacy, outcome expectancies, and risk awareness predict behavioral intentions as assumed by the HAPA, and to test for the discriminant predictive validity of the three phase-specific self-efficacy beliefs, we conducted a linear regression analysis. Task self-efficacy was the strongest predictor of intentions (see Table 1). Risk awareness and outcome expectancies contributed significantly to the prediction of intentions which is in line with Hypothesis 1. Unexpectedly, recovery self-efficacy was also significantly associated with intentions, although with a small effect only. Thus, Hypothesis 1 can be partly confirmed.

Table 1 Linear Regression of Intention at Time 1

<table>
<thead>
<tr>
<th>Predictor</th>
<th>$\beta$</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk awareness</td>
<td>.09*</td>
<td></td>
</tr>
<tr>
<td>Positive outcome expectancies</td>
<td>.20**</td>
<td></td>
</tr>
<tr>
<td>Task self-efficacy</td>
<td>.47**</td>
<td></td>
</tr>
<tr>
<td>Maintenance self-efficacy</td>
<td>.07</td>
<td></td>
</tr>
<tr>
<td>Recovery self-efficacy</td>
<td>.11*</td>
<td>.47</td>
</tr>
</tbody>
</table>

Note: *$p < .05$; **$p < .01$

Predicting Exercise Behavior

To examine the effects of phase-specific self-efficacy beliefs and other HAPA variables on physical exercise at T3, and to test for the hypothesized interaction effect between maintenance self-efficacy at T1 and past physical exercise (as an indicator for being in the maintenance phase), we conducted a hierarchical regression analysis. The independent variables were entered in two blocks: (Step 1) past physical exercise and baseline measures of task self-efficacy, intentions, action planning, maintenance self-efficacy, recovery self-efficacy; and (Step 2) the interaction term between maintenance self-efficacy and past physical exercise. Results showed that past physical exercise, action planning, and maintenance self-efficacy significantly predicted physical exercise at T3, whereas no effects were found for task self-efficacy, intentions, and recovery self-efficacy (see Table 2).
Furthermore, the effect of maintenance self-efficacy on physical exercise at T3 was moderated by past physical exercise. Persons who had already been active before their acute cardiac event, and were thus facing maintenance of their exercise regimen, benefited more from their maintenance self-efficacy in terms of their physical exercise 4 months after discharge than those who had not been active before. Figure 1 displays the interaction effect.

It was expected that the interaction term between past physical exercise and maintenance self-efficacy assessed at T2 would no longer be significant, as most persons had initiated the behavior change after discharge and thus were in the maintenance phase at Time 2. To analyze this, we conducted a second hierarchical regression analysis. Again, the independent variables were entered in two blocks to predict physical exercise at T3: (Step 1) past physical exercise, task self-efficacy at T1, intentions at T1, maintenance self-efficacy at T2, action planning at T2, and recovery self-efficacy at T3; and (Step 2) the interaction term between past physical exercise and maintenance self-efficacy at T2. As expected, maintenance self-efficacy at T2 was a significant predictor of physical exercise at T3, as well as past exercise behavior and T2 action planning. The interaction between past behavior and maintenance self-efficacy at T2 was no longer significant. Together with the results of the first hierarchical regression analysis, this supports Hypothesis 2 that maintenance self-efficacy is a crucial resource in the maintenance phase. Regression weights are listed in Table 3.

The role of recovery self-efficacy was examined by analyzing the effects of recovery self-efficacy at T3, together with the occurrence of a health related break from activity within the first 4 months after discharge, on physical exercise at T4. It was assumed that recovery self-efficacy displays the strongest effect on behavior when individuals need high confidence in recovering from lapses, such as when having to take a health related break from activity. A hierarchical regression analysis was conducted with past physical exercise, task self-efficacy at T1, intentions at T1, action planning at T2, maintenance self-efficacy at T2, recovery self-efficacy at T3, and occurrence of health related breaks between T1 and T3 in the first step. In the second step the interaction term between the occurrence

Table 2 Hierarchical Linear Regression of Physical Exercise at Time 3 on T1 Variables and Interaction Between Past Exercise and T1 Maintenance Self-Efficacy

<table>
<thead>
<tr>
<th>Predictor</th>
<th>β Step 1</th>
<th>β Step 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Past physical exercise at T1</td>
<td>0.26**</td>
<td>0.24*</td>
</tr>
<tr>
<td>Task self-efficacy at T1</td>
<td>0.03</td>
<td>0.05</td>
</tr>
<tr>
<td>Intentions at T1</td>
<td>−0.01</td>
<td>−0.00</td>
</tr>
<tr>
<td>Action planning at T1</td>
<td>0.19*</td>
<td>0.20*</td>
</tr>
<tr>
<td>Maintenance self-efficacy at T1</td>
<td>0.14*</td>
<td>0.12*</td>
</tr>
<tr>
<td>Recovery self-efficacy at T1</td>
<td>−0.09</td>
<td>−0.09</td>
</tr>
<tr>
<td>Past exercise × Maintenance self-efficacy</td>
<td>0.11*</td>
<td></td>
</tr>
<tr>
<td>( R^2 )</td>
<td>.17**</td>
<td>.18**</td>
</tr>
</tbody>
</table>

*\( p < .05; **p < .01 \)
of health related breaks and recovery self-efficacy at T3 was entered. Regression weights are listed in Table 4.

Maintenance self-efficacy significantly predicted physical exercise 12 months after discharge, whereas no significant effects were found for past physical exercise, intentions, action planning, or recovery self-efficacy at T3 on physical exercise at T4. Nevertheless, a significant interaction emerged between recovery self-efficacy and the occurrence of health related breaks from activity during the first 4 months after discharge (see Figure 2).
Table 4  Hierarchical Linear Regression of Physical Exercise at Time 4 on T1, T2, and T3 Variables and Interaction Between Health Related Lapse and T3 Recovery Self-Efficacy

<table>
<thead>
<tr>
<th>Predictor</th>
<th>β Step 1</th>
<th>β Step 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Past physical exercise</td>
<td>0.11</td>
<td>0.11</td>
</tr>
<tr>
<td>Task self-efficacy at T1</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>Intentions at T1</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td>Action planning at T2</td>
<td>0.08</td>
<td>0.07</td>
</tr>
<tr>
<td>Maintenance self-efficacy at T2</td>
<td>0.20*</td>
<td>0.19*</td>
</tr>
<tr>
<td>Recovery self-efficacy at T3</td>
<td>0.00</td>
<td>-0.06</td>
</tr>
<tr>
<td>Health-related lapse</td>
<td>0.03</td>
<td>0.02</td>
</tr>
<tr>
<td>Health-related lapse * Recovery self-efficacy T3</td>
<td></td>
<td>0.12*</td>
</tr>
<tr>
<td>$R^2$</td>
<td></td>
<td>.20**</td>
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<td>.21**</td>
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*$p < .05; **p < .01$

Figure 2 — Interaction between recovery self-efficacy at T3 and occurrence of health related break from activity.

Only the participants who had to take a break from physical exercise due to health constraints benefited from their recovery self-efficacy in terms of physical exercise at T4, whereas recovery self-efficacy did not influence physical exercise in those who had continuously exercised throughout these months. These results confirm Hypothesis 3 and suggest that resuming physical exercise after having paused demands different self-regulatory skills than initiating or maintaining behavioral change. Recovery self-efficacy seems to be a useful cognitive resource for mastering such demands.
**Discussion**

The present study provides further evidence for assuming that health behavior change includes different phases that need to be mastered in different ways. While people pass through these different phases of behavior change, they first need the necessary levels of task self-efficacy to form an intention to act, and later they need firm beliefs in their ability to maintain their physical exercise. If they have to interrupt their newly adopted exercise program for a while, they need an optimistic belief in being able to resume their physical exercise. In part the present study replicates previous findings (e.g., Luszczynska & Schwarzer, 2003; Sniehotta, Scholz, & Schwarzer, in press) in terms of different prediction patterns of the three phase-specific self-efficacy beliefs. However, there are also important differences from previous research on phase-specific self-efficacy, and from the existing research on exercise self-efficacy and exercise behavior in cardiac rehabilitation (e.g., Ewart, 1995).

The present study explicitly tested the moderating role of the phase a person is in during behavioral change. The results speak in favor of doing so, as it is then possible not only to gain a better prediction pattern but also to develop interventions that are tailored to the needs of the person and may thus be more effective in terms of behavior change. Furthermore, there were several studies that did not find any effects of exercise self-efficacy on behavior change in cardiac rehabilitation patients (e.g., Bray & Cowan, 2004; Jeng & Braun, 1997). It might be that the inclusion of phase-specific self-efficacy and the consideration of different phases of behavior change as possible moderators would have yielded different results. In the present study, for example, there was no main effect for recovery self-efficacy. High recovery self-efficacy, however, was crucial for persons who had to take a break from their regular exercise program.

Furthermore, there is some overlap between the phase-specific self-efficacy beliefs of this study and other types of self-efficacy in the literature on self-efficacy. For example, Maddux (1995) introduced barrier self-efficacy as a person’s confidence in his or her ability to perform a behavior under challenging conditions. This is similar to the maintenance self-efficacy in the present study. However, there are also important differences between these two concepts. Maintenance self-efficacy aims especially at a person’s confidence about maintaining a certain behavior under challenging conditions. Barrier self-efficacy, by contrast, may also address a person’s optimistic belief about performing a behavior once under challenging conditions. The term barrier self-efficacy is actually redundant because self-efficacy only exists in the face of barriers or difficulties.

Intentions were predicted by task self-efficacy, risk awareness, and outcome expectancies as specified by the HAPA model. This replicates findings from research on preventive nutrition (e.g., Schwarzer & Renner, 2000). Maintenance self-efficacy did not predict behavioral intentions. This is in line with the assumptions. Unexpectedly, recovery self-efficacy contributed significantly to the prediction of intentions, albeit only with a small effect. This might be due to former experience with the recovery from lapses. Persons who were unsuccessful in recovering from lapses and thus fell back into old habits might have a low recovery self-efficacy. This in turn might prevent them from forming an intention, whereas being confident in one’s ability to recover from a lapse might be helpful for intention formation. The result that postintentional variables might influence behavioral intentions should be focused upon more closely in future research.
Intentions did not significantly contribute to the prediction of physical exercise at T3 and T4. However, this is in line with results of a study by Johnston and colleagues (2004) with cardiac patients. They found no association between behavioral intentions and smoking cessation or physical exercise at 12 months follow-up. These results underline the need for including postintentional variables to gain a sufficient prediction of health behavior change.

Action planning was an important predictor of physical exercise at T3 but did not show a significant effect on physical exercise 12 months after discharge. This corresponds to previous findings (Sniehotta, Schwarzer, Scholz, & Schütz, in press), where action planning seemed especially important in initiating physical exercise, but for the long-term maintenance of behavioral change, different predictors emerged. In the present study this was maintenance self-efficacy. As expected, T1 maintenance self-efficacy was more strongly related to physical exercise at T3 for those who had been physically active before and were thus assumed to be already in the maintenance phase. Maintenance self-efficacy was predictive for the majority of persons 2 months after discharge, when participants had initiated their physical exercise programs and thus were no longer in the initiation but already in the maintenance phase. This underlines the moderating role of the phase a person is currently in while changing his or her health behaviors. Enhancing maintenance self-efficacy in those who still have to initiate the behavior change would be less effective for change in physical exercise than enhancing maintenance self-efficacy in those who must already master the specific demands of maintaining a behavior.

Recovery self-efficacy did not contribute to the prediction of change in physical exercise for the entire sample. However, persons who had to deal with a health related interruption of their physical exercise benefited. When coping with a health related break from activity during the first 4 months after discharge, individuals with high recovery self-efficacy improved their physical exercise levels 12 months after discharge. Considering that one-third of the patients took a health related break from activity within the first 4 months after discharge, this finding is relevant for the rehabilitation of CHD because these patients need tailored interventions to foster their recovery self-efficacy so as to prevent them from relapsing into their old habits.

There are several limitations of the present study. First, behavioral outcomes were assessed by self-reports. Some studies, however, indicate that self-report measures of physical exercise behavior are valid (Ainsworth, Sternfeld, Richardson, & Jackson, 2000; Bernstein, Sloutskis, Kumanyika, et al., 1998) and objective measures, and self-report measures have shown comparable results (Johnston et al., 2004). Second, in the present study, having to take a health related break from activity was the indicator for being in the recovery phase. Lapses due to failure in self-regulatory skills were not assessed. Although the results show that in the case of a health related break from activity, high recovery self-efficacy was helpful for resuming physical exercise, these results should be replicated with indicators for lapses due to poor self-regulation.

Results of the present study bear some implications for interventions. Taking into account that individuals—although being in the same setting, such as cardiac rehabilitation—are not necessarily in the same phase of the behavior-change process, interventions should be tailored to the (phase-)specific needs of those persons to be most effective. Thus it is necessary to assess in which phase of the behavior change a client is in. A person in the maintenance phase would benefit most from an intervention that applies, for example, role-playing skills to defeat possible impedi-
ments during behavior maintenance. By actively practicing how to overcome such difficulties, one can enhance his or her maintenance self-efficacy.

References


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