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Research article

Putting psychology into telerehabilitation: Coping planning as an example for how to integrate behavior change techniques into clinical practice

Lena Fleig[1,*], Maureen C. Ashe[2,3,4], Jan Keller[5], Sonia Lippke[6] and Ralf Schwarzer[5,7]

[1] Department of Natural Sciences, Health Psychology, Medical School Berlin, Berlin, Germany
[2] Center for Hip Health and Mobility, Vancouver, Canada
[3] Department of Family Practice, The University of British Columbia, Vancouver, Canada
[4] School of Psychology, The University of Adelaide, South Australia, Adelaide, Australia
[5] Department of Education and Psychology, Health Psychology, Freie Universität Berlin, Berlin, Germany
[6] Department of Psychology & Methods, Health Psychology and Behavioral Medicine, Jacobs University Bremen, Bremen, Germany
[7] SWPS University of Social Sciences and Humanities, Wroclaw, Poland

* **Correspondence:** Email: lena.fleig@medicalschool-berlin.de; Tel: +4930-76683758-16; Fax: +49307668375369.

Abstract: *Background:* Behavioral interventions based on psychological theory can facilitate continued recovery after discharge from cardiac or orthopedic rehabilitation. For example, health professionals can encourage patients to engage in coping planning to support the maintenance of physical activity. Telephone-based interviews or web-based interventions are two promising delivery modes to provide such after-care services from a distance (telerehabilitation). However, previous evaluations of such behavioral interventions lack a detailed description of the specific content, and its connection to psychosocial antecedents and health outcomes. Therefore, the primary aim of this study was to (i) describe the content of user-specified coping plans. Second, we aimed to identify (ii) coping plan characteristics associated with health outcomes post-rehabilitation and (iii) socio-demographic and psychosocial variables associated with coping plan characteristics. *Methods:* This was a secondary analysis from a larger behavioral intervention study, using remote delivery modes, within orthopedic and cardiac rehabilitation. Two raters evaluated the content, quality and number of coping plans from 231 participants. Physical activity and quality of life (health outcomes) were measured via self-reports at the end of rehabilitation and six months after discharge. We used linear regression analyses to examine the relationship between plan characteristics and health outcomes. *Results:* Content analyses of participants' coping plans emphasized that physical barriers such as

pain or other health limitations presented major obstacles for engagement in physical activity post-rehabilitation. The most frequently identified external barriers to physical activity were workload, family obligations or bad weather. There was a statistically significant difference in quality of life and physical activity for participants who formulated highly instrumental coping plans (higher quality of life and activity) compared with participants with coping plans of lower quality (lower quality of life and activity). The number of plans (quantity) was not related with outcomes. *Conclusion:* Generating coping plans can be a useful theory-based approach for inclusion in telerehabilitation to facilitate the maintenance of physical activity and quality of life. It is important to encourage adults and older adults to engage in coping planning and, specifically, to formulate strategies that support tenacious plan pursuit.

Keywords: behavior change theory; coping planning; physical activity; intervention fidelity; rehabilitation after-care; plan content; number of plans

1. Introduction

Health behavior management is essential for preventing and managing chronic diseases such as coronary heart disease or after musculoskeletal trauma [1]. In particular, engaging in regular physical activity is an important element throughout the rehabilitation process, including post-discharge [2]. Clinical interventions that incorporate psychosocial factors and adopt a guiding behavior change theory can facilitate continued physical activity after discharge [2,3]. For example, health care professionals can prompt rehabilitation patients to identify barriers interfering with their post-rehabilitation physical activity plans (e.g., physical discomfort) and encourage them to develop effective strategies [4,5]. Using this example of coping planning, the present study aims to illustrate how telerehabilitation may benefit from using psychological behavior change theory to optimize post-rehabilitation care.

1.1. Telerehabilitation meets health psychology: Implementing theory-based principles of behavior change to maintain rehabilitation outcomes

Theory of behavior change may be useful for guiding the development and evaluation of rehabilitation interventions [6–8]. In particular, theories on behavior maintenance such as the health action process approach (HAPA; [9]) or Rothman's framework of behavioral maintenance [10], may guide interventions aimed to engage individuals in sustained health behavior beyond supervised treatment. In a review, Kwasnicka et al. [11] identified coping with behavioral barriers as one of the key psychological processes to explain maintenance of health-related behaviors. *Coping plans* are a key component of the HAPA and refer to self-regulatory strategies consisting of two components: The anticipated barrier and the approach to overcome it. Coping plans are assumed to help individuals create a mental link between the anticipated barrier (e.g., bad weather) and suitable behavioral strategies (e.g., exercise indoors) thereby inhibiting distractions and decreasing the likelihood of relapse (e.g., [2,4]). As an effective strategy, individuals may vary their initial plan in terms of situational cues (e.g., different time, context) or in terms of their behavioral response (e.g., different type of physical activity). Following an if-then structure (i.e., if barrier x, then response y),

coping plans can be understood as implementation intentions [12]. Coping planning, the actual use of coping plans as a self-regulatory strategy, is an alterable variable and can be easily communicated [13]. In rehabilitation, for instance, coping planning can be implemented without the need of face-to-face contact with health care professionals. With the guidance of an interactive web-based program, individuals can initially brainstorm potential barriers to home-based physical activity and enter them in a web-based form. In a second step, individuals may choose those barriers that are most meaningful for them. Finally, they can be encouraged to generate and write down effective strategies, either self-identified or selected from a list, to cope with their barriers. In a web-based environment, strategy development can be easily supported by providing tailored examples (e.g., tailored to gender, age, medical indication etc.). Alternatively, health professionals can assist patients to formulate coping plans via means of computer-assisted telephone interviews, or telephone calls.

1.2. Evaluating coping planning interventions in rehabilitation care: What matters about coping plans?

Previous research yielded mixed findings regarding the efficacy of interventions using coping planning as a behavior change technique (BCT; [14]). Results of one systematic review [15] and one meta-analysis among non-clinical samples of older and younger adults [16], respectively, indicated that the inclusion of coping planning (in combination with other techniques) was associated with lower levels of both self-efficacy and physical activity in comparison to interventions that did not use coping planning. Similarly, intervention research on environmental behavior showed that complex interventions including coping planning may have adverse effects [17,18]. Conversely, a systematic review of randomized controlled trials that tested coping planning as a separate intervention module [19] found that the efficacy of interventions highly varied depending on the level of support provided during the formulation of coping plans. Higher level of support (e.g., telephone-assisted coping planning among older adults [20]; face-to-face, interviewer-assisted coping planning among middle-aged rehabilitation patients, [2]) resulted in a higher number of coping plans, and sustained physical activity [2,4,20] compared to self-administered coping planning.

Previous research (see e.g., [12]) on coping planning interventions is frequently based upon the implicit assumption that participants identify personally meaningful barriers and effective strategies to cope with those barriers. Although coping planning is usually implemented in a consistent manner (e.g., using written material or standardized interview), the content, quality and number of coping plans may highly vary. In other words, although the fidelity of intervention delivery may be very high, individuals may highly differ in how they receive a coping planning intervention [21] and how they enact coping planning skills in daily life [22], with the potential to affect health outcomes.

Other evidence highlights that among middle-aged adults a larger number of coping plans was associated with larger improvement in physical activity [23]. However, the content of behavior change techniques (BCTs) such as coping planning (e.g., type of barriers and type of strategies) has rarely been considered in evaluations, and especially within rehabilitation interventions [24]. To further develop and improve the efficacy of theory-based interventions, and specifically coping planning interventions, it is crucial to consider intervention content.

To close this research gap, the *first aim* of this study was to describe the content of physical activity-related coping plans generated at two different time points during recovery from a cardiac or orthopaedic health condition. To do so, this study investigated user-specified coping plans that

participants generated as part of a self-administered, web-based task at the end of rehabilitation (*early recovery phase*) and a subsequent computer-assisted telephone interview with a trained research assistant six weeks after rehabilitation (*late recovery phase*). As depicted in Figure 1, this study focussed on two different coping plan components: the *barriers* that participants anticipated would hinder them to engage in their intended behavior (i.e., if-part of coping plan) and the *strategies* that participants generated to overcome their barriers (i.e., then-part of coping plan). Besides plan content, we considered the number of coping plans (quantity) as an indicator of how individuals received the intervention. Our *second aim* was to examine the extent to which plan content and quantity contributed to subsequent health outcomes (i.e., physical activity and quality of life). The *third aim* of this study was to identify relevant psychosocial (e.g., self-efficacy, outcome expectancies, intention) and socio-demographic correlates (e.g., age, medical condition: orthopaedic vs. cardiac) of those coping plan characteristics that were linked to health-related rehabilitation outcomes. Finally, we explored whether there would be differences in coping plan content depending on the phase of recovery (early phase: at the end of rehabilitation, late recovery phase: 6 weeks after rehabilitation). The present study presents secondary analyses of an existing data set based on a larger behavioural rehabilitation intervention. Coping planning was only one of the BCTs used in the intervention, and the initial study did not evaluate the content of this single intervention module. Therefore, the present study further examines the characteristics, antecedents and consequences of coping plans for engagement in physical activity after cardiac or orthopaedic rehabilitation.

2. Materials and methods

2.1. Study context, research design and participants

This current study includes secondary analyses of data from a larger intervention trial [25,26] with 1,166 adults who participated in a medical rehabilitation program. Specifically, the FaBA study tested the effect of a psychological, computer-based delivery system on cardiac and orthopaedic patients' health and physical activity. Participants were German-speaking adults, aged ≥18 years, who were prescribed physical activity after discharge from rehabilitation. We provide details of participant recruitment elsewhere (*blinded for review*). For the present analyses, we only considered participants randomized to the intervention group, because participants randomized to the control group received standard rehabilitation treatment without any additional support for behavior change (i.e., no coping planning).

Briefly, 630 participants in the intervention group completed in-person, interviewer-assisted measurement sessions at the beginning of rehabilitation (Baseline, T0) via trained research assistants. Just prior to discharge from rehabilitation (Time 1, T1) 449 participants completed the web-based intervention including the coping planning module. We excluded participants from the present analyses were if they did not form any plans or only formed incomplete plans at T1 (i.e., specified a barrier but no strategy across all three plans). For the present analyses, 618 coping plans from 231 participants were considered for subsequent content analyses. Of these, 184 participants participated in the follow-up computer-assisted telephone interviews six weeks after discharge from rehabilitation (Time 2, T2). There were 158 participants who completed the 6-months follow-up (Time 3, T3) and were included in the longitudinal analyses. The Ethics Commission of the German Association of Psychology (DGPs) granted ethics approval for this study.

Participants received (i) usual clinical care, and (ii) access to a computer (T0, T1) and a telephone-based (T2) intervention aimed at promoting physical activity-related, self-regulatory strategies; self-efficacy, habit formation as well as behavior and health status. The present analyses focused on the coping planning module of the intervention. At the end of rehabilitation (T1, early recovery phase), participants could form up to three coping plans as part of the *self-administered, web-based task*. Initially, participants listed up to six barriers that might hinder their engagement in physical activity after discharge from rehabilitation. If participants did not fill in any barriers during the initial brain storming session, they were redirected to a page that prompted them to consider potential barriers to physical activity. For example, the webpage provided an image of a wristwatch (e.g., time as a barrier). Guided by the computer system, participants then selected their three most important self-generated barriers. For each of the identified barriers, participants generated a coping strategy (see Appendix A for screenshots of the barrier identification process). To support participants with the generation of effective strategies, the web-based system provided up to seven examples of useful strategies (e.g., mobilization of social support, visualization of goal, setting priorities). Participants could choose to skip the examples and directly proceed with entering their own plans. A trained research assistant was also present to assist participants in case of technical or content-related questions, and provided participants with a printed take-away summary of their plans. During the *computer-assisted telephone interview (late recovery phase)* six weeks after discharge (T2), participants could form up to two coping plans. In contrast to the self-administered task at T1, trained research assistants encouraged participants to think about particular barriers experienced since discharge (e.g., at work, at home). Following this, the interviewer guided participants to formulate specific strategies to overcome their most important barriers. Six months after discharge (T3), trained research assistants contacted participants via telephone to fill in another self-report questionnaire.

3. Measures

3.1. Behavior and quality of life (dependent variables)

Physical activity at baseline and at T3 was measured with a modified version of the Godin Leisure-Time Exercise Questionnaire [27,28]. Participants indicated how many sessions per week and how long per session, they performed vigorous and moderate physical activity. *Health-related quality of life* at T3 was measured with an adapted German version of the first item of the SF-8 (Short Form-8 Health Survey; [29]), "How would you rate your general health?" Responses were given on a 6-point scale from "very bad" (1) to "excellent" (6).

3.2. Predictors of coping plan characteristics (independent variables)

Intention to engage in regular physical activity after discharge was assessed at the end of participants' stay at the rehabilitation center (T1) using three items that asked participants to rate how much they intended to engage in mild, moderate, and vigorous physical activity [30]. The items started with *"I intend to perform the following activities at least three [two] days per week for 40 [20] minutes..."* (a) *"...strenuous (heart beats rapidly, sweating) physical activities;" (b) "...moderate (not exhausting, light perspiration) physical activities;"* and (c) *"...light (minimal effort, no*

perspiration) physical activity." Possible responses were on a 6-point scale from *"not at all true"* (1) to *"absolutely true"* (6). *Self-efficacy* to engage in regular physical activity after discharge was assessed at T1 with four items [28]. The item stem *"I am certain that I can be active on a regular basis..."* was followed by (a) *"...even if I have to motivate myself"*, (b) *"...even if it is difficult"*, (c) *"...even if it takes some time until it becomes a routine"*, and (d) *"...even if I need several attempts until I am successful."* Possible responses were on a 6-point scale from *"not at all true"* (1) to *"absolutely true"* (6). *Positive outcome expectancies* were assessed at T1 with a scale adapted from [9]. The stem *''If I was physically active I would expect that...''* was followed by five positive outcomes: (1) *''...it will have a positive impact on my health''*, (2)*''...I will feel better afterwards''*, (3) *''...I will feel more flexible afterwards''*, (4) *''...it will have a positive impact on my appearance''*, (5) *''...I will get to know other people.''* Response categories ranged from *''I totally disagree''* (1) to *''I totally agree''* (6). *Coping planning* was measured at T1 with two items, for example *"For the next month, I have already planned what to do if something interferes with my plans"* [4]. We assessed sex, age, and medical condition (orthopaedic vs. cardiac), and measured *severity of illness* with one item asking participants to what degree their illness interfered with their usual activities (e.g., work, leisure time, household). Possible responses were on a 6-point scale from *"strong impairment"* (1) to *"no impairment at all"* (6). We operationalized participants' *engagement* in the self-administered coping planning module as the number of strategy examples that participants clicked on during the intervention.

3.3. Coping plan characteristics

We used the Framework Method to analyse coping *plan content* [31]. One author (LF) and one independent rater (M.Sc. Psychology) individually familiarized themselves with participants' entries and developed a conceptual model with codes for each of the plan components. After coding the first few coping plans, raters compared their results, and agreed on a set of codes to apply to all subsequent coping plans. Each of the predefined plan categories (e.g., barriers) was further subdivided (e.g., physical barriers, barriers related to mood). Based on this working analytical framework, both raters independently coded coping plans generating a matrix in an Excel spreadsheet. The raters discussed the spreadsheets, compared and agreed upon coding allocations.

To measure the degree to which a coping strategy would help participants to engage in post-discharge physical activities, two independent raters assessed the instrumentality of coping plans. Raters assessed each coping plan strategy on a multiple-point scale, ranging from 4 *"very instrumental"* to 1 *"obstructive"*. Higher values indicated that a coping strategy supported the tenacious pursuit of the originally intended physical activity (e.g., make physical activity a priority) whereas lower values referred to strategies that were obstructive to plan pursuit (e.g., *"I can't do anything"*). The coding manual can be found at the end of this manuscript (see Table 4) and Appendix C. Inter-rater agreement was moderate (Cohen's k = 0.71). Raters solved disagreements through discussions.

Each rater calculated the *number of generated coping plans* independently, and confirmed the total amount with the other rater. Coping plans were only counted if participants specified a valid barrier and a strategy (i.e., one credit each). Since participants were encouraged to formulate up to three coping plans as part of the self-administered intervention module, the number of plans could range from zero to three. During the telephone interview, participants could generate up to two

coping plans. Accordingly, the number of coping plans of the telephone interview could range from zero to two. The inter-rater reliability was very high (Cohen's k = 0.92). Disagreement between raters was resolved by discussion.

3.4. Statistical analysis

We used counts and proportions for categorical variables (sex, medical condition) and means and standard deviations for continuous variables. We conducted drop-out analyses to compare participants who remained in the study with those who did not complete T3 using t-tests for continuous and χ^2-tests for categorical measures. To assess zero-order associations between all variables in the model (see Figure 1) we computed Pearson's correlation coefficients. To test the association between coping plan characteristics and health outcomes (i.e., quality of life and physical activity; see right side of Figure 1), we performed step-wise linear regression analyses. We only included a predictor in the regression model if it was significantly associated with physical activity and/or quality of life. To identify relevant psychosocial and socio-demographic correlates of coping plan characteristics (see left side of Figure 1), we ran step-wise linear regression analyses. We used SPSS V24 for all analyses (IBM Corp, Armonk, New York). Data missing at random (<10% on all variables) were imputed using the Expectation Maximization algorithm [32] in SPSS, as it has proven more robust than regression imputation [33].

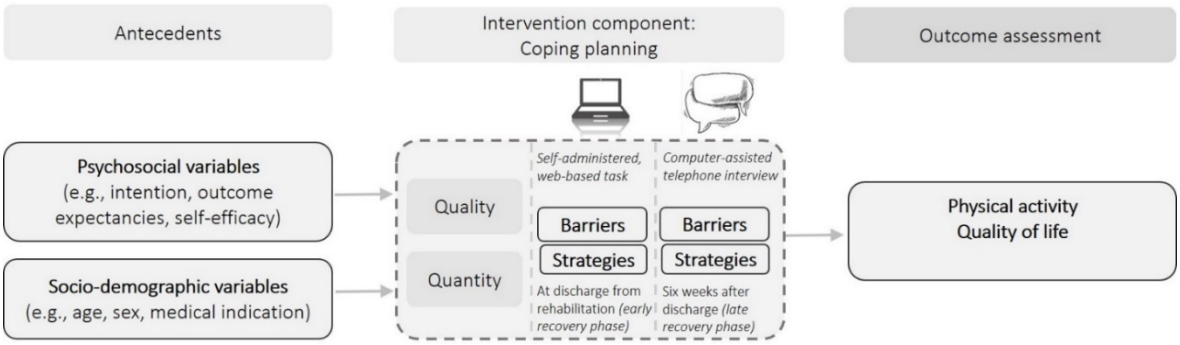

Figure 1. Conceptual model of this study.

4. Results

4.1. Preliminary findings and drop-out analyses

The mean age of the longitudinal sample was 50.45 years (SD = 8.96; range 21–77 years). More than half of all participants were women (59.5%). Most participants had an orthopedic injury or chronic condition, or a previous orthopedic surgery (84.8%). Regarding covariates and psychosocial predictor variables (i.e., intentions, self-efficacy, outcome expectancies, coping planning) there were no significant differences between participants who dropped out and those who remained in the study. Participants who completed the 6-months follow-up, however, were older (M = 50.45, SD = 8.91) than those participants who dropped out of the study (M = 42.79, SD = 9.6). In addition, participants

who remained in the study initially generated more complete coping plans at T1 (M = 2.70, SD = 0.61) than those who dropped out (M = 2.35, SD = 1.01).

4.2. Content analysis: Coping plans

To describe the generated *barriers*, we rated 618 coping plans from 231 participants (T1, *early recovery phase*). We also coded 263 coping plans of 184 individuals who took part in the computer-assisted telephone interview (T2, *late recovery phase*). Another goal of the content analyses was to describe which type of strategies participants intended to use to cope with barriers, and are presented below.

4.2.1. Barriers: Which barriers prevent participants from engaging in physical activities after discharge?

During the *self-administered web-based task* at the end of rehabilitation participants reported *physical barriers* (e.g., pain), *barriers related to a lack of motivation and volition* (e.g., "inertia"), *barriers related to mood and stress regulation* (e.g., stressed, feeling exhausted) as well as *external barriers* (e.g., work load, bad weather, lack of money). Figure 2a depicts the percentage of type of barriers by recovery phase. Across all coping plans (n = 618), participants most frequently referred to external barriers (54.21%), followed by physical barriers (22.65%) and barriers related to a lack of motivation and/or volition (15.21%). Participants most frequently identified "weather" or "work" as an external barrier. With regard to physical barriers, participants identified "pain" and "disease" as meaningful barriers. Only a small proportion of participants identified problems with mood or stress regulation as a barrier for physical activity (7.93%, see Figure 2a).

During the *telephone interviews* six weeks after discharge from rehabilitation (T2), the ranking of the reported barriers remained the same: As illustrated in Figure 2b, *external barriers* ranked first as the most frequently mentioned barrier (64.26%), followed by physical barriers (21.29%) and barriers related to motivational and/or volitional deficits (9.51%). For external barriers, most participants experienced work-related problems (e.g., shift work, long working hours) as a major barrier for their intended physical activities. Similar to the web-based task, participants rarely referred to mood or stress as a barrier to engaging in physical activity (4.49%, see Figure 2a).

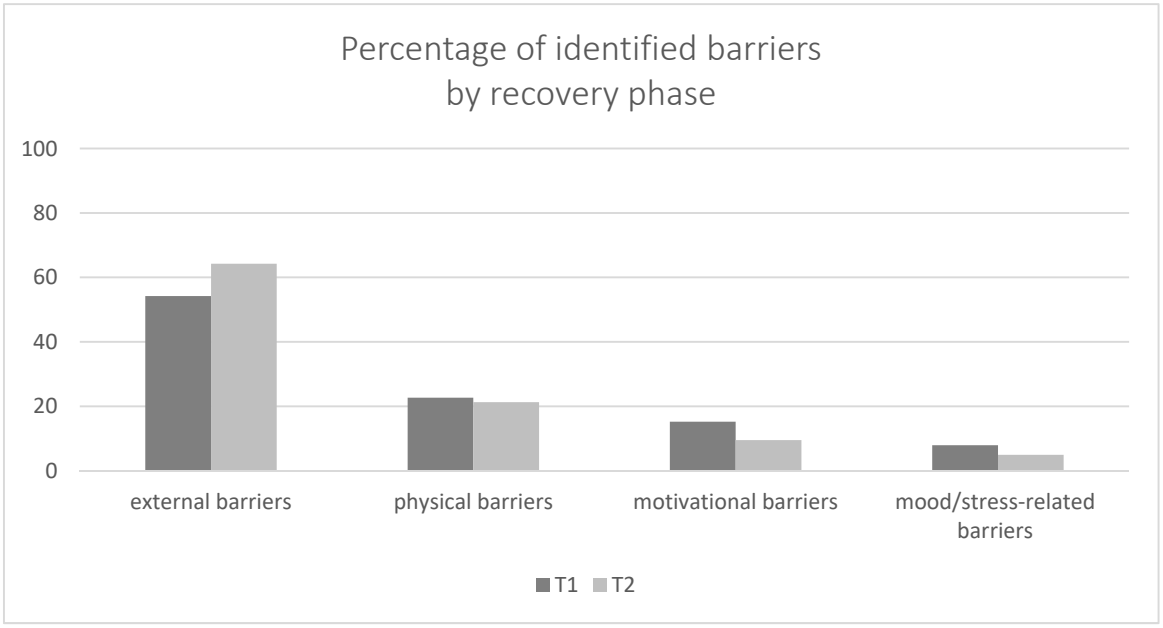

Figure 2a. Types of barriers generated during early (T1, at discharge, n = 231, n = 618 plans) and late (T2, six weeks, n = 184, n = 263 plans) recovery phase. Note: Percentages only add up add up to 100% within each measurement point.

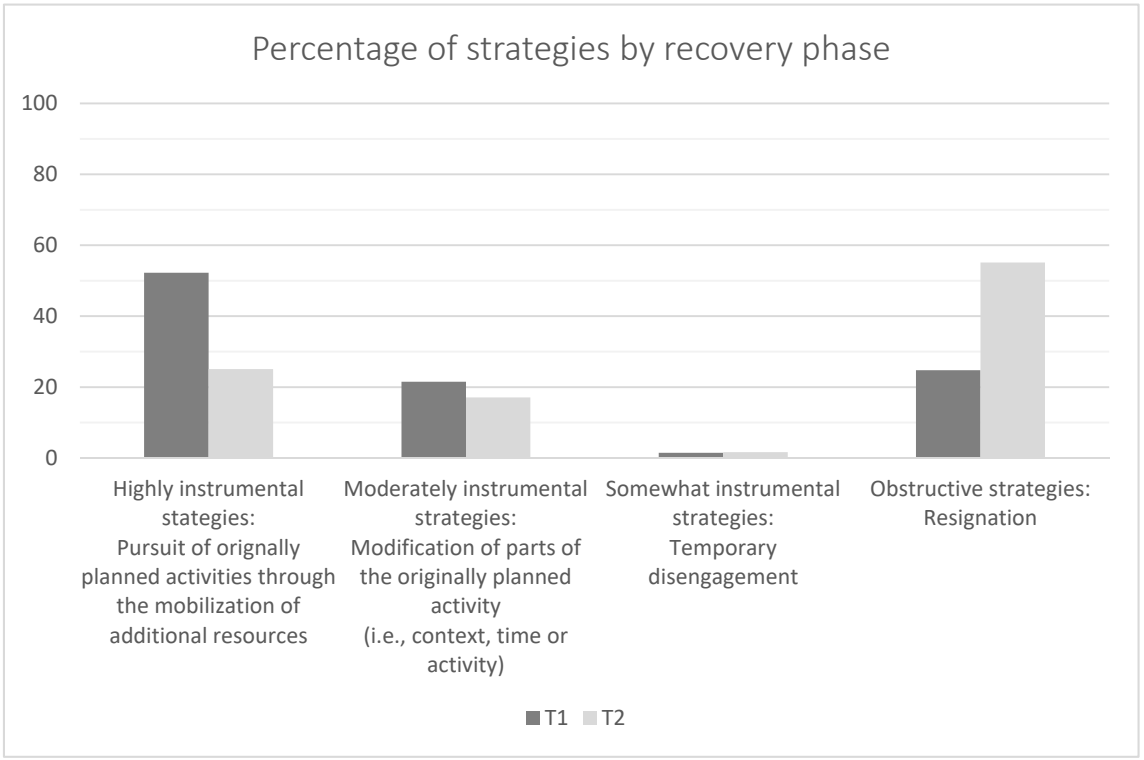

Figure 2b. Types of strategies generated during early (T1, at discharge, n = 231, n = 618 plans) and late (T2, six weeks, n = 184, n = 263 plans) recovery phase; Note: Percentages only add up add up to 100% within each measurement point.

4.2.2. Strategies: Which type of strategies do participants generate to overcome barriers related to post-rehabilitation physical activity?

At T1, participants most frequently formulated a coping strategy that involved the mobilization of resources to tenaciously pursue the planned post-rehabilitation physical activity (52.27%; e.g., visualization of goal). They frequently referred to a cognitive strategy (e.g., pull oneself together, better time management), followed by preventive behavioral strategies (e.g., change work schedule, put on raincoat). Besides the mobilization of resources, participants mentioned coping with a barrier by modifying aspects of their intended activity (21.52%), rather than trying to modify the barrier. To compensate e.g., a missed physical activity opportunity due to a visiting friend or high work load, participants frequently reported that they modified the following aspects: (i) the time of their planned activity, (ii) the behavior itself (e.g., different exercise, lower intensity level) or (iii) the location of activity (e.g., indoors instead of outdoors). Just over one quarter of all generated strategies involved a temporary disengagement from the intended physical activities (e.g., *"wait until I have less pain"*) or simply the conviction that nothing can be done (e.g., *"I cannot do anything about this", "I don't know"*, *"nothing"*).

In contrast to the early recovery phase (T1), the reported strategies at T2 were different. As depicted in Figure 2b, participants most frequently mentioned that they could not do anything about a barrier (57.79%). Only 25.10% of all reported coping strategies involved the mobilization of cognitive, social or behavioral resources to pursue the physical activities as originally planned. Similar to the self-administered task, even nearly one fifth all generated strategies (17.11%) included an adjustment of the originally intended physical activity in terms of type of physical activity or context (e.g., time, location, see Figure 2b).

4.3. Quantitative analyses

4.3.1. Plan quantity and instrumentality

At T1 coping plan generation, 73.2% of respondents (n = 175) formed three complete coping plans, 15.5% had two complete plans, 7.9% of participants generated one complete coping plan, and 3.4% filled in no coping plan. Participants' completion rate declined from plan 1 to plan 3. On average, each participant filled in 2.67 (SD = 0.62) complete coping plans at T1 (median = 3 plans). Approximately one quarter (n = 59) of participants looked at one example of coping strategies; only 5.6% of participants clicked through all seven examples of coping strategies. Thus, engagement in the coping planning task beyond the formulation of coping plans was low to moderate. During the late recovery phase (T2), only 31.5% (n = 58) of participants generated two complete coping plans. There were just over one third (n = 71) of participants who generated one complete coping plan and 29.9% of participants did not generate any complete plan. Participants reported a median of one complete coping plan. For the instrumentality of coping plans, participants' coping plans at T1 were rated as highly instrumental (M = 3.10, SD = 0.90). The instrumentality of the coping strategies generated at T2 was rated as moderately instrumental (M = 1.90, SD = 0.99).

4.3.2. Prediction of rehabilitation health outcomes

Table 3 presents the results of the stepwise linear regression analysis predicting *health-related quality of life* (left-hand side) and physical activity (right-hand side). To reach a parsimonious model we only included those variables in the prediction models that were significantly associated with either physical activity or quality of life. Zero-order correlations of all variables included in the conceptual model (Figure 1) can be found in Tables 1 and 2. Number of plans at T1, and the number and instrumentality of coping plans at T2 were not related to quality of life and physical activity. To test, however, whether instrumentality of plans (T1) would predict health-related outcomes over and above plan quantity, we included number of plans into the regression model (in its own block, see Step 2 in Table 3). As summarized in Table 3, the third model (using all predictors of the stepwise regression model) showed that instrumentality of coping plans generated at T1 was positively linked to quality of life reported six months after rehabilitation (T3) even when controlled for the number of coping plans. The addition of instrumentality of plans in Step 3 lead to a significant increase in R^2 (see Table 3). Of the covariates, coping planning was positively linked to quality of life while severity of illness and age were negatively linked to quality of life.

Next, we analyzed the association between coping plan characteristics and self-reported *physical activity*. Model 3 in Table 3 shows that instrumentality of coping plans at T1 was positively linked to physical activity at T3. This was the case when controlling for number of coping plans as well as the covariates of which baseline physical activity and coping planning (T1) were positively linked to post-rehabilitation physical activity (T3). The addition of instrumentality of plans in Step 3 lead to a significant increase in R^2 (see Table 3). Results from a regression analysis using dummy variables for the instrumentality variable did not substantially differ from the original model (see Appendix B).

4.3.3. Psychosocial and socio-demographic correlates of plan quality

To predict *instrumentality of coping plans* at T1 in $n = 231$ individuals, we entered those predictors into the linear regression model that showed a significant zero-order correlation with plan instrumentality (see Table 2). Regression analyses revealed that outcome expectancies were positively linked with plan instrumentality ($\beta = 0.12$, $p = 0.03$). In addition, women tended to generate more instrumental coping plans compared with men ($\beta = 0.18$, $p = 0.01$). Overall, the model accounted for 5% of the variance in plan instrumentality.

Table 1. Inter-correlations between quality of life, physical activity and physical activity-specific social cognitions in n = 158 rehabilitation patients.

		1	2	3	4	5	6	7	8	9	10	11	12
1.	Sex												
2.	Age	−0.15*											
3.	Medical condition	-	0.19**										
4.	Severity of illness T1	0.02	−0.11	−0.31**									
5.	Baseline physical activity	−0.03	−0.17*	−0.11	0.07								
6.	Baseline quality of life	0.04	−0.01	−0.09	−0.25**	0.05							
7.	Coping planning T2	0.07	0.01	−0.01	0.08	0.15*	0.07						
8.	Number of coping plans T1	0.22**	−0.08	−0.04	0.03	−0.04	0.11	0.01					
9.	Number of coping plans T2	0.10	−0.05	−0.01	−0.06	−0.08	0.01	0.06	0.07				
10.	Instrumentality of coping plans T1	0.17*	−0.08	−0.01	−0.05	−0.13	0.10	−0.02	0.41**	0.07			
11.	Instrumentality of coping plans T2	0.17*	−0.12	−0.07	−0.06	0.01	0.01	−0.02	0.13*	0.67**	0.20**		
12.	Physical activity T3	−0.01	−0.04	−0.13*	0.09	0.32**	0.12	0.22**	−0.02	−0.01	0.14*	0.05	
13.	Subjective health T3	0.09	−0.19*	0.03	−0.18*	−0.01	0.18*	0.13*	−0.07	0.14	0.16*	0.13	0.19*

Note: *$p < 0.05$; **$p < 0.01$; Sex was coded 0 = male, 1 = female; Medical condition was coded 0 = orthopedic condition; 1 = cardiac condition.

Table 2. Inter-correlations between plan content, psychosocial variables and sociodemographic variables in n = 231 individuals.

		1	2	3	4	5	6	7	8	9
1.	Sex									
2.	Age	−0.15*								
3.	Medical condition	-	0.19**							
4.	Severity of illness	0.03	−0.22	−0.31**						
5.	Baseline physical activity	−0.04	−0.17*	−0.13*	0.06					
6.	Intentions	0.09	−0.15*	−0.07	−0.01	0.17*				
7.	Outcome expectancies	0.07	−0.18**	−0.22**	0.04	0.15*	0.22**			

Continued on next page

		1	2	3	4	5	6	7	8	9
8.	Self-efficacy	0.02	−0.04	−0.09	−0.01	0.20**	0.35**	0.56**		
9.	Engagement	0.12*	0.09	−0.09	0.05	−0.08	−0.07	0.05	0.06	
10.	Instrumentality of coping plans T1	0.16*	−0.08	−0.01	−0.07	0.03	0.04	0.12*	−0.07	0.11

Note: *$p < 0.05$; **$p < 0.01$; Sex was coded 0 = male, 1 = female; Medical condition was coded 0 = orthopedic condition; 1 = cardiac condition; engagement = number of strategy examples viewed on during the intervention.

Table 3. Linear regression results: Plan quantity and quality as predictors (T1) of post-rehabilitation quality of life and physical activity (T3) in $n = 158$ rehabilitation patients.

	Quality of life T3						Physical activity T3					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
	β^1	p	β^1	p	β^1	p	β^1	p	β^1	p	β^1	p
Age	−0.18	0.03	−0.18	0.03	−0.18	0.03	-	-	-	-	-	-
Medical condition	-	-	-	-	-	-	−0.11	0.17	−0.13	0.14	−0.13	0.11
Severity of illness	−0.15	0.04	−0.14	0.04	−0.13	0.04	-	-	-	-	-	-
Baseline physical activity	−0.05	0.54	−0.06	0.43	−0.04	0.64	0.28	0.01	0.28	0.01	0.30	0.01
Baseline quality of life	0.12	0.15	0.13	0.12	0.13	0.12	-	-	-	-	-	-
Coping planning T1	0.14	0.07	0.14	0.07	0.13	0.07	0.16	0.03	0.16	0.03	0.16	0.03
Number of coping plans T1	-	-	−0.07	0.38	0.07	0.15	-	-	0.02	0.81	0.03	0.29
Instrumentality of coping plans T1	-	-	-	-	0.19	0.03	-	-	-	-	0.23	0.01
R^2	0.10			0.11		0.14		0.14		0.14		0.18

[1]standardized coefficients; medical condition was coded 0 = orthopedic condition; 1= cardiac condition.

Table 4. Coding scheme for instrumentality ratings of coping plan strategies.

Instrumentality score	obstructive (= 1)	somewhat instrumental (= 2)	moderately instrumental (= 3)	Highly instrumental (= 4)
	to adhering to the planned physical activities after discharge from rehabilitation			
	- strategy that does not support the planned physical activity at all (*e.g., read a book)* - when the answer does not refer to a strategy (*e.g., weekend)* - when participants did not fill in anything *(e.g., xx or left the field blank)* - when participants entered that they don't know what to do about a barrier *(e.g., I have no idea what to do; there is little I can do)* - when participants explicitly stated that nothing can be done about a barrier *(e.g., you can't do anything about it)*	- strategy that only supports the planned activity in the long-term *(e.g., find a new sports partner)* - strategy which implies a temporary disengagement from the planned activity *(e.g., wait until the pain is gone)*	- strategy that immediately supports the pursuit of the intended activity, but only parts of the planned physical activity: When strategy includes a modification of the original plan in terms of (i) context (e.g., location, time) and/or (ii) activity itself (e.g., type or intensity) *(e.g., I exercise indoors instead of outdoors, I make smaller exercises, I exercise at the weekend)*	- strategy which prevents that a barrier hinders a person from engaging in the planned activity: Strategies that immediately and fully support the pursuit of the originally planned physical activity through the mobilization of (i) cognitive *(e.g., visualize my goal, make physical activity my priority, think positively)* and/or (ii) social resources *(e.g., ask friend to exercise together)* and/or facilitating (iii) behavioral efforts *(e.g., appropriate clothes, change work schedule)*

5. Discussion

This study aimed to comprehensively describe characteristics of coping plans for physical activity generated by patients undergoing cardiac and orthopedic rehabilitation within a larger behavioral intervention. We chose the BCT of coping planning as an example of how to integrate psychological behavior change theory into clinical practice. To support the maintenance of rehabilitation health outcomes (i.e., physical activity and quality of life) beyond treatment, individuals of the present study received access to two subsequent coping planning modules, which were embedded within a *self-administered, web-based task (early recovery)* and a computer-based *telephone interview (late recovery)*. Besides the description of intervention content, we aimed to examine whether coping plan characteristics such as quantity and instrumentality mattered for subsequent health outcomes. Finally, we aimed to explore whether phase of recovery and other psychosocial and socio-demographic variables would make a difference for coping plan content.

5.1. Coping plan content: Hanging in and letting go in the pursuit of post-rehabilitation physical activity

Content analyses of coping plans of both intervention modules provided insights into the types of barriers and strategies individuals formulated. Meaningful *barriers* included obstacles in participants' perceived social or physical environment (external) rather than barriers that related to problems with motivation or mood regulation (internal). Similar to previous research among patients in rehabilitation [34], individuals most frequently identified external barriers such as work and family obligations as well as weather (e.g., rain or heat) as obstacles to their physical activity. Analyses further emphasized that physical barriers such as pain or other health limitations (e.g., unexpected cold or flu) presented a major barrier for participants. External and physical barriers were both highly prevalent: when individuals had already spent some weeks at home, they identified even more external issues than at the end of rehabilitation. It may be possible that participants refrained from open disclosure of their internal barriers (such as inertia), preferring to state external causes of inaction to preserve a positive image of themselves. Such a self-serving bias is very common [35].

Coping strategies were categorized under three general themes: participants either (1) planned to tenaciously pursue their intended physical activities despite the occurrence of a barrier, (2) planned to temporarily disengage from their intended activities until the barrier disappeared or (3) were convinced that there would be no alternative course of action to cope with a barrier. At discharge from rehabilitation (early recovery), most participants planned to tenaciously pursue their goals by mobilizing reserve capacities (e.g., visualize goal, set priorities) and increase compensatory efforts. To compensate, e.g. a missed opportunity to exercise, some participants planned to modify their intended physical activity (e.g., type, intensity) or the context of the behavior (e.g., timing, location). In other words, individuals planned to transform their circumstances (e.g., put on raincoat, change work schedule) in accordance with their personal preferences. These strategies may be understood as a form of assimilative coping [36,37]. Engagement in assimilative coping has been shown to be adaptive for successful health goal pursuit and quality of life, particularly among younger and middle-aged adults [38]. An alternative to assimilative coping is accommodative coping [38]. Accommodative coping consists in adjusting personal goals to a given situation (e.g., by

letting go of the original goal). The concept of accommodative coping aligns well with theme 3 of our content analysis of coping strategies ("temporary disengagement and resignation"; see Figure 2b). In the context of coping planning, an accommodative strategy may be not to exercise when pain is present. In other words, a person tries to cope with a barrier (e.g., pain) by temporarily disengaging from the original plan to be physically active. In contrast to assimilative efforts, accommodative coping strategies may be less beneficial for relapse prevention after treatment—but this would have to be tested empirically in the future. In sum, despite standardized instructions of the coping planning modules, the content of plans highly varied between participants. The fact that some individuals generated coping strategies that might even promote relapses (e.g., plan to disengage from goal; complete resignation) emphasize the value of considering intervention content. The latter type of coping plans should be of particular interest for future coping planning interventions (e.g., automatically detect and address these plans during an intervention).

5.2. Predicting health outcomes: Which coping plan characteristics matter?

The present findings extend the conceptual framework of coping planning interventions by emphasizing the importance of the quality of plans in the intervention: In general, the higher the instrumentality of the plans, the more likely participants were to maintain their physical activity and quality of life. Instrumentality ratings were based on the content of the coping plans, with higher levels of instrumentality reflecting a higher level of commitment to directly cope with an identified barrier to behavior engagement. In the present sample, participants who planned to engage in assimilative coping strategies appeared to be more likely to have a higher quality of life and remain physically active. In contrast to previous findings [23], forming multiple plans was not associated with continued behavior engagement. Wiedemann et al. [23] argued that a rich repertoire of strategies to overcome action barriers should rather facilitate the uptake and maintenance of physical activity. Our findings, however, suggest that, when tested concurrently, the instrumentality of plans seems to be more relevant to behavior maintenance and quality of life than the number of plans. Taken together, the present findings highlight that plan content matters and should be considered when evaluating behavioral interventions. Intervention developers should encourage participants to engage in coping planning and, specifically, to formulate strategies that support tenacious plan pursuit.

5.3. Correlates of coping plan quality

Women's plans had higher instrumentality than plans created by men. It is possible that women tend to respond with higher compliance to the demands of interviewers and web-based requests. Future research might want to examine this possibility along with an assessment of sex differences in conscientiousness. Instrumentality may also be a function of outcome expectancies—expecting positive consequences from engaging in physical activity was positively linked to coping plan instrumentality.

5.4. Strengths and limitations of the study

This study has many strengths such as, it is theory-based, uses a large longitudinal dataset, and it examines the role of coping planning in a fine-grained manner by looking at detailed plan characteristics. Coping planning as a mental simulation represents a proximal antecedent of behavioral maintenance, but there has not been much research on the content of the actual plans, which has been the focus of the present study. Identifying how people create and enact a coping planning intervention (e.g., generate plans in terms of frequency and instrumentality) has valuable insights for developing future clinical interventions. However, we acknowledge limitations that need to be addressed in subsequent research. For example, the quality ratings were performed post-hoc and participants were not randomized to different intervention instructions (e.g., instruction to generate strategies that support the tenacious pursuit of the originally planned activity vs. strategies that allow more flexibility). However, the time lag of six months between the completion of the coping planning module and the measurement of health outcomes support the hypothesized associations. In addition, the evaluation of the coping planning module was limited to aggregated health outcomes. Future studies may use more detailed, plan-specific outcome measures [39] assessing, for example, whether participants encountered an anticipated barrier and enacted the planned coping strategy.

6. Conclusions

Remote delivery of rehabilitation (e.g., telerehabilitation, mhealth) can benefit from using behavior change theories to facilitate maintenance of target behaviors such as physical activity. It is important to identify a parsimonious set of psychological constructs, one of them being coping planning, which can be easily implemented with technology. Reporting of behavioral interventions needs to improve, for example by including a description of intervention content and its link to theory-based psychosocial and behavioral outcomes. Analyzing how individuals receive and enact specific BCTs can be one option to assess and ensure intervention fidelity [22]. This may be particularly relevant for BCTs that use self-management strategies rather than simply looking at or listening to advice (e.g., behavioral instruction). Coping with behavioral barriers is only one psychological process to promote maintenance [11]: It is important to consider other theory-based mechanisms (e.g., habit formation) for integration into remote delivery of rehabilitation.

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Conflict of interest

The authors declare no conflict of interest.

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