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Motivation, Self-Regulation and Physical Activity among Patients with Rheumatoid Arthritis

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General Introduction

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Chapter 1

Rheumatoid arthritis (RA) is a chronic inflammatory disease which causes pain, swelling and stiffness in the joints of the body – usually in a symmetrical manner [1]. RA affects between 0.1 and 1.1 percent of the population [2], and is two to three times more prevalent among women than among men [3]. The typical age of RA onset is between 35 and 50 years of age [4].

Although its causes are unclear, it is suspected that the immune system plays a role in both the chronic nature and progression of the disease [5]. Perhaps due to varying levels of immune system activity, RA runs an oft-changing and unpredictable course, with alternating periods of symptoms and remission. These frequent fluctuations in symptoms and disease activity mean that patients must remain on guard, adjusting activity and medication regimens in accordance with their symptoms.

In long-standing cases, the progression of RA can result in deterioration of joint structures, deformity, and limitation or loss of joint function, leading to difficulties in conducting day-to-day activities such as walking, cooking, cleaning, dressing oneself and working [6]. This can result in a vicious circle, where stiffness, joint pain and joint damage lead to withdrawal from activities, reduced fitness and functional capacity, and in turn to further decreases in activity and fitness [7, 8]. As the destruction of joint structures is irreversible, early treatment is essential in slowing or limiting disease progression [9].

Apart from the direct physical consequences of the disease, people with RA report reduced quality of life [10] and elevated levels of psychological distress [11]. Between 13 and 17% of people with RA suffer from major depressive disorder [11], a prevalence rate two to three times that of the general population [12]. As a result, screening for depression and attention to psychosocial functioning have been integrated into guidelines for managing RA [13].

People with RA are also at an increased risk of cardiovascular events (e.g. myocardial infarction (MI), stroke, other conditions characterized by blocked arteries), even after controlling for traditional risk factors such as smoking status, blood pressure, high cholesterol and body mass index (BMI) [14]. In one study, women with RA were found two times more likely to suffer a MI than age matched women without RA. Within these women with RA, those who had a disease duration of longer than 10 years were three times more likely to suffer an MI [15]. Furthermore, cardiovascular risk appears to interact with depression, as individuals with RA who suffer from depression are 40% more likely to suffer an MI than those who are not depressed [16].

Treatment of RA

The treatment of rheumatoid arthritis typically focuses on physical aspects of disease, as well as social, psychological and behavioral factors. Typically used in conjunction, the pharmacological and non-pharmacological methods used to manage RA aim to control joint damage, minimize pain, maintain or improve physical functioning and improve health-related quality of life (HRQOL) [9, 17].

Pharmacological Treatment

Rheumatoid arthritis is typically treated with two classes of medications: non-steroidal anti-inflammatory drugs (NSAIDs) to temporarily alleviate pain and swelling, and disease-modifying anti-rheumatic drugs (DMARDs), to reduce disease activity and slow progression of the disease.

This first class of medications includes nonselective NSAIDs such as ibuprofen and naproxen which are both commonly available over the counter, as well as COX-2 inhibitors such as celecoxib and valdecoxib which require a prescription. These medications are typically effective in reducing inflammation and pain in the short term, but can produce side-effects such as headache, nausea and diarrhea. Furthermore, prolonged regular use of NSAIDs, as is typical among patients with RA, has been linked with an increased risk of stomach ulcers, gastrointestinal bleeding and adverse cardiovascular events (e.g. myocardial infarction)[18, 19].

The second class of medications includes synthetic DMARDs such as methotrexate and sulfasalazine, and biological DMARDs such as abatacept, etanercept and infliximab, all of which require a prescription. The American College of Rheumatology recommends beginning treatment with DMARDs within 3 months of an official RA diagnosis, and patients are typically prescribed DMARDs successively, or in combination, until an effective medication regimen is found [20]. As treatment with DMARDs suppresses immune system activity thereby increasing patients' risk of infections, regular monitoring of side effects is recommended throughout treatment [20].

Non-Pharmacological Treatment

In addition to medication taking, treatment of RA may also involve a number of non-drug therapies which aim to improve or sustain patients' present levels of functioning and improve HRQOL [21]. These non-drug approaches to treatment may also target changes in behaviors associated with improved outcomes in RA such as physical activity, smoking cessation and medication adherence.

Occupational therapy. Occupational therapy aims to increase patients' abilities to conduct their activities of daily living or reduce pain by providing patients with information on how they can protect their joints by adapting their movements or using specialized assistive devices. Joint protection may include the use of splints and orthoses, picking up certain items with two hands instead of one, distributing the weight of items across larger areas of the hand (i.e. the palm instead of the fingers), and avoiding twisting movements which place unnecessary strain on the joints while they are not aligned [22]. Specialized assistive devices include jar openers, large handled cutlery/utensils, reaching aids, grab bars, shower chairs and orthopedic footwear which make common daily tasks possible, more convenient or less painful for people with RA [23].

Patient education. Patient education programs typically provide patients with information about the progressive and cyclical nature of RA, about pharmacological and non-pharmacological treatment options and about joint protection, and have been recommended as part of care for all patients with RA [9, 24]. Some patient education programs also include components meant to improve patients' abilities to self-manage the medical, social and emotional consequences of RA [25]. These self-management education programs not only provide information, but also help patients to identify and solve (potential) problems one might face when dealing with RA.

The most widely implemented program of this type is the Arthritis Self Management Program (ASMP)[26], wherein patients collaborate with a health professional (or trained layperson) in order to develop active coping strategies which are applicable across multiple life domains [25]. Such strategies include realistic goal setting, action planning, coping planning and problem solving [27], and apply to a number of behavior patterns relevant to physical, social and psychological outcomes in RA. Among these behaviors are energy conservation and fatigue, medication adherence, relaxation, fitness and exercise, dealing with difficult emotions, and stimulating social contact [28].

Physical activity. Most patient education and self-management interventions delivered to RA patients place a strong emphasis on regular physical activity (PA), which includes leisure time activities such as cycling or walking, as well as structured exercise programs focused on aerobic conditioning and/or strength training [29,30,82,83]. To promote and maintain health, the Dutch Institute for Sport and Movement (Nederlands Instituut voor Sport en Bewegen), as well as the American College of Sports Medicine, the American Heart Association and other organizations, recommend that adults age 18-65 undertake a minimum of 30 minutes of moderate-intensity aerobic PA five days per week; or alternatively, a minimum of 20 minutes of vigorous-intensity

aerobic PA three days per week [31, 32]. Adherence to these guidelines reduces one's risk of developing cardiovascular disease [31], which, due to their increased risk of cardiac events [15], is particularly important among patients with RA. Furthermore, as physical *in*activity is linked with an increased risk of cardiovascular disease among patients with RA [33], helping patients in transitioning from inactivity to meeting these guidelines can help save lives.

In several studies conducted among patients with RA, higher levels of PA have been associated with better mental and physical quality of life, better subjective functioning, and lower levels of pain [34]. Furthermore, for a majority of patients, dynamic exercise programs (aerobic exercise and/or muscle strength training) have been shown to reduce pain, and to improve functional ability, aerobic capacity and muscle strength without deleterious consequences to joint structures [35, 36]. One exception to this is that patients with existing damage in large joints should not engage in high-intensity weight-bearing exercises, as within this subgroup, such activities can lead to further deterioration of joint structures [37].

Physical activity is a relatively new approach to the treatment of RA, and as a result, little is known about (a) the dose-response relationship between PA and RA outcomes, (b) which types of exercise or PA are most beneficial for patients with RA, (c) how (or whether) PA has differential effects on RA variables at different stages of disease, and (d) whether PA can, in a cost-effective manner, slow disease progression and improve quality of life outcomes [38]. Additionally, as there is evidence which suggests that PA has maximum benefit when sustained over the course of a lifetime [31, 39], it is important to understand which factors lead to long-term maintenance of physical activity.

Physical Activity among Patients with RA

For many years, it was commonly believed that physical activity and exercise among people with RA would put unnecessary strain on affected joints, and result in a worsening of symptoms and additional joint damage [8]. As a result, bed rest was commonly prescribed, and inpatient treatment of RA was commonplace [40]. Only within the last 30 years, and after a number of controlled and uncontrolled trials which have demonstrated its benefits, has PA has been cast in a more positive light by physicians and RA patients alike [7]. However despite the growing evidence of the benefits of PA for patients with RA, some evidence suggests that rheumatologists and physical therapists still do not believe in, or are under informed about, the usefulness of aerobic exercises for people with RA [41, 42]. Some patients too report negative attitudes and beliefs about PA [43, 44], which may explain why between 35% and 75% of

people with RA fail to comply with physical activity recommendations given by their rheumatologist or physical therapist [45-48].

Despite some evidence to the contrary [49], a large body of evidence indicates that patients with RA are, in general, less physically active than their healthy age/sex matched counterparts [50-53]. This means that a majority of patients with RA do not meet the recommended norm of 30 minutes per day on five days of the week [54, 55], and therefore place themselves at a greater risk of developing additional chronic conditions associated with a sedentary lifestyle [56].

The mismatch between the demonstrated benefits of physical activity for patients with rheumatoid arthritis and the low levels of physical activity undertaken by this group has created a need for interventions targeting PA increases within this population. Although there are many structured exercise programs available which increase PA and improve disease related variables in the short term, such interventions may not be cost-effective [57], and there is evidence that some patients do not continue to exercise regularly after such programs end [58, 59].

As a result of these factors, programs designed to increase leisure time physical activity have been developed for people with RA. Leisure time PA is targeted by such programs because it is believed that allowing patients to choose an enjoyable and self-selected modality of exercise may increase long-term maintenance of PA [60], however, this has not been demonstrated for certain, and it is not known whether increases in leisure-time PA yield the same improvements in disease related variables demonstrated by more structured exercise programs.

Changing Physical Activity Behavior

The promotion of leisure-time physical activity among patients with rheumatoid arthritis mirrors, in many respects, the promotion of physical activity among healthy individuals and among other chronic disease populations. Accordingly, the application of behavior change theories can improve the efficacy of interventions aiming to increase physical activity behavior among patients with RA. Behavior change is often conceptualized as progressing through various stages, wherein an individual must first develop an intention to change, before acting on this intention and subsequently maintaining this new course of action [61, 62].

Intention formation. According to several theories of behavior change (e.g. Self-Regulation Theory [61] and the Health Action Process Approach [62]),

intention formation, or the decision to set a behavioral goal, comes about by way of several psychological and experiential factors.

The first of these factors is the attitude an individual has toward a certain behavior, or in other words, what the individual expects to occur if he or she engages in said behavior. The concept of attitude can be best conceptualized by any number of continua relating to the consequences of executing the behavior, or to the execution the behavior in itself (e.g. beneficial – not beneficial, safe – dangerous, fun – not fun). In a number of studies, measures of attitude and/or outcome expectancy are consistently linked with intention formation [63].

Whether or not one perceives that he or she has control over the execution of a particular behavior also predicts intention formation. Also known as self-efficacy beliefs, one's judgments about whether or not he or she has what it takes to undertake a behavior have been linked to both intention formation and action, as well as to maintenance of behavior changes [64, 65]. This concept is particularly important for people with RA, as those individuals who view their RA as debilitating view themselves as less capable of changing PA behavior.

Finally, according to self-regulation theory, goals or intentions are more likely to be achieved when they are of personal relevance to the individual (i.e. not assigned to an individual by someone else) [61]. When setting physical activity goals, this goal ownership or autonomous motivation of behavior allows individuals to choose physical activity modalities which they would enjoy doing, and which might also contribute to valued health outcomes. Setting enjoyable goals autonomously has been linked to maintenance of physical activity behavior, and to a stronger link between intention and action [66].

Action. After forming an intention to change behavior, individuals can utilize a number of strategies derived from self-regulation and control theories to increase the likelihood of achieving their change goals [67]. This goal achievement is important, not only as something which accompanies and guides shifts in behavior, but also as an instrument to improving outcome expectancies, feelings of control, and self-efficacy for the achievement of subsequent goals [68].

As self-regulation can be viewed as a "goal guidance process," [61] the establishment of a properly formulated goal (intention) is fundamental to the initiation of this process. As such, individuals engaging in self-regulation are first prompted to set short-term behavioral goals, based to some extent on recent performance. Setting realistic goals which are challenging, yet not overly difficult, increases motivation for goal achievement, and at the same time, helps

to reduce the likelihood of goals going unachieved, thereby mitigating the negative effects of failures in goal pursuit [69, 70].

Once a realistic goal is formulated, individuals can form action plans or implementation intentions [71], detailing the circumstances under which they will work toward their goals (i.e. what, when, where). Such action planning has been shown to reduce the oft-evidenced gap between intentions and action [72], and can be restructured as needed, to facilitate goal achievement in the face of changing individual circumstances.

After planning a course of action, individuals are prompted to monitor their progress toward their goals, and to obtain feedback on their progress by examining the extent to which their actual behavior matched with the behavior they had planned to undertake. Self-monitoring of behavior serves to focus one's attention on behavior, and has been identified as a critical component of successful self-regulation [73].

Additional self-regulation strategies which encourage goal achievement include utilizing self-chosen incentives to reward goal achievement, maintaining a positive outlook despite setbacks in goal pursuit and creating contingency plans to avoid such setbacks in the future, avoiding self-criticism, and maintaining a focus on goal pursuit despite the presence of distracting stimuli or physiological states [61].

Maintenance. Once an initial shift in behavior has been achieved, a number of factors and strategies can help to maintain this new pattern of behavior over time. Perhaps first and foremost is the concept of autonomous motivation, which is hypothesized to enhance maintenance of a behavior through its interaction with self-efficacy [74]. Derived from self-determination theory, autonomous motivation describes participation in an activity for the purpose of personal enjoyment or fun, as opposed to doing so to achieve external rewards or to avoid feelings of guilt [75]. Autonomous motivation can be built up through the accumulation of positive and enjoyable experiences with a behavior [76], and can be further facilitated through interactions with important others which support the autonomy of the individual [77].

Perhaps due to changes in environmental circumstances, an increased importance of other activities, or due to other personally important obligations, individuals may periodically have their attention drift away from the behavioral shift they had previously initiated. When this occurs, individuals can be prompted to once again begin self-monitoring their behavior, to set new goals, or to refocus on behavior. Within interventions, this has been done through the use of follow-up phone calls, email and text message reminders, and through the provision of tools to self-monitor behavior in the long-term [78].

Even when individuals are autonomously motivated to maintain their behavior and successfully sustain their attention toward goal pursuits and maintenance, situations can arise which disrupt newly acquired behavioral patterns. Such relapses can best be prevented through proactively planning ways to overcome such obstacles before they are encountered. This coping planning has been shown to predict maintenance of behavior changes across several health-related domains [79, 80].

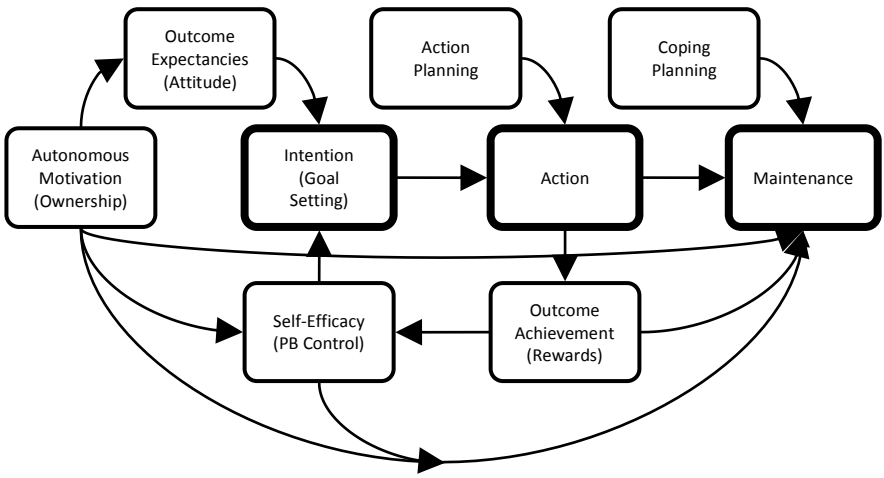

Figure 1. Psychological constructs predicting phases of behavioral engagement. Devised from Hagger, Chatzisarantis & Biddle (2002); Maes & Karoly (2005); Ziegelmann, Luszczynska, Lippke & Schwarzer (2007); Rothman, Baldwin, Hertel & Fuglestad (2011); and Hurkmans et al. (2010).

This Thesis

Aims

Despite the fact that physical activity appears to be safe and beneficial for people with RA, this group typically perform physical activity at levels below what is commonly recommended (i.e. 30 minutes per day on 5 days per week). Although several previous interventions have successfully increased levels of physical activity and demonstrated improvements in psychological and disease related variables within this population in the short term [34, 81], exactly how these treatment gains come about and what factors predict the long-term maintenance of these gains have not been sufficiently investigated. Furthermore, existing interventions targeting increases in PA among patients with RA have focused almost exclusively on the action phase of behavior change

[82,83], paying little attention to intention formation or the maintenance of such gains.

With these thoughts in mind, this thesis will describe the development and testing of a theory-based intervention to increase physical activity, which targets the motivation, action and maintenance phases of behavior change, and in addition, several preliminary investigations which informed the development of said intervention. In doing so, the focus will be on the following research questions:

1. To what extent does the use of self-regulation techniques explain treatment gains within existing psychological interventions for patients with RA?
2. What role do self-efficacy, physical activity and goal achievement play in predicting pain and quality of life among patients with RA?
3. Does the combination of motivational interviewing and self-regulation coaching increase physical activity more than information provision alone?
4. Does the quality and content of a motivational interview have a direct impact upon patients' motivation (regulatory style) or physical activity?
5. Do changes in motivation, self-efficacy and use of self-regulation skills resulting from participation in a motivational interviewing and self-regulation coaching intervention explain increases in physical activity?

Outline

This chapter provided some background about rheumatoid arthritis, its treatment, and the importance of self-management and physical activity for people with RA, as well as how long-term behavioral change can occur in theory. The next two chapters (Chapters 2 and 3) will describe preliminary investigations which informed the development of an intervention to increase physical activity among patients with rheumatoid arthritis. After that, the results of a randomized controlled trial testing this intervention will be presented in Chapters 4, 5 and 6; and finally, additional points from the development of the intervention, our overall findings and implications for practice and future research will be discussed in detail in Chapter 7. More specifically:

Chapter 2 will describe a meta-analysis of psychological treatments for RA, which focused specifically on the impact self-regulation techniques have upon behavioral, psychological and disease related outcomes.

Chapter 3 will present the results of a longitudinal study which investigated whether physical activity and the achievement of physical activity goals mediate the relationships between autonomous motivation and self-efficacy on the one hand, and arthritis pain and quality of life on the other.

Chapter 4 will report the results from a pilot randomized controlled trial, which compared the combination of patient education, motivational interviewing and self-regulation coaching to patient education alone. This study examined the relative efficacy of these intervention ns upon self-efficacy, autonomous motivation, physical activity, and psychological and disease-related variables.

Chapter 5 will investigate the quality of the motivational interviews delivered during the intervention, and explore whether this was related to changes in motivation, self-efficacy or physical activity within patients who received the intervention.

Finally, Chapter 6 will explore mediation effects within the intervention, by examining whether changes in motivation, self-efficacy and use of self-regulation skills led to sustained increases in physical activity and achievement of physical activity goals.

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Chapter 2

Psychological interventions for rheumatoid arthritis

Examining the role of self-regulation with a systematic review and meta-analysis of randomized controlled trials

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Abstract

Objective: To examine the efficacy of psychological interventions for rheumatoid arthritis (RA), and to determine whether self-regulation interventions demonstrate efficacy superior to that of other psychological treatments.

Methods: Only randomized controlled trials testing a face-to-face psychological intervention among patients with RA were included. Two independent investigators extracted pertinent study data, rated each study on a scale of methodological quality, and assessed each treatment condition for its inclusion of five behavior-change techniques derived from self-regulation theory (goal setting, planning, self-monitoring, feedback, and relapse prevention).

Results: Twenty-seven trials were included, and cumulative effect sizes were calculated for 5 outcomes. Significant effect sizes (Hedges' *g*) were found at post-treatment for physical activity (0.45), pain (0.19), disability (0.29), depressive symptoms (0.24), and anxiety (0.16). At follow-up (ranging from 2 to 14 months), significant effect sizes were obtained for physical activity (0.37), pain (0.15), disability (0.15), and depressive symptoms (0.30). Comparative analyses revealed that interventions utilizing more self-regulation techniques reduced depressive symptoms and anxiety significantly more than interventions utilizing fewer. Additionally, depressive symptoms were reduced significantly more among recently diagnosed RA patients than those with long-standing RA.

Conclusions: Psychological interventions are beneficial for many patients with RA, particularly when it comes to increasing physical activity levels. Intervention techniques derived from self-regulation theory appear to play a role in reducing depressive symptoms and anxiety among patients with RA.

Rheumatoid arthritis (RA) is a chronic auto-immune disorder which affects roughly one percent of the general population [1]. Common symptoms include pain, swelling, and tenderness in joints, morning stiffness, and functional limitations (disability). These symptoms are most frequently treated with a combination of medication and physical exercise [2,3], but in addition several psycho-social and behavioral treatments have been developed to address these symptoms. Some of the most commonly implemented psychological interventions use either a) stress-management training to help patients cope with functional problems caused by their RA, b) cognitive-behavioral therapy (CBT) to teach patients methods to control their arthritis pain [4], and/or c) education to help patients make informed decisions about how to best self-manage their condition [5].

Among these psychological interventions for RA, the Arthritis Self-Management Program (ASMP) [6] is perhaps the most widely implemented. The ASMP combines elements of patient education and cognitive-behavioral interventions: educating patients about arthritis and the importance of physical activity, while engaging them in goal-setting, action planning, and self-monitoring of physical exercise and other self-management strategies. In several trials, the ASMP and other interventions based on it have increased practice of physical exercise, and reduced pain, depressive symptoms, and anxiety among patients with RA [6-9].

Several techniques utilized by the ASMP (goal setting, action planning, self-monitoring, and provision of feedback) closely reflect the basic tenants of self-regulation theory (SRT) [10,11]. SRT puts forth the idea that behavior is goal-directed; and that by taking an active rather than passive role in the management of a chronic condition, patients can create their own pathways to goal achievement [10,12]. The techniques of goal setting, planning, self-monitoring, and feedback serve then to focus the attention of patients on the steps necessary to self-manage their condition.

Apart from the successes of the ASMP among arthritis patients, the ability of self-regulation based interventions to improve behavioral, physical, and psychological outcomes has also been demonstrated among other chronic disease populations (coronary heart disease [13], asthma [14], renal disease [15]). For that reason, this meta-analysis will examine whether interventions which use more core self-regulation principles (goal-setting, planning, self-monitoring, feedback, relapse prevention) [16] produce greater treatment gains for RA patients than interventions which use fewer such techniques.

Several previous meta-analyses have shown that psychological interventions produce small significant effect sizes upon physical and

psychological outcomes important in RA [4,17,18]. However, no meta-analysis has yet assessed the effects of psychological interventions upon levels of physical activity among patients with RA. The American College of Rheumatology (ACR) guidelines for the management of RA [2] include strengthening and aerobic conditioning, and various studies have demonstrated the safety and efficacy of physical exercise at improving strength, disability, disease activity, pain, mobility, and aerobic capacity among RA patients [19-21]. However, patients with RA remain less physically active than members of the general population, and 35 - 75% of RA patients do not comply with the physical activity recommendations of their rheumatologist or physical therapist [7,22-24]. Many RA patients therefore miss out on the assumed benefits of physical exercise, and place themselves at greater risk of developing other chronic illnesses associated with a sedentary lifestyle [25].

Low adherence to physical activity recommendations, and lowered physical activity in general, are influenced by a number of personal and environmental factors including the high prevalence of sedentary work and leisure activities in western societies, lack of access to safe or appropriate exercise settings, lack of time, lack of knowledge, lack of motivation (including depression), and certain aspects of patient-provider interactions [26]. As a result, psychological interventions which help patients to better plan for physical activity, increase motivation and problem solving skills, or improve aspects of patient care might lead to increased physical activity and prove beneficial in clinical practice. This review will therefore examine the effects of psychological interventions upon physical activity levels among patients with RA.
The primary aims of this study are thus:

1. To determine the overall efficacy of psychological interventions at increasing physical activity, and at reducing pain, disability, depressive symptoms, and anxiety among patients with RA.
2. To determine whether interventions including more techniques derived from self-regulation theory produce greater treatment gains than those using fewer.

Methods

Search Strategy

This meta-analysis (without protocol) included only randomized controlled trials (RCT) published in peer-reviewed journals in either English or Dutch, which tested face-to-face psychological interventions for adult humans with rheumatoid arthritis. To be included, studies must have reported data suitable for meta-analysis for at least one of these five outcomes: physical activity, pain, disability, depressive symptoms, anxiety.

To find RCTs, searches were conducted for the years 1980-2008 within the electronic databases Ovid PsycInfo, Ovid MEDLINE, and the central catalog of Dutch libraries**.** The explicit search strategies for PsycInfo and MEDLINE are available in Appendix A.

Recovery of Trials

Our initial search returned 288 relevant articles. After reviewing the abstracts of these articles, 54 articles remained which met the inclusion criteria. The reference lists of all review articles eliminated at this stage were then scanned, revealing four additional studies to be considered for inclusion; however, the full-text of one of these articles was unavailable. The full-texts of these 57 articles were then reviewed; 30 of which were subsequently excluded for the following reasons: lack of a control group (*n* = 3); did not report on outcomes of interest (*n* = 3); study did not provide separate data for different illness groups (*n* = 9); provided data was not suitable for meta-analysis and further data was unavailable (*n* = 13); study provided secondary analysis of data provided by another study (*n* = 2). Twenty-seven studies were finally included, some of which tested multiple treatment conditions. Figure 1 demonstrates how the recovered articles were scrutinized, and the included studies are summarized in Table 1.

Coding

Coding and data extraction were conducted by two independent coders using an a priori developed data extraction form. Articles were coded for the following features: type of intervention tested, country/year of study conduct, type of RA diagnostic criteria, provider of the intervention, number of sessions, total time of patient-provider contact in hours, and the type of control group used for comparison. We also assessed each study for its stated aims, outcome measures used, and the average age and disease duration of its participants.

Study quality and risk of bias. A 29-item version of the CCDAN scale [52], as adapted by Lackner et al. [53] to suit the evaluation of psychological trials, was used to assess the quality of the included studies. Each of the 29 items was scored as a 0, 1, or 2 according to the criteria inherent in the scale (Table 2). Any discrepancies were discussed by the two coders until consensus was reached. Four study quality items (blinding of assessors, concealed treatment allocation, inclusion of dropouts, and manualized treatment), as well as whether or not a study's control contained an active component were considered the largest risks of bias among the included studies.

Self-regulation principles. Each treatment condition from the included studies was assessed for the presence of the five core self-regulation principles (goal setting, planning, self-monitoring, feedback, and relapse prevention) using

the following, a priori validated procedure. Each self-regulation principle was assigned a score of 0, 1, or 2 based on the extent to which that principle was a part of the intervention (See appendix B). Both the published intervention descriptions and any secondary references cited therein were used to determine the final score. When possible, the authors of studies which, according to our coding of study quality, inadequately described their treatment conditions (i.e. scored less than 2 on item seven of the modified CCDAN scale) were contacted for more information regarding the content of their interventions.

To increase the transparency of the coding process for later comparison, the coders were instructed to note down which source (original article or specific cited reference), page, and paragraph contained the text on which their coding decision was based. In the case of minor discrepancies (0 vs. 1, or 1 vs. 2), the mean of the two ratings was used, and in the case of major discrepancies (0 vs. 2), the two coders discussed the items and referred back to their notes to reach consensus.

At the end of the coding process, a *total* self-regulation score was calculated by summing the five principle scores for each treatment condition. Total self-regulation scores could thus range from 0 to 10. The included studies were then dichotomized at the median to allow for subsequent comparisons of the effects of studies high vs. low in self-regulation. For studies which tested multiple treatment groups against the same control group, only the treatment group with the highest total self-regulation score was included in order to maintain between-studies independence.

Calculations

Meta-analyses were conducted using Comprehensive Meta Analysis software [54]. The analyses were weighted by trial size, and the DerSimonian and Laird random-effects model was used [55]. For each of the assessed outcomes, a separate meta-analysis was conducted to determine the cumulative effect sizes (Hedges' *g*) [56] at both post-treatment and follow-up. The statistical consistency (heterogeneity) of included studies was examined using the I^2 statistic [57].

Additional analyses. Comparative subgroups analyses were used to examine the effects of categorical study variables (treatment type, dichotomized self-regulation score, within study risk of bias, and dichotomized disease duration of study participants) upon treatment effects for each outcome. Meta-regressions were subsequently used to examine the effects of continuous study variables (patient-provider contact time, total study quality, and sample size) upon treatment effects for each outcome. All analyses involving subgroup comparisons and meta-regression were conducted using SPSS 16.0 for Windows

[58]. Publication bias was then assessed by visually examining funnel plots for asymmetry.

Results

Analyses of Outcomes at Post-treatment

For each of the assessed outcomes (physical activity, pain, disability, depressive symptoms, and anxiety), cumulative effect sizes and heterogeneity statistics obtained from post-treatment data are presented in Figures 2-4.

Analyses of Outcomes at Follow-up

Physical activity. Four studies provided follow-up data on physical activity for periods varying from 10-14 months after baseline. These studies produced a small but significant effect size of $g = 0.361$ ($p = 0.020$; 95% CI = 0.058 - 0.665). (Effect size for this subset of studies at post-treatment: $g = 0.471$; $p = 0.009$; 95% CI = 0.116 - 0.826).

Pain. Thirteen studies provided follow-up data for pain. The follow-up periods ranged from two to fourteen months post-treatment. The effect size for this data from baseline to final follow-up was not significant ($g = 0.127$; $p = 0.069$; 95% CI = -0.010 - 0.265). (The effect size for this subset of studies at post-treatment: $g = 0.189$; $p = 0.006$; 95% CI = 0.054 - 0.325).

Disability. Twelve studies provided follow-up data for disability, with follow-up periods ranging from two to fourteen months post- treatment. The effect size for this data from baseline to final follow-up was $g = 0.145$ ($p = 0.047$; 95% CI = 0.002 - 0.288). (The effect size for this subset of studies at post-treatment: $g = 0.417$; $p = 0.001$; 95% CI = 0.179 - 0.655).

Depression. Twelve studies provided follow-up data for depression with follow-up periods ranging from two to fourteen months post- treatment. The effect size for this data from baseline to final follow-up was $g = 0.318$ ($p < 0.001$; 95% CI = 0.160 - 0.475). (The effect size for this subset of treatments from baseline to post-treatment: $g = 0.279$; $p = 0.015$; 95% CI = 0.054 - 0.504)

Anxiety. The cumulative effect size for anxiety at final follow-up was not significant ($g = 0.122$; $p = 0.200$; CI = -0.065 – 0.308; $k = 8$). (At post-treatment, this subset of eight treatments had a cumulative effect size of $g = 0.121$ ($p = 0.201$; 95% CI = -0.064 – 0.306))

Additional Analyses

Inter-rater reliability. Calculation of inter-rater reliability yielded a Cohen's Kappa of 0.68 for study quality coding and 0.78 for self-regulation score coding; both of which are satisfactory [59,60].

Comparative subgroup analyses. For each outcome variable, comparative subgroup analyses separately examined the effects of the categorical study variables treatment type (cognitive behavior therapy, patient

education, or stress management), median-dichotomized self-regulation score (High SR score ≥ 4.5 vs. Low SR score < 4.5), control type (active vs. passive), adequacy of blinding (adequate vs. inadequate), allocation concealment (concealed vs. not concealed), inclusion of withdrawals/dropouts (included vs. not included), and dichotomized average disease duration of participants (disease duration ≥ 10 years vs. disease duration < 10 years) upon effect sizes.

To assess normality of the effect size distributions, Shapiro-Wilks tests were conducted on the effect sizes of each outcome. For the outcomes pain, disability, depressive symptoms and anxiety, the tests were non-significant; meaning that effect size distributions for these outcomes could be considered normal. Subsequently, Welch's *t*-tests were used to compare subgroups for these outcomes. The results of these comparative analyses are presented in Table 3. As the Shapiro-Wilks statistic was significant for the outcome physical activity, normality could not be assumed and no comparative analyses were conducted.

Meta-regression analyses. A regression line was fit to the study quality data to determine if study quality has increased over time within this body of research. A line with $\beta_s = 0.74$ ($p < 0.001$) was calculated, indicating that methodological quality of studies has generally increased over time.

Additionally, meta-regression analyses examined the effects of the continuous study variables of study quality, hours of patient-provider contact time, and total sample size upon the effect sizes of each outcome. For the outcome physical activity, larger sample size was significantly associated with smaller effect sizes. The meta-regression analyses revealed no other significant associations. See Table 3.

3.4 Publication Bias

To examine whether publication bias may have affected our cumulative effect sizes, funnel plots of effect size vs. standard error were examined for each outcome. Visual inspections revealed some asymmetry for physical activity, but not for other outcomes.

Additionally, fail-safe numbers were calculated for each outcome. Based on the limit ($5k + 10$) set forth by Rosenthal [61], publication bias is unlikely for the outcome disability (FSN = 147), but not for the others (physical activity, FSN = 24; pain, FSN = 80; depression, FSN = 61; anxiety, FSN = 3).

Discussion

The benefits of physical exercise for most patients with RA are well documented, but despite this, a high percentage of patients with rheumatoid arthritis lead a sedentary lifestyle [7,19-24]. Based on the set of studies included

here, psychological interventions appear to have a positive impact upon physical activity levels among patients with RA. A cumulative effect size (*g*) of 0.45 was found for five patient-education interventions which reported on physical activity, most commonly assessed as self-reported exercise sessions per week. This effect size represents a gain of approximately one exercise session per week for the treatment groups over the control groups. These results however do not provide any insight into the types of exercise these patients increased, or whether this general increase in physical exercise leads to the same improvements in pain and disability demonstrated by more structured exercise programs [62,63]. As RA is a chronic and progressive condition, longitudinal data is crucial in determining whether increased physical activity leads to sustained, rather than deteriorating, radiological condition, the maintenance of functional ability, and ultimately, reduced healthcare utilization.

The set of psychological interventions included in this analysis had small effects upon the physical and psychological outcomes of RA. The effect sizes (*g*) calculated for pain (0.18), disability (0.32), depressive symptoms (0.23) and anxiety (0.17) are significant, small, and similar to those calculated in previous meta-analyses examining psychological treatments for RA [17,18] and mixed arthritis populations [4]. These small effect-sizes occur in addition to what is achieved by standard care alone, thereby illustrating the possible utility of such treatments in practice. However, as all outcomes were measured using self-report questionnaires which vary in their respective sensitivities to change, the relationship between statistical and clinical significance should be examined on a case by case basis. Furthermore, when examining these results, it should be noted that several studies yielded negative effect sizes for various outcomes; indicating that psychological treatments [8,31,36,38,42,51] are not beneficial for all patients or for all outcomes.

To compare the efficacy of several categories of psychological treatment, we conducted a series of comparative subgroup analyses. Confirming the results of previous researchers [17,18], neither CBT, nor patient education, nor stress management interventions produced effect sizes which were significantly greater than the others. As previously noted [64], CBT, patient education, and stress management interventions utilize overlapping techniques derived from multiple theoretical backgrounds (see Table 1). The similarity of their treatment effects is therefore not surprising.

In an attempt to isolate a specific set of techniques (as opposed to over-reaching treatment modalities) and to assess its combined impact upon rheumatoid arthritis outcomes, we assessed each included intervention for the use of five techniques derived from self-regulation theory: goal setting, planning,

self-monitoring, feedback provision, and relapse prevention. Comparative analyses subsequently revealed that studies which utilized more of these self-regulation techniques reduced depressive symptoms and anxiety significantly more than those utilizing fewer.

As several of the studies from this analysis excluded clinically depressed or anxious patients, and the studies' baseline means generally indicate that patients reported only mild to moderate anxiety and depressive symptoms, we must question whether these findings also hold for RA patients with clinical levels of depression or anxiety. As highly distressed patients have been shown to have difficulty setting realistic goals and engaging in goal-directed behaviors [65], self-regulation interventions are likely most effective among RA patients with sub-clinical levels of anxiety and depression. Before beginning any behavioral or exercise program, RA patients with clinical levels of psychological distress should receive evidence-based treatment for those symptoms, in order to optimize the chances of success in that program.

Among patients with sub-clinical levels of depression and anxiety, self-regulation interventions perhaps reduce psychological symptoms through increases in arthritis self-efficacy, or one's perceived ability to influence or control various aspects of arthritis [8]. Techniques which typify self-regulation interventions (goal setting, self-monitoring, and receiving feedback) have each been linked in previous research to increased self-efficacy, which has in turn been linked to improvements in psychological variables among patients with RA [66]. Achieving behavioral goals which are believed to directly affect the course of arthritis empowers patients, and may subsequently reduce worry and negative thoughts about living with RA. This relationship is supported by research in other chronic disease populations as well, in which perceived control and self-efficacy have been inversely linked to depression and anxiety [67-69].

As depressive disorder is two to three times more prevalent among patients with RA than among members of the general population [70], and as it has been linked to reduced physical activity adherence [23,72,73], it is an important target of intervention within this population. Our results, and those of previous researchers [18], suggest that psychological interventions reduce depressive symptoms most effectively among recently diagnosed RA patients. This is perhaps the case because depressive symptoms among recently diagnosed patients stem from factors which are more alterable by psychological interventions. One might expect recently diagnosed patients to experience depressive symptoms in response uncertainty about the future, or as a reaction to the unknown course of the illness with which they have just been diagnosed; whereas patients with more long-standing diagnoses may experience depressive

symptoms stemming from the pain and functional limitations more common in the later stages of RA [71]. Future research should investigate other patient characteristics (e.g. personality or illness perceptions) which might also predict the success of psychological treatments for RA.

The present study has a number of limitations. First, the large cumulative effect size found for physical activity increases must be taken with caution due to the small number of studies which reported on this outcome (k = 5). Although the cumulative effect size was itself significant, and two of the five included studies demonstrated large increases in physical activity [7,40], more studies examining this relationship are required before any firm conclusions can be drawn.

Second, as physical activity data was collected by all included studies using self-report measures, the tendency for people to overestimate their own levels of physical activity, particularly after repeated measurements [74], may have inflated the results. In future research, using a physical activity diary might allow for more accurate measurement of physical activity. It should also be mentioned that self-report measures used by the included studies to measure disability, anxiety, and depressive symptoms may not fully correspond with clinical or objective measurements of these same variables.

Third, publication bias might also have affected our results, as the fail-safe numbers for all outcomes beside disability failed to exceed the limits set forth by Rosenthal [61]. Although a visual inspection of funnel plots did not reveal any obvious asymmetry, it is possible that the existence of unpublished studies with negative results could render our cumulative effect size estimates non-significant.

Finally, for some studies included in this analysis, our self-regulation coding process had to rely solely on the intervention descriptions provided in the published articles. In these circumstances, it is possible that our coding process under-reported the use of self-regulation principles within those studies. Conversely, as there are no guarantees that all techniques mentioned in an intervention description were actually applied during treatment, it is possible that for some interventions we have over-reported their use of self-regulation principles. In the future, researchers of psychological interventions should strive to fully and accurately report on the techniques they have utilized [64], and provide at least some assessment of therapist adherence to an intervention protocol.

This meta-analysis demonstrates the efficacy of psychological interventions as adjuncts to standard care for patients with RA; not only because of their effects upon physical and psychological variables, but also because of

their apparent ability to increase physical activity among these patients. It appears however that most effects of psychological treatment seem to dissipate after the treatment (contact) period ends. Future research should therefore address how these small symptom improvements and behavioral changes might be increased and better maintained over time. Finally, our findings implicate the use of self-regulation interventions to target mild anxiety and depressive symptoms within this population, particularly among patients with more recent diagnoses. Future longitudinal research should examine whether self-regulation interventions which improve psychological status produce carry-over effects upon pain, disability, or physical activity.

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We would like to thank Rebecca Schouten for her assistance with coding the included studies.

Table 1 *Characteristics of Included Studies*

Study 1st author, year Country	Groups used in analysis (*n*)	Sessions/ Length	RA Criteria	Intervention provider(s)	Measures	GS	PL	SM	FB	RP	SR score	Study Quality
Appelbaum, 1988 [27] USA	Relaxation, cognitive pain management strategies (9) Symptom monitoring control group (9; active)	10 x 60min / 6 wks	AF	PhD student	VAS	1.5	0	2	1	0	4.5	24
Barlow, 2000 [8] UK	Group Arthritis Self-Management Program (ASMP; 114) Wait-list control group (77; passive)	6 x 2hr / 6 wks	NR	Layperson	VAS, HAQ, HADS	2	1	0	2	0	5	35
Bradley, 1984 [28] USA	Group CBT with biofeedback, relaxation, education, goal setting (4) No intervention control group (3; passive)	15 / Unknown	ARA	Psychologist	VAS, STAI, DACL	1	2	0	0	1	4	21
Brus, 1998 [29] Netherlands	Group training in physical exercise, info about RA, contracting (25) No intervention control group (30; passive)	4 x 2hr / 4 wks	ACR	Medical Doctor (MD)	AIMS, HAQ	1	2	0	1	0.5	4.5	33
Evers, 2002 [30] Netherlands	CBT with relaxation, goal setting, cognitive restructuring (30) Standard medical care (29; active)	10 x 1hr / 20wks	ACR	PhD student	IRGL, BDI	1.5	0.5	0	1.5	2	5.5	39
Hammond, 1999 [31] UK	Group education, contracting, joint-protection, problem solving (17) Wait-list control group (18; passive)	4x 2hr / 12wks	ACR	Occupational Therapist (OT)	HAQ	2	1.5	2	2	0.5	8	34
Hammond, 2001 [32] UK	Group education, contracting, joint-protection, problem solving (63) RA education control group (58; active)	4 x 2hr / 4wks	NR	Physical Therapist (PT)	VAS	2	1.5	2	2	0	7.5	41
Helewa, 1991 [33] Canada	Education on joint protection and use of aids, counseling (52) Wait-list control group (50; passive)	Unknown / 6 wks	ARA	Occupational Therapist	HAQ, BDI	0	0	0	0	0	0	31

Helliwell, 1999 [34] UK	Group education about RA, pacing, joint protection, and exercise (43) Wait-list control group (34; passive)	4 x 2hr / 4wks	ARA	Medical Doctor	HAQ	1	0.5	0	1	0	2.5	32
Hill, 2001 [35] UK	Education about RA, exercise, joint protection, and coping (33) Standard medical care (30; active)	7 x 30min / 6mos	ARA	Nurse	Pain score	0	0	0	0	0	0	35
Huiskes, 1991 [36] Netherlands	Group CBT/OT: GS, relaxation, homework, active coping, JP/exercise (21) Wait-list control group (19; passive)	10 x 2hr / 10wks	ARA	PhD student	IRGL	1	0	0	2	0	3	24
Kaplan, 1981 [37] USA	Education about RA + group counseling of RA problems (11) Education about RA (17; active)	12 x 90min / 12wks	ARA	Counselor	ZDS	0	0	0	0	0	0	26
Kraaimaat, 1995 [38] Netherlands	Group CBT: relaxation, GS, FB, active coping, homework, info (24) Wait-list control group (19; passive)	10 x 2hr / 10wks	ARA	Psychologist	IRGL	1	0	0	1.5	0	2.5	36
Leibing, 1999 [39] Austria	Group education: pain, relaxation, pain management, SM (19) Standard medical care (20; active)	12 x 90min / 12wks	ACR	Medical Doctor	VAS, HAQ, DS, STAI	2	1	2	0	2	7	42
Lindroth, 1997 [40] Sweden	Group education: pacing, pain coping, exercise, relaxation (37) Wait-list control group (36; passive)	8 x 2.5hr / 8wks	ACR	Team (Nurse, MD, PT, OT, dietician, and social worker)	VAS, HAQ	2	1	0	2	0	5	32
Lundgren, 1999 [41] Sweden	Group relaxation: Jacobson and guided imagery (33) No intervention control group (27; passive)	20 x 30min / 10wks	ACR	Physical Therapist	VAS	0	0	0	0	0	0	39
Neuberger, 1993 [42] USA	Self-instruction, practice of ROM/JP, contracting for ROM/JP (15) No intervention control group (11; passive)	6 contacts / 16 wks	NR	Nurse	VAS, CES-D	2	0	0	2	0	4	20
O'Leary, 1988 [43] USA	Group CBT: goal setting, pain management, relaxation, self-reward (14) Self-help book (12; active)	5 x 2hr / 5wks	NR	Unknown	VAS, HAQ, ZDS	2	2	2	1	2	9	26

Parker, 1988 [44] USA	1-week clinic stay; Group CBT: pain coping, relaxation, stress mgmt (29) Standard medical care (28; active)	24 x 1hr / 6mos	ARA	PhD student	VAS, AIMS	1	1	0	1	1.5	4.5	32
Parker, 1995 [45] USA	CBT: stress management, relaxation, pain coping strategies (44) Standard medical care (44; active)	10 x 90min / 10wks	ACR	Counselor	VAS, AIMS	1	1	0	1	1.5	4.5	37
Pradhan, 2007 [46] USA	Group mindfulness-based stress reduction, home practice (28) Wait-list control group (32; passive)	8 x 2.5hr / 8wks	ACR	Counselor	SCL90-R	0	0	0	0	0	0	42
Radojevic, 1992 [47] USA	Group CBT: relaxation, cognitive pain coping, family participation (15) No intervention control group (15; passive)	4 x 2.5hr / 6wks	ARA	PhD student	AIMS, CES-D	0	0	2	0	1	3	33
Riemsma, 2003 [48] Netherlands	Group GS, contracting, FB, relaxation, exercise, partner participation (71) Self-help book (76; active)	5 x 2hr / 5wks	ACR	Nurse	AIMS	2	0.5	0	2	0.5	5	35
Scholten, 1999 [49] Austria	Group education: RA, pain, relaxation, exercise, joint protection, GS (38) Wait-list control group (30; passive)	9 x 90min / 2wks	ARA	Team (Psychologist, MD, PT, and social worker)	HAQ, BDI	1	0	2	0	1.5	4.5	28
Sharpe, 2001 [50] UK	Education/CBT: RA, relaxation, GS, pacing, problem solving (23) Standard medical care (22; active)	8 x 1hr / 8wks	ARA	PhD student	VAS, HAQ, HADS	1	1.5	2	0	2	6.5	40
Shearn, 1985 [51] USA	Group stress management, relaxation, coping strategies (22) No intervention control group (26; passive)	10 x 90min / 10wks	ARA	PhD student	VAS, HAQ, CES-D	0	0	0	0	0	0	27
Taal, 1993 [7] Netherlands	Group education: RA, exercise, GS, problem solving (27) No intervention control group (30; passive)	5 x 2hr / 5wks	ARA	Nurse or Physical Therapist	AIMS, HAQ	2	0	1	2	0	5	31

Note. Self-regulation code abbreviations: GS = goal setting; PL = planning; SM = self-monitoring; FB = provision of feedback; RP = relapse prevention; Treatment abbreviations: ROM = Range of motion; JP = Joint protection; CBT = Cognitive behavior therapy; OT = occupational therapy; Outcome measure abbreviations: BDI = Beck depression inventory; DACL = Depression adjective checklist; HADS = Hospital anxiety and depression scale; STAI = State-trait anxiety inventory; HAQ = Health assessment questionnaire; IRGL = Impact of rheumatic diseases on general health and lifestyle questionnaire; VAS = Visual analog scale; CES-D = Center for epidemiologic studies depression scale; AIMS = Arthritis impact measurement scales; SCL = symptom checklist; DS = Depression scale; ZDS = Zung depression scale Diagnosis abbreviations: AF = Arthritis Foundation 1981 Criteria; ACR = American College of Rheumatology criteria; ARA = American Rheumatology Association criteria; NR = Not reported.

Table 2

Consensus Ratings of Methodological Quality

Methodological Criterion	Included studies – First author [reference number]																										
	Appelbaum [27]	Barlow [8]	Bradley [28]	Brus [29]	Evers [30]	Hammond [31]	Hammond [32]	Helewa [33]	Helliewell [34]	Hill [35]	Huiskes [36]	Kaplan [37]	Kraaimaat [38]	Leibing [39]	Lindroth [40]	Lundgren [41]	Neuberger [42]	O'Leary [43]	Parker [44]	Parker [45]	Pradhan [46]	Radojevic [47]	Riemsma [48]	Scholten [49]	Sharpe [50]	Shearn [51]	Taal [7]
Clear objectives	1	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	0	2	2	2	2	2	2	2	2	2	2
Sample size	0	2	0	1	1	0	2	2	2	2	0	0	0	0	2	1	0	0	1	2	1	0	2	1	0	1	1
Trial duration	2	2	2	2	1	1	2	0	2	1	2	1	2	2	2	2	1	1	2	2	1	1	2	2	2	2	2
Power calculation	0	1	0	0	0	2	2	2	0	0	0	0	0	1	0	2	0	0	0	0	2	1	0	0	2	0	0
Method of allocation	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2
Concealment of allocation	0	2	0	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	1	0	2	0	0	0	2	0	0
Treatment clearly described	1	2	1	1	2	2	2	1	1	1	2	0	2	2	1	2	1	2	0	1	2	2	2	2	1	0	2
Manualized treatment	0	1	0	0	2	1	1	0	0	0	0	0	2	2	0	0	0	0	0	0	0	2	1	0	1	0	1
Representative sample	1	1	0	1	1	1	1	1	1	2	1	2	1	2	2	1	1	1	1	1	1	1	1	0	2	1	1
Inclusion criteria	2	1	1	2	2	2	0	2	1	2	1	2	2	2	2	2	1	1	2	2	2	1	2	2	2	2	2
Exclusion criteria	0	2	0	1	2	2	2	2	0	1	0	1	1	2	0	1	0	0	1	2	2	1	2	0	2	0	2
Described demographics	2	1	0	1	2	2	2	2	1	0	1	2	2	2	2	2	0	0	2	2	2	1	2	1	1	1	2
Assessor blinded	0	0	0	1	0	1	1	1	1	1	0	0	1	1	0	1	0	1	0	0	1	0	0	0	2	0	0
Treatment compliance	2	0	0	2	0	2	2	0	2	2	0	1	1	0	0	2	1	1	2	2	2	2	0	0	0	1	2

Side-effects of treatment	2	0	1	1	2	0	2	1	1	2	0	0	1	2	0	2	0	1	0	0	2	1	1	0	1	0	0
Information about drop-outs	0	1	2	1	2	2	2	1	1	2	2	2	2	1	2	2	0	2	2	2	2	1	1	1	1	1	1
Outcome measures	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Between group comparisons	0	2	0	2	2	2	2	1	2	1	2	2	2	2	2	2	2	1	2	2	2	2	2	1	2	2	1
Inclusion of drop-outs	0	1	0	0	1	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
Results presented well	2	2	2	1	2	0	2	2	0	1	2	0	2	2	0	0	1	1	0	0	2	2	2	2	2	2	0
Appropriate analyses	1	2	0	1	2	2	2	1	1	2	2	1	2	2	1	2	2	1	2	1	2	2	2	2	2	2	2
Justified conclusions	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2
Interests declared	0	2	2	2	2	2	2	2	0	2	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Allegiance to therapy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Duration of follow-up	2	2	2	2	1	1	2	0	2	0	1	0	1	2	2	2	0	1	2	2	1	0	2	2	1	2	2
Co-interventions avoided	0	0	0	0	2	0	0	2	0	2	0	0	0	1	0	1	0	2	0	0	0	0	0	0	0	0	0
Drug use assessed	0	0	0	1	2	0	2	0	2	2	0	2	1	2	2	2	0	2	0	2	2	2	0	0	1	0	0
Treatment credibility	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	2	0	1	1	0	0	0	0
Consecutive subjects	0	0	0	2	0	0	0	0	0	0	0	0	0	2	2	0	2	0	0	2	0	0	0	2	2	0	0
Total Quality	**24**	**35**	**21**	**33**	**39**	**34**	**41**	**31**	**32**	**35**	**24**	**26**	**36**	**42**	**32**	**39**	**20**	**26**	**32**	**37**	**42**	**33**	**35**	**28**	**40**	**27**	**31**

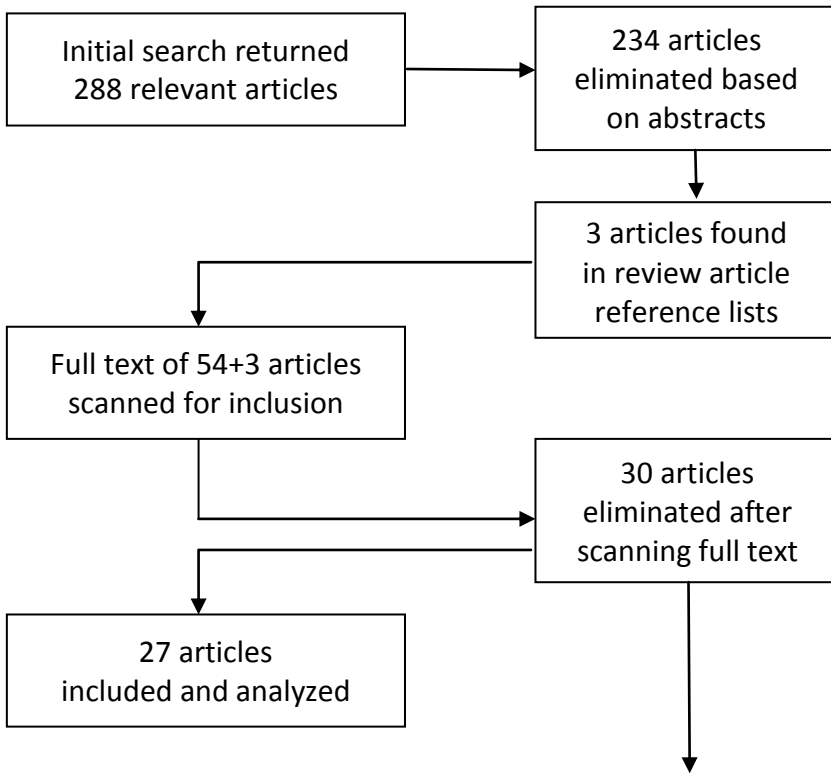
Note. 0 = Not done and/or not reported; 1 = Done and/or reported to some extent; 2 = Adequately done and/or adequately reported.

Table 3 *Comparative and Meta-Regression Analyses Assessing the Effects of Study and Treatment Characteristics upon Effect Size, Separated by Outcome*

	Physical Activity			Pain			Disability			Depressive Symptoms			Anxiety		
Subgroup Analyses	***k***	***g***	***p***	***k***	***g***	***p***	***k***	***g***	***p***	***k***	***g***	***p***	***k***	***g***	***p***
C-B Therapy	-	-		10	0.15		8	0.37		9	0.25		7	0.14	
Patient Education	5	0.45	--	9	0.15	*ns*	6	0.29	*ns*	5	0.29	*ns*	3	0.21	*ns*
Stress Management	-	-		2	0.40		2	0.29		2	0.16		-	-	
High Self-Regulation	4	0.47	--	15	0.20	*ns*	13	0.36	*ns*	11	0.40	**	9	0.22	*
Low Self-Regulation	1	0.32		7	0.12		4	0.21		8	-0.00		2	-0.22	
Adequate Blinds	1	0.51	--	9	0.21	*ns*	7	0.21	*ns*	7	0.17	*ns*	4	0.21	*ns*
Inadequate Blinds	4	0.44		13	0.17		10	0.41		12	0.30		7	0.15	
Allocation concealed	-	-	--	4	0.13	*ns*	5	0.37	*ns*	5	0.25	*ns*	3	0.21	*ns*
Not concealed	5	0.45		18	0.20		12	0.17		14	0.23		8	0.14	
Dropouts included	-	-	--	4	0.12	*ns*	5	0.06	*	4	0.34	*ns*	3	0.24	*ns*
Not included	5	0.45		18	0.21		12	0.41		15	0.20		8	0.12	
Active controls	2	0.39	--	11	0.20	*ns*	8	0.33	*ns*	7	0.40	†	6	0.23	*ns*
Passive controls	3	0.55		11	0.17		9	0.32		12	0.15		5	0.10	
DD ≥ 10 years	2	0.34	--	11	0.17	*ns*	8	0.24	*ns*	9	0.14	*	5	0.08	*ns*
DD < 10 years	1	0.48		8	0.20		8	0.43		6	0.55		4	0.33	
Meta-Regressions	**β_s**	***k***	***p***	**β_s**	***k***	***p***	**β_s**	***k***	***p***	**β_s**	***k***	***p***	**β_s**	***k***	***p***
Study Quality	-0.02	5	*ns*	0.01	22	*ns*	-0.03	17	†	0.01	19	*ns*	0.02	11	*ns*
Contact Time	0.03	4	*ns*	0.00	20	*ns*	0.02	16	*ns*	-0.02	16	*ns*	-0.02	10	*ns*
Sample Size	-0.01	5	*	-0.00	22	*ns*	-0.00	17	*ns*	0.00	19	*ns*	0.00	11	*ns*

Note. ns = non-significant (*p > 0.1); * = p ≤* 0.05; *** = p ≤* 0.01; †= *p ≤* 0.10; - = missing data; -- = no comparison possible; *k* = number of studies included per subgroup per outcome; *g* = Hedges' *g* effect size; *p* = p-value for between groups comparison; β_s = standardized beta coefficient; C-B = cognitive behavior; DD = mean disease duration of patient sample

Figure 1. Flow of studies through the search and acquisition process.



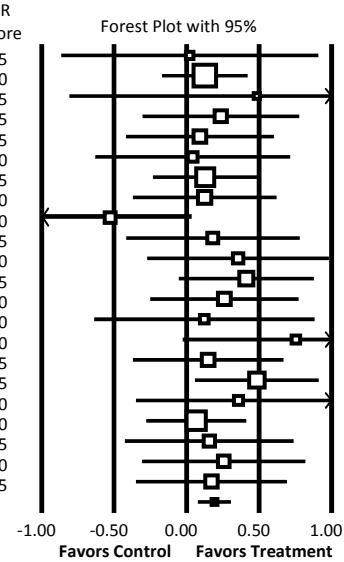
REASONS FOR FINAL 30 EXCLUSIONS	#
No control group	3
No outcomes of interest	3
RA & OA data combined and inseparable	9
Data unsuitable and no additional info available	13
Secondary analysis of another study	2

Post-treatment effect sizes for Pain

Study name	Hedges's g	Lower limit	Upper limit	p-Value	Group Sizes Treat.	Cont.	SR Score
Appelbaum 1988	0.02	-0.86	0.90	0.96	9	9	4.5
Barlow 2000	0.13	-0.16	0.41	0.39	114	77	5.0
Bradley 1984	0.48	-0.80	1.77	0.46	3	4	4.5
Brus 1998	0.24	-0.30	0.77	0.39	25	30	4.5
Evers 2002	0.09	-0.41	0.60	0.72	30	29	5.5
Hammond 1999	0.04	-0.62	0.71	0.90	17	18	8.0
Hammond 2001	0.13	-0.23	0.48	0.48	63	58	7.5
Hill 2001	0.12	-0.36	0.61	0.62	33	30	0.0
Huiskes 1991	-0.53	-1.15	0.09	0.09	21	19	3.0
Kraaimaat 1995	0.18	-0.41	0.77	0.55	24	19	2.5
Leibing 1999	0.35	-0.27	0.97	0.26	19	20	7.0
Lindroth 1997	0.41	-0.05	0.87	0.08	37	36	4.5
Lundgren 1999	0.26	-0.24	0.76	0.31	33	27	0.0
Neuberger 1993	0.12	-0.63	0.88	0.75	15	11	4.0
O'Leary 1988	0.75	-0.02	1.53	0.06	14	12	9.0
Parker 1988	0.15	-0.36	0.66	0.57	29	28	4.5
Parker 1995	0.48	0.06	0.91	0.02	44	44	4.5
Radojevic 1992	0.36	-0.34	1.06	0.32	15	15	3.0
Riemsma 2003	0.07	-0.27	0.40	0.70	61	73	5.0
Sharpe 2001	0.16	-0.42	0.73	0.59	23	22	6.5
Shearn 1985	0.26	-0.30	0.81	0.37	22	27	0.0
Taal 1993	0.17	-0.34	0.69	0.51	27	30	4.5
OVERALL	**0.18**	**0.08**	**0.29**	**0.00**	**678**	**638**	

Random effects model

Heterogeneity: I^2 = 0.0 (Low)



Post-treatment effect sizes for Disability

Study name	Hedges' g	Lower limit	Upper limit	p-value	Group Sizes Treat.	Cont.	SR Score
Barlow 2000	-0.09	-0.38	0.19	0.52	114	77	5.0
Brus 1998	0.00	-0.53	0.53	1.00	25	30	4.5
Evers 2002	0.21	-0.30	0.71	0.42	30	29	5.5
Hammond 1999	-0.04	-0.71	0.63	0.91	17	18	8.0
Helewa 1991	0.30	-0.11	0.70	0.15	48	45	0.0
Helliwell 1999	0.22	-0.23	0.67	0.33	43	34	2.5
Leibing 1999	0.30	-0.31	0.92	0.34	19	20	7.0
Lindroth 1997	0.51	0.05	0.97	0.03	37	36	4.5
O'Leary 1988	0.21	-0.49	0.91	0.55	15	15	9.0
Parker 1988	0.44	-0.09	0.96	0.10	28	28	4.5
Parker 1995	0.47	0.05	0.89	0.03	44	44	4.5
Radojevic 1992	0.19	-0.51	0.89	0.59	15	15	3.0
Riemsma 2003	0.26	-0.08	0.60	0.13	61	73	5.0
Scholten 1999	1.81	1.25	2.38	0.00	38	30	5.5
Sharpe 2001	0.33	-0.25	0.91	0.26	23	22	6.5
Shearn 1985	0.03	-0.52	0.58	0.92	23	27	0.0
Taal 1993	0.38	-0.14	0.89	0.15	27	30	4.5
OVERALL	**0.32**	**0.13**	**0.51**	**0.00**	**607**	**573**	

Random effects model

Heterogeneity: I^2 = 60.26 (Medium)

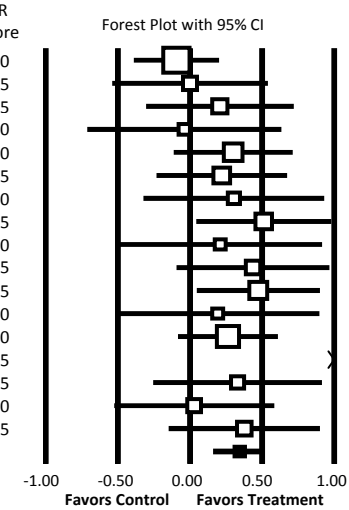
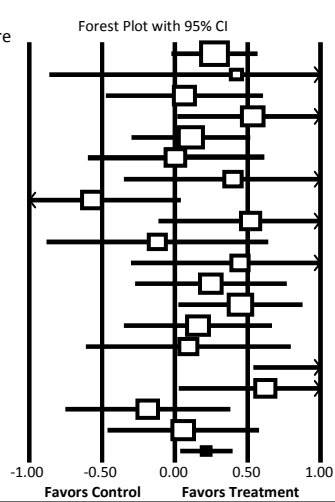


Figure 2. Forest plot of post-treatment data for physical outcomes.

Post-treatment effect sizes for Depressive Symptoms

Study name	Hedges's g	Lower limit	Upper limit	p-Value	Group Sizes Treat.	Cont.	SR Score
Barlow 2000	0.27	-0.02	0.56	0.07	114	77	5.0
Bradley 1984	0.42	-0.86	1.70	0.52	3	4	4.5
Brus 1998	0.07	-0.47	0.60	0.81	25	30	4.5
Evers 2002	0.53	0.02	1.05	0.04	30	29	5.5
Helewa 1991	0.11	-0.29	0.51	0.59	49	45	0.0
Huiskes 1991	0.03	-0.58	0.64	0.93	21	19	3.0
Kaplan 1981	0.40	-0.34	1.14	0.29	11	17	0.0
Kraaimaat 1995	-0.57	-1.17	0.03	0.06	24	19	2.5
Leibing 1999	0.52	-0.11	1.15	0.10	19	20	7.0
Neuberger 1993	-0.12	-0.87	0.63	0.75	15	11	4.0
O'Leary 1988	0.45	-0.30	1.19	0.24	14	13	9.0
Parker 1988	0.25	-0.27	0.76	0.35	29	28	4.5
Parker 1995	0.45	0.03	0.87	0.04	44	44	4.5
Pradhan 2007	0.16	-0.34	0.66	0.54	28	32	0.0
Radoievic 1992	0.09	-0.60	0.79	0.80	15	15	3.0
Scholten 1999	1.05	0.55	1.56	0.00	38	30	5.5
Sharpe 2001	0.62	0.03	1.21	0.04	23	22	6.5
Shearn 1985	-0.19	-0.75	0.37	0.51	22	26	0.0
Taal 1993	0.06	-0.46	0.57	0.83	27	30	4.5
OVERALL	**0.23**	**0.06**	**0.39**	**0.01**	**551**	**511**	
Random effects model							
Heterogeneity: I^2 = 46.95 (Medium)							



Post-treatment effect sizes for Anxiety

Study name	Hedges's g	Lower limit	Upper limit	p-Value	Group Sizes Treat.	Cont.	SR Score
Barlow 2000	0.20	-0.09	0.49	0.18	114	77	5.0
Bradley 1984	0.17	-1.09	1.44	0.79	3	4	4.5
Brus 1998	0.25	-0.29	0.79	0.37	25	30	4.5
Evers 2002	0.24	-0.27	0.74	0.36	30	29	5.5
Huiskes 1991	-0.10	-0.71	0.51	0.74	21	19	3.0
Kraaimaat 1995	-0.33	-0.92	0.27	0.28	24	19	2.5
Leibing 1999	0.57	-0.05	1.20	0.07	19	20	7.0
Parker 1988	0.10	-0.41	0.61	0.70	29	28	4.5
Parker 1995	0.11	-0.30	0.53	0.59	44	44	4.5
Sharpe 2001	0.37	-0.21	0.95	0.21	23	22	6.5
Taal 1993	0.22	-0.30	0.73	0.41	27	30	4.5
OVERALL	**0.17**	**0.02**	**0.32**	**0.03**	**359**	**322**	
Random effects model							
Heterogeneity: I^2 = 0.0 (Low)							

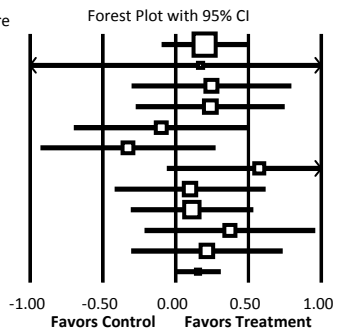


Figure 3. Forest plot of post-treatment data for psychological outcomes.

Post-treatment effect sizes for Physical Activity

Study name	Hedges's g	Lower limit	Upper limit	p-Value	Group Sizes Treat.	Group Sizes Cont.	SR Score
Brus 1998	0.51	-0.02	1.04	0.06	25	30	4.5
Lindroth 1997	0.66	0.20	1.13	0.01	37	36	4.5
Neuberger 1993	0.32	-0.44	1.08	0.41	15	11	4.0
Riemsma 2003	0.06	-0.28	0.40	0.72	61	73	5.0
Taal 1993	0.78	0.27	1.29	0.00	22	30	4.5
OVERALL	**0.45**	**0.14**	**0.75**	**0.00**	**160**	**180**	
Random effects model							
Heterogeneity: I^2 = 0.0 (Low)							

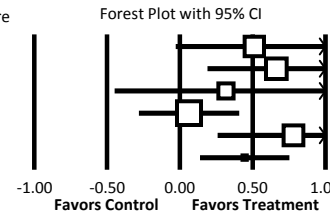


Figure 4. Forest plot of post-treatment physical activity data.

Appendix A. Search Strategy for MEDLINE and PSYCInfo

S1. exp arthritis/ or exp rheumatoid arthritis/
S2. TI arthritis or TI rheum$
S3. S1 or S2
S4. exp clinical trials/
S5. TI crossover or AB crossover or SU crossover
S6. TI ((doubl$ OR singl$) AND blind$) or AB ((doubl$ OR singl$) AND blind$) or SU ((doubl$ OR singl$) AND blind$)
S7. TI random$ or AB random$ or SU random$
S8. clinical trial.pt.
S9. controlled clinical trial.pt.
S10. randomized controlled trial.pt.
S11. or/S4-S10
S12. exp behavior therapy/ or exp behaviour therapy/
S13. exp hypnosis/
S14. exp self regulation/
S15. exp biofeedback/
S16. exp relaxation/
S17. exp cognitive therapy/
S18. exp stress/
S19. exp stress management/
S20. exp psychological/
S21. exp psychodynamic/
S22. exp disclosure/ or exp writing/
S23. TI stress and TI (manag$ or reuc$ or therapy)
S24. TI emotional disclosure or TI hypnosis or TI therapy
S25. TI psycho$
S26. or/S12-S25
S27. exp physical activity/ or exp exercise/
S28. exp walking/ or exp cycling/ or exp biking/
S29. exp pain/ or exp disability/ or exp disease activity/
S30. exp depression/ or exp anxiety/ or exp depressive symptoms/
S31. or/S27-S30
S32. S3 and S11 and S26 and S31
S33. S32 and (TI arthritis) and (Patient group = human)

Date of last search: March 23rd, 2009

Appendix B. Self-Regulation Techniques Coding Form

Self-regulation principles	
Goal setting	0 = No mention of goal-setting (Might also say patients were encouraged to …); 1 = Goal-setting mentioned explicitly, with or without a description of actual goals; 2 = Goal-setting mentioned explicitly, content of goals is specified, and goals are shared or personal in nature (For Example: "realistic goals," specification with regard to time, "client and therapist worked together to create goals")
Planning	0 = No mention of planning; 1 = Mentioned simply as planning, OR by use of one of the terms 'sub-goals' 'steps' 'laddering' or breaking large goals down into smaller goals; 2 = Planning mentioned specifically in regard to either where, when, how, or with whom a specific action is to take place. May also be termed "action planning" or "implementation intention"
Self-monitoring	0 = No mention of self-monitoring OR mentioned in the form of an "emotional diary" 1= Self-monitoring mentioned explicitly mentioned, but unspecified. (E.g. record keeping) 2 = Self-monitoring mentioned in regard to a specific behavior, target, or problem.
Progress evaluation/ feedback	0 = Not mentioned; Self-monitoring diaries not reviewed 1 = Feedback is provided to patients regularly 2 = Feedback is provided regularly regarding goal-related progress
Relapse prevention	0 = No mention of relapse prevention; 1 = Mentioned specifically as "relapse prevention," or identifying problem situations for maintaining behavior change; 2 = The relapse prevention involves planning the avoidance or management of such problem situations which could inhibit maintenance of behavior change.

References

[*] – indicates study was included in meta-analysis

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Chapter 3

Self-efficacy and physical activity goal achievement predict arthritis pain and quality of life among patients with rheumatoid arthritis

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3

Abstract

Objectives: To examine physical activity and achievement of physical activity goals in relation to self-reported pain and quality of life among patients with rheumatoid arthritis (RA).

Methods: At baseline, 271 patients with RA were asked to specify a physical activity goal, and filled in questionnaires assessing physical activity, motivation and self-efficacy for physical activity, arthritis pain, and quality of life. Six months later, patients indicated to what extent they had achieved their baseline physical activity goal, and completed the same set of questionnaires. These data were used to construct multiple mediation models which placed physical activity and physical activity goal achievement as mediators between self-efficacy and motivation on one hand, and arthritis pain and quality of life on the other.

Results: 106 patients with RA completed both questionnaires. Self-efficacy at baseline predicted subsequent level of physical activity and achievement of physical activity goals. Goal achievement had a direct effect upon quality of life outcomes. Bootstrapping confidence intervals revealed indirect effects of self-efficacy upon arthritis pain and quality of life through goal achievement, but not through physical activity.

Conclusions: Higher levels of self-efficacy for physical activity increase the likelihood that patients will achieve their physical activity goals. Achievement of physical activity goals seems to be related to lower self-reported arthritis pain, and higher levels of quality of life. In practice, clinicians can foster self-efficacy and goal achievement by assisting patients in setting realistic, attainable exercise goals, developing action plans, and by providing feedback on goal progress.

Significance and Innovation of these findings

Innovation

- The extent to which patients with RA achieve their physical activity-related goals appears to be a more powerful predictor of arthritis pain and quality of life than level physical activity itself.

- Patients with higher levels of self-efficacy for physical activity are more likely to achieve their self-set physical activity goals.

Significance

- For clinicians and researchers involved in intervention development, the results indicate that an increased focus on self-efficacy enhancement, realistic goal-setting, and techniques which increase the likelihood of goal achievement may maximize the benefit of such interventions upon pain and quality of life outcomes.

Patients with rheumatoid arthritis (RA) cite pain and stiffness as the most limiting factors of their illness [1], and report lower health-related quality of life (QoL) than healthy individuals [2]: a relationship which is even more pronounced for RA patients who do not participate in regular physical activity [3]. In the last decades, research illustrating the importance of physical activity for patients with RA has begun to accumulate. Several treatment trials have demonstrated that physical activity has positive impacts upon pain, disease activity, and functional status [4-6]. Despite these apparent benefits, and the fact that even dynamic forms of exercise are generally safe for this group [7], RA patients remain less physically active than the general population [8], with most exercising less than the recommended norm of 30 minutes per day on five days of the week [9].

In the general population, stable factors such as age, gender, and environmental barriers each predict lower physical activity, whereas enjoyment of exercise, social support, self-efficacy, and autonomous motivation (autonomous regulation) for exercise each predict higher levels of physical activity [10]. Among patients with RA, these last two variables, self-efficacy and autonomous motivation, have both been linked to increased physical activity participation.

Self-efficacy, or one's belief in his or her own capabilities to perform a specific behavior [11], predicts physical activity levels among RA patients [12]. This has lead to the development of interventions aimed at increasing self-efficacy for physical activity. Such interventions typically encourage patients to set physical activity goals, and to develop detailed plans about how to achieve those goals [13]. The idea behind these goal-setting interventions is that the more realistic and achievable a goal is, and the more concrete its plan of execution, the more likely it is to be achieved. This mastery experience (goal achievement) then contributes to a virtuous circle of improved self-efficacy evaluations and increased physical activity [14]. Increases in physical activity are thereafter assumed to impact upon disease related variables [15].

In addition, an individual's regulatory style also predicts engagement in physical activity among people with RA. The term regulatory style is derived from self-determination theory, and describes the extent to which individuals engage in behavior for either personal, self-chosen reasons (autonomous motivation), or for external reasons chosen by others (coerced motivation)[16]. People with RA who give more autonomously motivated reasons for being physically active have been shown to be more physically active than their more coerced motivated counterparts [17].

In practice and in intervention research, autonomous motivation can be fostered by allowing patients, either individually or in collaboration with practitioners, to set their own goals for treatment [18]. Goals set in a collaborative manner have been shown to increase patient adherence to rehabilitation goals [19], and to increase achievement of goals [20]. In other populations, autonomous motivation has been linked to adherence to both physical activity and medication regimens (21-22), both of which can improve reports of pain [23-24] and quality of life [23,25] among patients with RA.

Taken together, both self-efficacy and autonomous motivation predict increased physical activity among patients with RA [12,17], but it is unclear whether these variables predict greater goal achievement among this group. Additionally, the achievement of personal goals has been shown to predict improved quality of life outcomes in other chronic disease populations [26-27], but this relationship has not yet been examined among patients with RA.

To explore these hypotheses among patients with RA, the present study will test three multiple-mediation models which assume that physical activity and goal achievement mediate the relationships between self-efficacy and autonomous motivation on the one hand, and either arthritis pain, physical quality of life or mental quality of life on the other (Figure 1). Within a sample of RA patients, we hypothesize that, after controlling for age, gender and baseline levels of dependent variables, indirect effects through both physical activity and goal achievement will predict arthritis pain, and both physical and mental quality of life (QoL).

Patients and Methods

Study Design and Procedures

This was a multi-center longitudinal investigation performed in the rheumatology outpatient clinics of three hospitals in the Netherlands (Leiden University Medical Center; HAGA Hospital, The Hague; and Reiner de Graaf Gasthuis, Delft). After obtaining ethical approval from the medical ethics committees of each of the participating hospitals, 643 patients who fulfilled the ACR criteria for RA and who had visited the outpatient clinic of any of the hospitals within the last 12 months were randomly selected and mailed a baseline questionnaire (T1). This initial mailing included a written informed consent form which was to be returned with the questionnaire if the patient chose to participate.

Six months later, a follow-up questionnaire (T2) was mailed to the 271 patients who had returned the baseline questionnaire and provided informed consent. At both time points, questionnaires assessed regulatory style

(motivation), self-efficacy for physical activity, physical activity, arthritis pain and quality of life. Figure 2 provides further detail on the flow of participants through the study.

Measurements

Regulatory style. The Treatment Self Regulation Questionnaire for physical activity (TSRQ)[28] assessed participants' regulatory style at baseline. The TSRQ consists of the two subscales autonomous motivation (3 items) and coerced motivation (7 items), each scored on a 7-point Likert scale (1 = not true at all; 7 = very true).Both subscales were calculated by summing the items, and then standardized using the formula $z = (x - \mu)/\sigma$; where *z* is the standardized score, *x* is the raw score, and μ and σ are the mean and standard deviation of the sample, respectively. Subsequently, one variable for regulatory style was created by subtracting standardized coerced motivation scores from standardized autonomous motivation scores. Positive scores on this combined scale represent more autonomous motivation, and negative scores represent more coerced motivation. The TSRQ has reasonable validity, reliability and internal consistency [28], and this method of combining the subscales has been used previously [17].

Self-efficacy. At baseline, participants were asked to write down a physical activity goal which they wished to strive toward in the months thereafter, and completed the four-item goal-efficacy subscale of the Self-Regulation Skills Battery (SRSB)[29] in relation to that self-set physical activity goal. The scale includes items such as '*I have what is needed to achieve this goal*' and '*I am capable of achieving this goal*,' each of which is scored on a five-point scale (1 = completely disagree; 5 = completely agree). Possible scores range from 4 to 20, with higher scores indicating more self-efficacy for the physical activity goal.

Goal achievement. At follow-up, participants were reminded of the goal they had set at baseline, and were asked to rate the degree to which they had achieved the goal using a 100 millimeter visual analog scale (VAS) which had anchors of '*I have not yet begun working toward this goal*' and '*I have achieved this goal.*' The score for goal achievement was obtained by measuring the distance (in mm) from the left anchor to the stripe.

Physical activity. The Short Questionnaire to Assess Health-Enhancing Physical Activity (SQUASH)[30] contains questions assessing physical activities related to commuting, leisure time, sports, household activities, and work/school activities. Each of these activities is assessed using 2 items: days per week, and average minutes per day. The product of these 2 items represents

minutes per week for that activity, and total minutes per week are calculated by summing all activity scores.

Arthritis pain. Three items from the Rheumatoid Arthritis Disease Activity Index (RADAI) were used to assess arthritis pain [31]. The first two items assessed current tenderness and swelling in joints and current arthritis pain: both using a 0-10 rating scale (0 = no pain/tenderness; 10 = extreme pain/tenderness). The third item assessed pain in 16 individual joints (both left and right toes, ankles, knees, hips, fingers, wrists, elbows, and shoulders) on a 0-3 scale (0 = no pain; 3 = severe pain). These were then summed (range 0-48) and transformed to a 0-10 scale. The RADAI total pain score was calculated by taking an arithmetic mean of the 3 0-10 scaled items.

Quality of life. To assess quality of life (QoL), a validated Dutch version of the Short Form-36 (SF-36) was used [32]. The SF-36 assesses 8 separate domains of quality of life: physical functioning, role limitations due to physical health problems, bodily pain, social functioning, mental health, role limitations due to emotional problems, vitality, and general health perceptions. These 8 subscales were combined into a physical component summary (PCS) and mental component summary (MCS), which operationalize QoL at a more general level. Possible scores on the PCS and MCS range from zero (0) to 100, with lower scores representing worse physical and mental quality of life respectively.

Statistical Analyses

Initially, independent *t*-tests compared baseline data of participants who had completed both questionnaires (completers) to those of participants who had only completed the baseline questionnaire (drop-outs). Independent *t*-tests also compared baseline data of male versus female completers, and completers with recent versus longstanding RA on each of the variables assessed in the study. Pearson correlations and linear regression analyses examined possible multicollinearity between the variables.

The mediation models presented in figure 1 were tested using the bootstrapping procedure suggested by Hayes [33]. This method produces an estimate of the magnitude of each indirect effect (mediation), as well as a corresponding confidence interval. An indirect effect is assumed to be significant at the $\alpha = 0.05$ level if its 95% confidence interval does not include zero.

The *indirect.sps* macro for SPSS [34] was used for all mediation analyses. This macro accepts one independent variable, one dependent variable, and up to 10 mediator variables per analysis. As the proposed mediation models each contain two independent variables, a two-step approach was used. In step

one, autonomous motivation was entered as the independent variable and self-efficacy as a covariate. In step two, self-efficacy was entered as the independent variable and autonomous motivation as a covariate. In both steps, physical activity and goal achievement were entered as potential mediators, and age, gender, and baseline levels of the dependent variable were entered as additional covariates. This method evaluates the indirect effects of each independent variable separately, and does so after taking into account the effects of the other independent variable and the covariates [35].

Results

Of the 271 patients who returned the baseline questionnaire, 129 (48%) also returned the follow-up questionnaire. Patients who returned only the baseline questionnaire reported significantly less physical exercise (t = 2.06; p = 0.04) and worse mental quality of life (t = 2.27; p = 0.02) at baseline than those who returned both questionnaires, but did not significantly differ on any other variables (See Table 1).

Among the 129 questionnaires returned at follow-up, 23 were excluded because of considerable amounts of missing data. In total, the data from 106 patients were included in this study (39% of total respondents at baseline). No significant differences were found between men and women who completed both questionnaires; nor were significant differences found between people with recent versus longstanding RA (≥ 10 years).

At follow-up, participants rated the extent to which they had achieved the physical activity goal they had set for themselves at baseline. Ratings of goal achievement ranged from 3 to 100 (Median = 72; IQR = 50 to 87), with 75% of participants having rated their goal achievement as 50% or more.

None of the Pearson correlations (Table 2) between the study variables exceeded the 0.80 multicollinearity threshold suggested by Field [36]. However, as a second test of multicollinearity, one linear regression analysis was conducted for each of the three dependent variables (arthritis pain, physical QoL, and mental QoI). In each of these analyses, all proposed independent and mediator variables were entered as predictors, and the variance inflation factors (VIF) were examined. The largest of the VIFs was 1.456, indicating that multicollinearity would not greatly influence the results of the mediation analyses [37].

Before examining the proposed mediation models, we first examined the relationships between the independent and mediating variables (the *a* paths) which were common to all mediation models. Although all bivariate correlations between independent and mediating variables were significant

(Table 2), only the associations between self-efficacy, goal achievement and physical activity remained significant after controlling for age, gender and baseline levels of dependent variables.

Contrary to our hypothesis, our first mediation model did not demonstrate a significant relationship between physical activity and arthritis pain (*b* path). This model did however yield a significant indirect effect of self-efficacy upon arthritis pain through goal achievement (*a* x *b* path). As a whole, the model was significant and explained 31.4% of the variance in T2 arthritis pain. See Table 3.

In the two mediation models predicting quality of life, one *b* path was significant: goal achievement predicted better physical and mental quality of life. In both models (mental QoL and physical QoL), self-efficacy had a significant indirect effect upon QoL through goal achievement. No significant indirect effects through physical activity were found for either physical QoL or mental QoL. Both models were significant overall, and explained 43.8% and 60.0% of the variance in T2 physical QoL and T2 mental QoL respectively. Results of these analyses are presented in Table 3.

Discussion

This study examined whether self-efficacy for physical activity (SE_{PA}) and/or autonomous motivation of behavior are indirectly linked to arthritis pain and quality of life among patients with RA: either through physical activity or through the achievement of physical activity goals. In investigating these links, we tested multiple mediation models which indicated that the achievement of physical activity goals at least partially explains the relationships between SE_{PA} on the one hand, and arthritis pain and quality of life on the other.

In our mediation models, SE_{PA} at baseline was shown to predict physical activity at follow-up. This relationship has been repeatedly demonstrated before(10). Patients with RA who are more physically active quite naturally rate themselves as competent to remain physically active, and vice versa. It therefore remains important for clinicians interacting with patients who might benefit from increased physical activity to foster self-efficacy in their consultations [38].

Our analyses also demonstrated a positive relationship between SE_{PA} at baseline and subsequent achievement of physical activity goals. Although this association had been hinted at in early work on goal-setting theory [39], only one study had previously examined it quantitatively within the domain of physical activity [40]. Among individuals given the opportunity to set personal goals, as was the case in both the present study and that of Poag and McAuley [40], high levels of self-efficacy predict an increased likelihood of self-set goal

achievement. Although not tested in the present study, this relationship is assumed to become cyclical as mastery experiences and goal achievement lead to further increases in self-efficacy [14].

Surprisingly, although autonomous motivation was significantly correlated with physical activity and goal achievement, no significant relationships were found between these variables in the overall mediation model after controlling for age, gender, and self-efficacy. This may indicate that SE_{PA} is a stronger predictor of both physical activity and goal achievement than autonomous motivation, but also that these variables, as well as their interactions, should be further examined in this population.

Our first mediation model revealed significant indirect effects of self-efficacy upon arthritis pain, through the achievement of physical activity goals. This indirect effect through goal achievement may provide new ideas of how goal-setting interventions operate among patients with RA. Taking hints from research within the occupational domain, individuals with higher levels of self-efficacy are likely to set goals at a higher level of performance than individuals with lower levels of self-efficacy [39]. The indirect effects through goal achievement may therefore reflect a tendency of highly self-efficacious individuals to set more difficult physical activity goals, perhaps involving more dynamic conditioning or strengthening exercises [7,41], which in turn have greater effects upon arthritis pain.

Our second and third mediation models demonstrated significant relationships between goal achievement and physical and mental domains of quality of life, respectively. These relationships provide evidence for the importance of goal achievement in RA patients' subjective assessments of quality of life; a relationship which has previously been demonstrated among patients with chronic obstructive pulmonary disorder (COPD)[42].

As a whole, these two mediation models demonstrated indirect effects of self-efficacy, through goal achievement, upon both physical and mental quality of life. Achievement of physical activity goals seems to improve patient-rated quality of life among patients with RA. This may be explained, at least in part, by improvements in patients' perceived control over their disease, as among a sample of patients with COPD, the achievement of treatment goals was shown to predict increased feelings of control over illness and increased quality of life [42].

The mediation models presented here were tested using robust non-parametric resampling techniques (bootstrapping), and the data were collected with a time-lag appropriate to the expected changes in variables from baseline to follow-up. Additionally, the direction of the indirect effects was confirmed by

a lack of significant findings when testing alternative directional possibilities within the models (reverse mediation, etc.)[43].

Despite these strengths, the present study also has several limitations. First, we did not examine the content of participants' physical activity goals. Future research which rates and/or quantifies the difficulty and potential benefits of the participants' physical activity goals might shed more light on whether these factors strengthen or weaken the impact of goal achievement. Future research might also examine the impact of other aspects of goal content (e.g. specificity, time-frame)[44], as well as the importance of patients' physical activity goals in relation to other important goals they may have [45].

Additionally, only 39% of baseline participants returned a follow-up questionnaire which contained usable data. As those patients who dropped out of the study reported significantly less physical activity and lower quality of life at baseline than study completers, it is possible that our sample does not represent the full range of these variables within the population. A replication of this study with less attrition would therefore increase the external validity of our findings.

Finally, when compared to objective measures of physical activity like accelerometers, self-report measures like the one used in the present study may overestimate both the amount and intensity of physical activity undertaken by participants [46]. As a result, it is unclear whether participants who completed this study performed as much physical activity as they stated and at what intensity these activities were done. To determine whether our results hold in the presence of over-reported physical activity, future research should examine the mediation models proposed here using an objective measure of physical activity.

This novel longitudinal examination of the mediating effects of physical activity and the achievement of physical activity goals demonstrates the importance of subjective goal achievement in relation to self-reported pain and quality of life among patients with RA. In future research in this area, efforts should be made to examine other psychological variables, such as depressive symptoms and optimism, which influence self-reports of pain among patients with arthritis [47].

In practice, clinicians can foster goal achievement in a number of ways when setting rehabilitation goals with RA patients. First, since unattained goals can be detrimental to self-efficacy [14], goals should be patient-owned, short-term and as realistic as possible. In addition, clinicians can employ strategies which increase the likelihood of goal achievement, such as assisting patients in making detailed action plans, breaking down objectives into smaller, more manageable

sub-objectives, providing regular feedback on goal progress (e.g. by use of pedometers or accelerometers), fostering self-monitoring, and brainstorming solutions to problems before they arise (creating coping plans)[18,48]. Due to time limitations, however, these techniques may be difficult to work into a typical rheumatology consultation. Delivering these techniques may therefore require a slightly longer consultation or referral to a health professional with more time allotted per patient (e.g. clinical nurse specialist, physical therapist)[49].

Conflicts of Interest

None of the authors received financial support or other benefits from commercial sources for the work reported in this manuscript. None of the authors have financial interests which may have presented a conflict of interests in this work.

Table 1. Comparisons between baseline data of drop-outs and completers, and comparisons between baseline and follow-up data within completers.

	Baseline Data (T1)		Follow-up Data (T2)
Variable; Measure (Range)	Drop-outs (n = 142)	Completers (n = 129)	Completers (n = 129)
Age; years	63.1 ± 14.5	60.5 ± 13.6	--
Disease duration; years	10.2± 8.6	9.8 ± 6.8	--
Regulatory style; TSRQ (-4-4) §	-0.13 ± 1.51	0.14 ± 1.37	-0.01 ± 1.43
Self-efficacy; SRSB (4-20)	15.5 ± 2.2	15.5 ± 2.2	15.8 ± 2.9
Goal achievement; VAS (0-100)	--	--	68.4 ± 23.9
Physical activity; SQUASH (min/week)	1577 ± 1061*	1873 ± 1258*	1945 ± 1327
Arthritis pain; RADAI (0-10) §	3.18± 2.32	3.05± 2.24	2.95 ±2.26
Physical QoL; SF-36 (0-100) §	53.1 ± 23.7	57.8 ± 22.2	55.9 ± 22.8
Mental QoL; SF-36 (0-100)§	67.3 ± 23.1*	73.4 ± 20.2*,‡	70.8 ± 20.7‡

Note. Data are presented as Mean ± SD; *P < 0.05 for comparison between drop-outs and completers at baseline;‡P < 0.05 for comparison of baseline versus follow-up data within completers; §More positive/higher scores represent more autonomous regulation, more arthritis pain, and better quality of life.

Table 2. Pearson correlation coefficients between variables included in the mediation models† (n = 106).

	1	2	3	4	5	6	7
1. T1 Age	--						
2. T1 Regulatory style	-0.45**	--					
3. T1 Self-efficacy	-0.32**	0.36**	--				
4. T2 Goal achievement	-0.21*	0.29**	0.34**	--			
5. T2 Physical activity score	-0.54**	0.36**	0.25**	0.16	--		
6. T2 Arthritis pain	-0.24**	-0.09	-0.07	-0.20*	-0.26**	--	
7. T2 Physical QoL	-0.31**	0.32**	0.24*	0.40**	0.43**	-0.58**	--
8. T2 Mental QoL	-0.22*	0.31**	0.19	0.31**	0.36**	-0.39**	0.75**

Note. † Variables 1 through 3 were measured at baseline (T1), and variables 4 through 8 were measured six months later (T2); * $p \leq 0.05$; ** $p \leq 0.01$.

Table 3. Summary of mediation analyses, controlled for age, gender and baseline levels of dependent variables.

Independent variables (IV)	*a* paths a_n: IV → M	Mediator variables (M)	*b* paths b_n: M → DV	Dependent variable (DV)	Indirect effect $a_n \times b_n$	95% Bootstrap CI of indirect effect
Autonomous	$a_1 = 2.87$	Goal achievement	$b_1 = -0.018$*	Arthritis Pain	$a_1 \times b_1 = -0.052$	(-0.181 – 0.011)
Autonomous	$a_2 = -12.79$	Physical activity	$b_2 = -0.001$	Arthritis Pain	$a_2 \times b_2 = 0.002$	(-0.040 – 0.087)
Self-efficacy	$a_3 = 3.25$*	Goal achievement	$b_1 = -0.018$*	Arthritis Pain	$a_3 \times b_1 = -0.059$	(-0.151 – -0.008)†
Self-efficacy	$a_4 = 103.49$*	Physical activity	$b_2 = -0.001$	Arthritis Pain	$a_4 \times b_2 = -0.018$	(-0.100 – 0.009)
Autonomous	$a_1 = 2.34$	Goal achievement	$b_1 = 0.218$**	Physical QoL	$a_1 \times b_1 = 0.511$	(-0.302 – 1.849)
Autonomous	$a_2 = -18.65$	Physical activity	$b_2 = 0.002$	Physical QoL	$a_2 \times b_2 = -0.039$	(-0.904 – 0.378)
Self-efficacy	$a_3 = 3.07$*	Goal achievement	$b_1 = 0.218$**	Physical QoL	$a_3 \times b_1 = 0.670$	(0.128 – 1.593) ‡
Self-efficacy	$a_4 = 75.41$*	Physical activity	$b_2 = 0.002$	Physical QoL	$a_4 \times b_2 = 0.156$	(-0.056 – 0.693)
Autonomous	$a_1 = 1.76$	Goal achievement	$b_1 = 0.122$*	Mental QoL	$a_1 \times b_1 = 0.215$	(-0.192 – 1.230)
Autonomous	$a_2 = -72.21$	Physical activity	$b_2 = 0.002$	Mental QoL	$a_2 \times b_2 = -0.157$	(-1.245 – 0.222)
Self-efficacy	$a_3 = 3.17$*	Goal achievement	$b_1 = 0.122$*	Mental QoL	$a_3 \times b_1 = 0.388$	(0.032 – 1.072) †
Self-efficacy	$a_4 = 86.47$*	Physical activity	$b_2 = 0.002$	Mental QoL	$a_4 \times b_2 = 0.188$	(-0.033 – 0.786)

Note. Confidence intervals (CI) presented are bias corrected and accelerated, and based on 5000 bootstrap re-samples;* $p < 0.05$; ** $p < 0.01$; † -95% CI does not include zero; ‡ - 99% CI does not include zero; Adjusted R^2predicting arthritis pain= 0.314, $p < 0.0001$; Adjusted R^2 predicting physical QoL = 0.438, $p < 0.0001$; Adjusted R^2 predicting mental QoL = 0.600, $p < 0.0001$

Figure 1

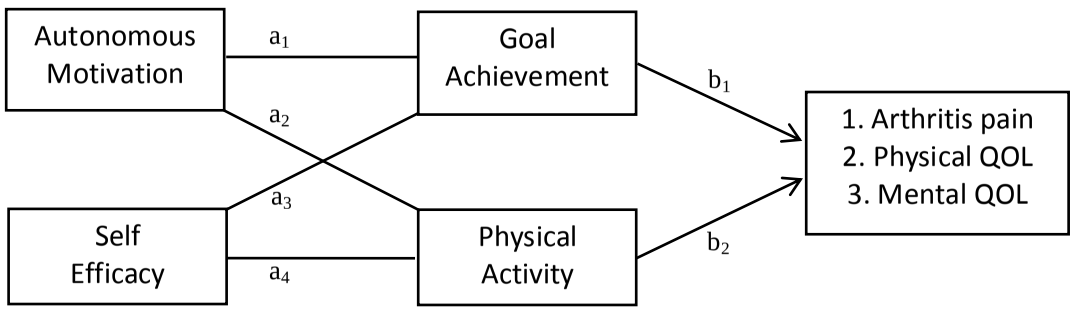

Figure 1.Graphic representation of the indirect effects of autonomous motivation and self-efficacy upon arthritis pain and quality of life, through goal achievement and physical activity.

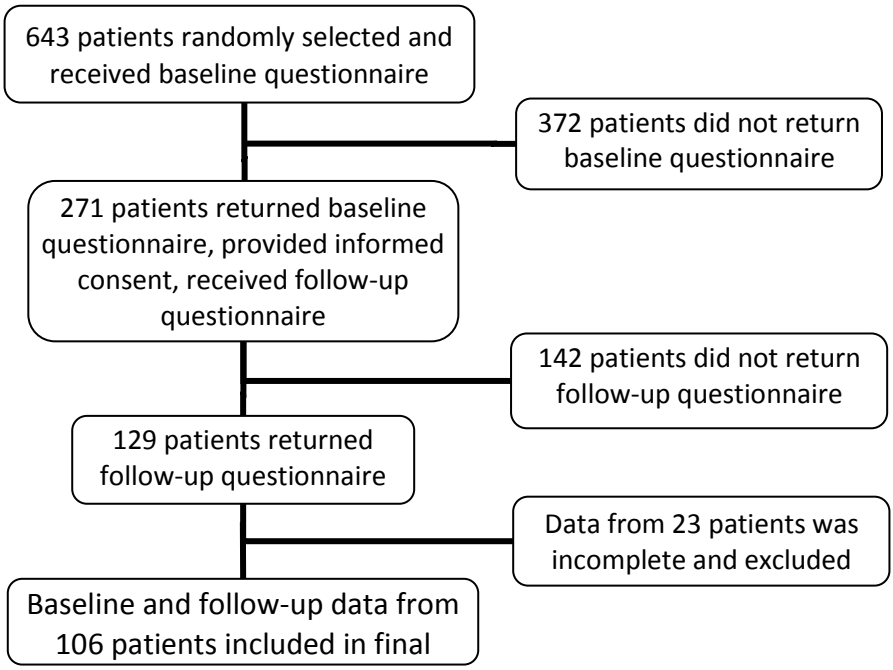

Figure 2 – Flow of participants through the study.

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Chapter 4

A randomized controlled trial targeting motivation and self-regulation to increase physical activity among patients with rheumatoid arthritis

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Submitted

4

Abstract

Objective: To evaluate whether a 5-week intervention that targets both the motivation and action phases of behavior change leads to increased physical activity (PA) among insufficiently active patients with rheumatoid arthritis (RA).

Methods: Seventy-eight patients with RA who did not meet the 5x30 minutes recommendations for healthy PA were randomly allocated to receive a group-based patient education session led by a physical therapist (control), or the education session plus a motivational interview and 2 self-regulation coaching sessions led by a physical therapist and a rheumatology nurse respectively (treatment). At baseline, 6-weeks and 32-weeks patients in both groups filled-in questionnaires assessing self-efficacy and autonomous motivation for PA, leisure-time PA, and days per week with at least 30 minutes of moderate-intensity PA; and the secondary outcomes disease activity, functional status, depressive symptoms and fatigue.

Results: The intervention had significant effects over time on self-efficacy, autonomous motivation, leisure-time PA and active days/week compared to the control group. At 6-weeks, 67% and 23% of the treatment and control groups met the 5x30 recommendation for healthy PA. At 32 weeks, these percentages were 48% and 25%, respectively. Furthermore, the treatment group reported significant reductions in depressive symptoms and fatigue at 6-weeks.

Conclusion: This minimally resource-intensive intervention combined motivational interviewing and self-regulation coaching, and led to sustained increases in PA which may be attributable to changes in self-efficacy and autonomous motivation for PA. Programs emphasizing patients' personal goals and motivations when promoting PA among patients with RA may help maintain changes in behavior.

Significance and Innovations

- This pilot intervention was the first to combine motivational interviewing and self-regulation coaching to promote physical activity (PA) among insufficiently active patients with RA.
- The intervention, which targeted both the motivation and action phases of behavior change, had significant effects on autonomous motivation and self-efficacy for PA, as well as on leisure-time PA.
- Despite only 5 hours of contact time per patient, rates of PA initiation and maintenance were higher than those achieved by more resource-intensive interventions which only targeted the action phase of behavior change.

The importance of physical activity (PA) for patients with rheumatoid arthritis (RA) is well documented [1], and PA promotion forms part of recommended care for these individuals [2]. Despite this, many RA patients do not undertake regular PA, and most do not meet the recommended norm of 30 minutes of moderate-intensity PA on 5 days of the week (5x30 recommendation)[3, 4]. These facts, coupled with the elevated risk of cardiac events and cardiac-related mortality within this patient group [5], have led to the development and implementation of several interventions to increase PA among patients with RA. A recent review indicates that such interventions lead to large increases in PA behavior, and to small improvements in pain and both subjectively and objectively measured functional ability [6].

Among patients with arthritis, interventions to increase PA often employ strategies derived from self-regulation theory [7], including behavioral goal setting, action planning, self-monitoring of behavior, feedback about progress toward goals, and problem solving strategies [8, 9]. Such interventions may alternatively (or in addition) include supervised exercise sessions, PA prescription and/or contracting about PA behavior [6]. Although most of these interventions have led to short-term increases in PA, they focus solely on the action phase of behavior change, paying little attention to the motivational aspects of behavior change: a deficit that may explain decreases in the effects of these interventions over time [10, 11].

According to several prominent behavior change theories, the action phase of behavior change is preceded by a motivational stage, in which changes in cognitions lead to the formulation of outcome goals or intentions [12]. As strong intentions are more readily and consistently translated into behavior [13], interventions targeting cognitions which strengthen intentions might lead to better uptake and maintenance of behavioral changes, particularly when coupled with the self-regulation strategies described above [14, 15]. Two cognitions of particular importance in the motivational phase of physical activity behavior change are self-efficacy and autonomous motivation for physical activity.

Self-efficacy for PA is the extent to which an individual believes he or she could be physically active across a variety of situations, including when faced with barriers to PA such as pain, bad weather or a busy schedule [16]. Higher levels of self-efficacy for PA predict higher levels of PA, both among patients with RA [17] and in the general population [18], so increasing self-efficacy is important when promoting PA, particularly among individuals who are not already physically active [19]. As self-efficacy for PA is greatly affected by successful, positive experiences with PA [20], interventions targeting it try to

increase the likelihood of such experiences occurring. This is best done utilizing the same set of self-regulation techniques described earlier, but tailored toward small, measurable achievements and limiting failures when pursuing PA goals [21].

Another variable underlying PA behavior is autonomous motivation for PA, or the extent to which one participates (or would participate) in PA because it is personally important, as opposed to doing so because it is valued or chosen by someone else (e.g. spouse, doctor)[22]. As autonomous motivation predicts sustained PA among patients with RA [23], PA interventions that target this variable may yield better long term maintenance of behavioral changes. In terms of methods to increase autonomous motivation for PA, motivational interviewing (MI) is one therapeutic technique believed to do so [24], but to date, it's efficacy at increasing autonomous motivation has scarcely been investigated [25].

The present study aimed to examine the effects of an intervention to promote PA, which included both motivational and action phase-related components. This pilot randomized controlled trial, among individuals with RA not meeting the 5x30 recommendation, compares the effects of an intervention which combines patient education, motivational interviewing (MI) and self-regulation coaching to specifically target the psychological variables autonomous motivation and self-efficacy for PA, to patient education alone. Aside from testing the effects of the intervention upon these psychological variables and physical activity, the effects of the intervention upon disease activity, functional status, depressive symptoms and fatigue will also be examined.

Participants and Methods

Study Design

This randomized controlled pilot study was approved by the Leiden University Medical Center Ethics Review Board and was conducted between August 2010 and November 2011. A detailed protocol is registered with the Netherlands Trial Register (http://www.trialregister.nl/trialreg/admin /rctview.asp?TC=2240). All patients provided informed consent after being informed that they would at least be provided with advice on PA and information about PA opportunities in the area.

Participants and Procedures

Potential participants were identified through registers of patients who had attended the outpatient rheumatology department of either Leiden

University Medical Center, HAGA Hospital in The Hague, or Reinier De Graaf Gasthuis in Delft. To be eligible for inclusion, patients must have been at least 18 years of age and diagnosed with RA according to the American College of Rheumatology criteria [26].

Those identified as eligible for participation were randomly selected in groups of 250 and were mailed leaflets describing the physical activity program tested in this study. Participants who responded with interest in participating were screened via telephone, and were excluded if they reported 30 minutes of moderate-intensity physical activity on 5 or more days each week, had received physical therapy for their RA within the last six months, had difficulty ambulating, or could not attend the treatment sessions due to scheduling or transportation issues. Remaining patients who provided informed consent were randomly assigned and allocated to either the control or intervention group using a random number generator. After randomization, patients were mailed a baseline questionnaire that was to be returned 1-2 weeks later, when they attended a group patient-education meeting.

Power calculations using a power level of 0.8 and alpha of 0.05, and based on the findings of a meta-analysis of PA interventions among individuals with arthritis (*d* = 0.69) [6] and an intervention which targeted PA increases among sedentary individuals with RA (a 24% between-groups difference of people meeting the 5x30 recommendation at post-treatment) [27], indicated required sample sizes of 35 and 38 per group, respectively. Groups of eligible patients were mailed leaflets until at least 38 participants had been allocated to each condition.

The researcher who conducted randomization and allocation (EH) was not involved in data analysis, and the allocation code was concealed from other researchers until after all data had been prepared for analysis.

Demographic characteristics. Data on age, sex, body mass index, employment, education levels obtained and use of non-steroidal anti-inflammatory medications were collected from questionnaires filled-in at baseline.

Primary outcome measures. Physical activity (PA) was assessed by means of two self-report measures. The Short Questionnaire to Assess Health-Enhancing Physical Activity [28] assessed leisure-time PA. In this questionnaire, participants were asked how many days per week and minutes per day they engaged in walking, cycling and sporting activities in spare time. For each activity, days per week were multiplied by minutes per day, and these products were summed to calculate minutes per week of leisure-time PA.

Additionally, participants answered one question to determine whether they met the Dutch PA recommendation of 5 days per week with at least 30 minutes of moderate intensity PA (5x30 recommendation) [29]. This single item has been used in previous interventions to promote PA among sedentary individuals with RA [27], and asks individuals on how many days per week they engaged in at least 30 minutes of moderate intensity PA over the last month. The question is preceded by a description of the effects of moderate-intensity PA (e.g. increased heart-rate) and forms of moderate-intensity PA (e.g. brisk walking, cycling).

Self-efficacy for PA was assessed using the 18-item self-efficacy scale created by Bandura [30]. Each item presents a situation in which it may be difficult to engage in PA (e.g. when busy, during bad weather), and allows participants to rate the likelihood that he/she would be physically active in the given situation. Participants could respond with a number from 0 (not at all likely) to 10 (certainly), and the 18 item scores were summed to create the total self-efficacy score.

Autonomous motivation for PA was measured with 3-items from the Treatment Self-Regulation Questionnaire [31]. Each item is scored using a 7-point Likert scale with anchors of 1 (totally disagree) and 7 (totally agree), and measures the extent to which participants engaged in PA for personal reasons (e.g. enjoyment, fun), as opposed to reasons important to others. The autonomous motivation score was calculated by taking the mean of the 3 items.

Secondary outcome measures. Disease activity was measured with the Rheumatoid Arthritis Disease Activity Index (RADAI) [32]. The RADAI assesses disease activity across five domains: joint inflammation over the last 6 months, present joint tenderness/swelling, present arthritis pain, duration of morning stiffness, and present level of pain in 16 individual joints (both left and right shoulders, elbows, wrists, fingers, hips, knees, ankles and toes). Each of these domains is scored from 0-10, with higher scores indicating more disease activity. Total disease activity is calculated by taking the mean of these five domains.

Functional status was assessed with the 20-item disability scale of the Health Assessment Questionnaire (HAQ)[33]. Each item is scored on a 0-3 scale, where zero indicates no functional limitations and three indicates severe functional limitations. The mean of the 20 item scores was used as a total functional status score.

Depressive symptoms were assessed using the 6-item scale of the Brief Symptom Inventory (BSI) [34]. Participants rated each distress item from 0-4, with higher scores representing more distress. The mean of the scored items was taken as the total depressive symptoms score.

Fatigue was assessed with the 20-item Checklist of Individual Strengths (CIS-20)[35]. The CIS-20 presents statements such as "I feel well rested" and "I feel physically exhausted," to which participants respond with the extent to which the statement describes them on a 7-point scale. After reversing the appropriate items, the sum of all items produces a total fatigue score, with higher scores indicating more fatigue.

Interventions. All interventions took place in the Leiden University Medical Center, irrespective of recruitment site. In week one of the intervention, all patients attended a group educational session which included exclusively intervention or control participants, and provided information about the importance of physical activity for people with RA and about pacing when beginning a new activity. The session also focused on dispelling myths surrounding PA and RA, and provided patients with a list of arthritis patient organizations and exercise classes in the area. The educational session was delivered in a small group format (3-7 people) by a physical therapist who had provided similar educational talks to arthritis patients for 5 years, and who was unaware of participants' group allocations.

In the four weeks following the education session, patients allocated to the intervention group received a one-on-one motivational interview (MI) and two one-on-one self-regulation (SR) coaching sessions. The MIs took place in week 2 or 3 of the intervention, lasted between 15 and 45 minutes, and were conducted by one of three physical therapists who had previously received four, four-hour training sessions on the delivery of MI. During the MI, patients weighed the pros and cons of (re-)engaging in regular PA, and attempts were made to link a more physically active lifestyle with long-term goals that were important to the patient (e.g. maintaining independence, being able to spend time with grandchildren). At the end of the MI, patients set a long-term (outcome) goal that could be achieved through PA, and received a folder containing an exercise diary. Patients completed the exercise diary on seven consecutive days by noting down periods of physical activity lasting at least 10 minutes, and were instructed to bring the diary along to the first self-regulation coaching session.

A rheumatology nurse delivered the two SR coaching sessions two and three weeks after the MI, in weeks 4 and 5 of the intervention, respectively. These 40-60 minute sessions followed the structure of a workbook which was developed for this study and emphasized the tenets of self-regulation theory [7]. Both SR sessions began with a review of the exercise diary patients had completed in the previous week. Patients received feedback on their progress,

and worked together with the rheumatology nurse to set a short-term, realistic PA goal and create a corresponding action plan for the coming week (i.e. what physical activities would take place, as well as when, where, and for how long each would take place). At the end of each session, patients were again prompted to complete the exercise diary for the following week. Additional workbook components covered in the sessions included barrier identification and problem solving (coping planning), breaking large goals down into smaller ones, activating social support, self-reward, and the use of prompts/cues as reminders to be physically active. The behavior change techniques used in each session of the intervention are presented in Table 1.

In weeks 6, 12 and 18 of the intervention, patients in the intervention group received a follow-up phone call from the rheumatology nurse to further discuss the patient's efforts in self-regulating his or her physical activity. These follow-up phone calls utilized the same techniques as the face-to-face sessions, and lasted between 10 and 20 minutes.

Statistical procedures. Between-groups differences at baseline were assessed by means of t-tests for continuous variables, and chi-square tests for categorical variables. The effects of the intervention were investigated in two separate datasets: an as-treated dataset which included individuals who had received the intervention according to the protocol and who had provided data at the given time point, and an intention-to-treat (ITT) dataset which included all participants as they were randomized, with missing values imputed using the last observation carried forward method (LOCF).

As a primary test of intervention effects, a mixed (split-plot) repeated measures ANOVA with group assignment as a between-subjects factor and time point as a within-subjects factor was run for each outcome variable within the intention-to-treat dataset. A significant interaction ($P < 0.05$) of the within- and between-subjects factors (Group x Time) signifies that the respective changes in outcomes of the intervention and control groups differed over time. These repeated measures analyses were controlled for age, sex, and baseline levels of disease activity.

To examine the within-group effects of the intervention, paired t-tests compared values of outcome variables at post-treatment and follow-up with their corresponding values at baseline in both datasets. Finally, chi-squared analyses examined between-groups differences in the proportion of individuals meeting the 5x30 recommendation at post-treatment and follow-up.

Results

In total, 1251 patients were mailed information about the study, 701 responded with interest in participating and were screened for eligibility, and 78 were randomized to either the MI+SR intervention group (n = 38) or the education control group (n = 40). The flow of patients through the trial and reasons for exclusions are shown in Figure 1. At baseline, the intervention group reported significantly less disease activity and included significantly more females than the control group. The groups did not significantly differ on any other demographic or disease-related variables (Table 2).

Within the intention to treat dataset, there were significant Group x Time interactions for the primary outcomes total self-efficacy, autonomous motivation, leisure time PA, and days per week with 30 minutes of PA; but not for the secondary outcomes disease activity, functional status, depressive symptoms and total fatigue (Table 3).

At post-treatment (6 weeks), the intervention group reported significant improvements in total self-efficacy, leisure time PA, days per week with 30 minutes of PA, depressive symptoms and total fatigue compared to baseline. No significant within-group changes were reported for autonomous motivation, disease activity or functional status. In the control group, only days per week with 30 minutes of PA had significantly increased from baseline.

At follow-up (32 weeks), the intervention group had maintained significant improvements from baseline in total self-efficacy, leisure time PA, and days per week with 30 minutes of PA. The control group reported significantly less autonomous motivation than at baseline, while the intervention group reported significantly more (although the latter was not found in the as-treated dataset). Depressive symptoms in the intervention group were significantly lower than baseline values (although this was not found in the as-treated dataset). Follow-up levels of total fatigue did not significantly differ from baseline levels.

At 6 weeks, a significantly higher percentage of participants in the intervention group (67%) met the 5x30 recommendation for PA than in the control group (23%). This difference decreased, but remained significant, at 32 weeks with 48% and 25% of intervention and control participants meeting the 5x30 recommendation, respectively (Table 4).

Discussion

This randomized controlled pilot study, among individuals with RA not meeting the 5x30 minutes recommendation for PA, tested an intervention that combined physical therapist-led motivational interviewing and nurse-led self-

regulation coaching to address both the motivation and action stages of behavior change. After receiving this five-week intervention, patients had significantly increased their leisure time PA by roughly 65 minutes more per week than the control group, and had also increased their number of active days per week by 1.5 over the control group.

There was also a significant increase in the percentage of individuals meeting the 5 x 30 minutes PA recommendation. Two-thirds of the participants in the treatment group met this recommendation at post-treatment, and although that percentage fell to 48% six months after the intervention, this rate was still significantly higher than the 25% of individuals meeting it in the control group and somewhat higher than the 38% who reported meeting it six months into an internet-based intervention among a similar RA population [27].

The effects of this relatively low resource-intensive intervention (less than 5 hours of total contact time including follow-up phone calls), which combined motivational interviewing and self-regulation coaching, are in contrast to those from several more resource-intensive PA interventions tested among patients with RA, which targeted only the action phase of behavior change. In recent studies, neither the 8-week People with Arthritis Can Exercise program [36], nor the 1-year PA coaching program of Brodin and colleagues (which also included patients who were physically active) [37] led to significant increases in PA behavior. This difference in outcomes lends support to the importance of addressing the motivational phase in PA interventions for individuals not meeting recommended levels of PA.

Further support is lent to this hypothesis by the significant effects of the intervention upon both self-efficacy and autonomous motivation for PA; both of which were specifically targeted by the combination of techniques included in the intervention. Although several other interventions to increase PA have increased self-efficacy for PA [36, 38], this is the first study to demonstrate an effect upon autonomous regulation among individuals with RA. Interestingly, although there was a significant group x time effect upon autonomous motivation over the course of the study, significant within-group changes in autonomous motivation did not occur until the 32-week follow-up. This may imply that the effects of motivational interviewing upon autonomous motivation take time to appear, as patients begin to internalize their once extrinsic PA goals and build repertoires of enjoyable experiences with PA [39]. Furthermore, in the control group, inactivity coupled with confronting information about PA (i.e. filling in the questionnaires) might explain how autonomous motivation decreased over time.

Although there was no significant overall effect of the intervention on depressive symptoms, the intervention group reported significant decreases in depressive symptoms at post-treatment (and at the 6-month follow-up in the intention to treat analysis). These changes may be attributable to a number of factors including dopaminergic response from PA [40], social contact received during the intervention [41] or goal achievement [42]. It should be noted that the sample had very low reports of depressive symptoms overall, so the clinical relevance of this finding might be further explored among individuals reporting higher levels of depressive symptoms.

At post-treatment, the treatment group reported a significant decrease in levels of fatigue from baseline. This is a common finding for PA interventions, and is likely attributable to improvements in muscle strength and aerobic capacity accrued through increases in PA [43, 44]. This finding should be interpreted with caution however, as the Group x Time effect on fatigue was minimal, and the change did not remain significant at follow-up.

Although this intervention led to increases in PA that were maintained at the 32-week follow-up, no such improvements occurred in disease activity, or functional status. This finding may have arisen from an incongruity between the types of PA participants undertook in this study (self-chosen, enjoyable, fun, and which they were autonomously motivated to do), and the types of PA that participants have undertaken during more structured PA interventions (suggested by others, possibly difficult or strenuous, and perhaps more likely to improve disease activity and functional ability) [45, 46]. As autonomously motivated forms of PA are more likely to be maintained in the long-term, clinicians and researchers in this area are therefore tasked with making dynamic forms of exercise more appealing to individuals with RA, and presenting targeted physical activity advice in an autonomous supportive way [47].

Despite the novelty of this study, several limitations should be discussed. First, although the study led to increases in both leisure time PA and days per week with at least 30 minutes of PA, these are both self-report measures and may be subject to response bias [48, 49]. More objective measures of PA (e.g. accelerometers) should be used in any replication of this study. Second, the design of this study makes it difficult to determine which components of the intervention led to changes in cognitions and behavior. Future investigations could test motivational interviewing and self-regulation coaching in a full-factorial design to determine whether each has individual effects on cognitions and behavior, or whether this particular combination of components is necessary to increase PA behavior. Finally, although this pilot study provides some evidence that changes in PA-related cognitions are related

to increased PA behavior, it was only powered to detect changes in PA, and the power calculations did not take potential dropouts from the study into account. Future studies should be powerful enough to specifically test whether changes in cognitions predict changes in behavior, and should consider potential dropouts when conducting power calculations.

In conclusion, this novel, theory-based intervention that targeted both the motivation and action phases of behavior change led to increases in the PA-related cognitions self-efficacy and autonomous motivation, as well as to increases in physical activity that were maintained at 32-weeks follow-up. Although no changes were reported in disease activity or functional status as a result of the intervention, the fact that it was delivered by physical therapists and nurses typically involved in the treatment of patients with RA, and led to increased PA with a minimal amount of contact time, makes it a good starting point for promoting PA among insufficiently active individuals in clinical practice.

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Figure 1. Flow of participants through the intervention

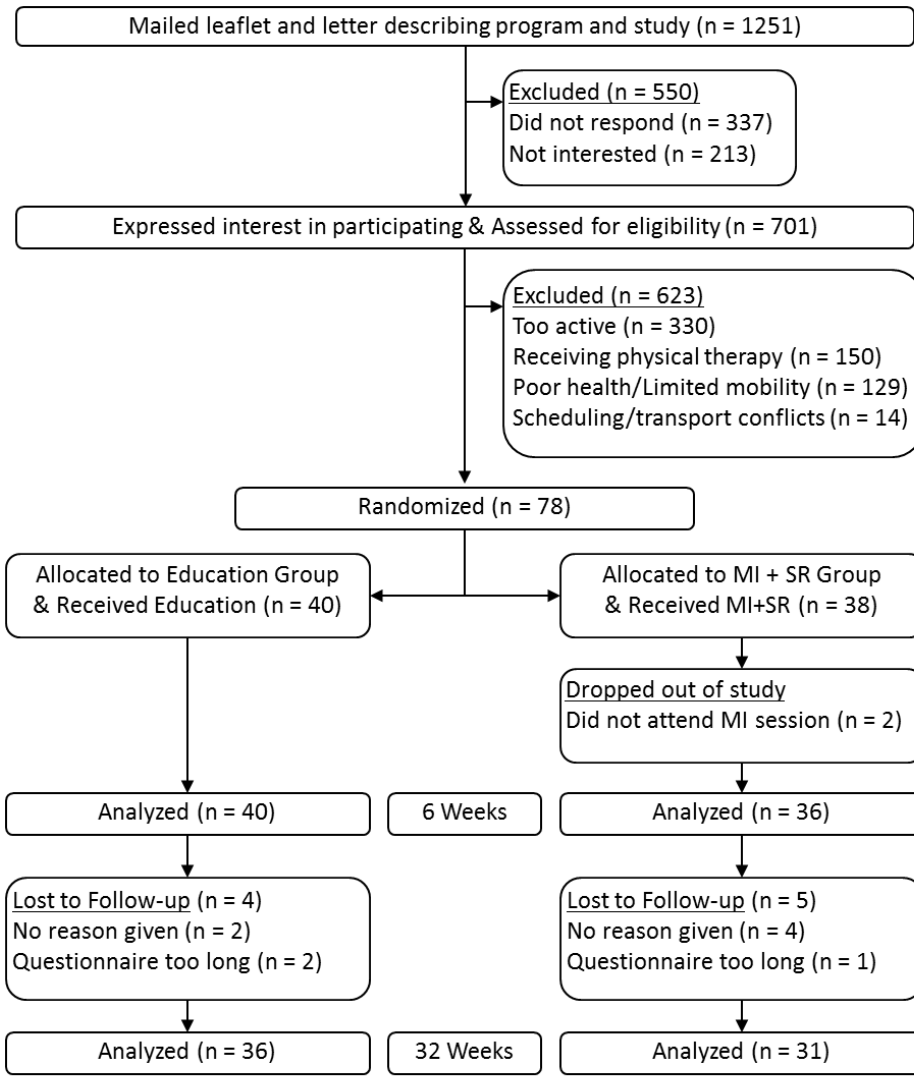

Table 1. Session-by-session description of intervention content using CALO-RE taxonomy of behavior change techniques*

Behavior Change Technique	BCT #	Session 1 (GPES)	Session 2 (MI)	Session 3 (SRC 1)	Session 4 (SRC 2)	Session 5 (TFU 1)	Session 6 (TFU 2)	Session 7 (TFU 3)
Provide information on consequences of behavior in general	1	✔						
Provide information on consequences of behavior to the individual	2	✔						
Provide information on where and when to perform the behavior	20	✔						
Provide instruction on how to perform the behavior	21	✔						
Facilitate social comparisons	28	✔		✔	✔			
Motivational interviewing	37		✔					
Prompting focus on past success	18		✔					
Prompt self-monitoring of behavior	16		✔	✔	✔	✔	✔	✔
Goal setting (outcome goal)	6		✔					
Goal setting (behavioral goal)	5			✔	✔	✔	✔	✔
Action planning	7			✔	✔	✔	✔	✔
Set graded tasks	9			✔	✔			
Prompt review of outcome goals	11			✔			✔	✔
Provide feedback on performance	19			✔	✔	✔	✔	✔

Behavior Change Technique	BCT #	Session 1 (GPES)	Session 2 (MI)	Session 3 (SRC 1)	Session 4 (SRC 2)	Session 5 (TFU 1)	Session 6 (TFU 2)	Session 7 (TFU 3)
Teach to use prompts or cues	23			✔	✔			
Barrier identification or problem solving	8				✔	✔	✔	✔
Relapse prevention or coping planning	35				✔	✔	✔	✔
Prompt review of behavioral goals	10				✔	✔	✔	✔
Prompt rewards contingent on effort or progress towards behavior	12				✔			
Plan social support or social change	29				✔			
Use of follow-up prompts	27					✔	✔	✔

* BCT # = Behavior change technique number taken from CALO-RE taxonomy of behavior change techniques [50]; GPES = Group patient education session, led by physical therapist and took place in week one of the intervention; MI = Motivational interview, delivered by different physical therapist and took place in either week 2 or week 3 depending upon scheduling availability; SRC = Self-regulation coaching sessions, led by rheumatology nurse practitioner and took place in week 4 and week 5 of the intervention; TFU = Telephone follow-up contacts, conducted by same rheumatology nurse practitioner in weeks 6, 12 and 18 of the intervention.

Table 2. Baseline characteristics of control and intervention groups*

Characteristic	Intervention (n = 38)	Control (n = 40)	P
Age	60.7 ± 11.9	64.7 ± 11.5	.141
Women, n (%)	30 (79%)	22 (55%)	.024
Body Mass Index	27.7 ± 4.3	26.3 ± 3.6	.122
Employed, n (%)	13 (34%)	9 (23%)	.128
Education			
Primary, n (%)	18 (47%)	16 (42%)	.645
Secondary, n (%)	14 (37%)	15 (40%)	.813
Tertiary, n (%)	6 (16%)	7 (18%)	.761
NSAID use, n (%)	24 (63%)	21 (53%)	.347
Disease Activity, RADAI (0-10)	2.86 ± 1.74	3.87 ± 2.03	.021
Functional Status, HAQ (0-3)	0.98 ± 0.73	1.25 ± 0.59	.078

* Values are presented as mean ± standard deviation unless otherwise indicated; NS = non-significant; NSAID = Non-steroidal anti-inflammatory drugs; RADAI = Rheumatoid Arthritis Disease Activity Index; HAQ = Health Assessment Questionnaire.

Table 3. Main Group x Time intervention effects and between- and within-groups comparisons on primary and secondary outcomes at baseline, post-treatment, and follow-up with last observation carried forward for missing data (intention to treat dataset)*

	Intervention Group (n = 38)			Control Group (n = 40)			Main Effect†		
Outcome	Baseline	6 Weeks	32 Weeks	Baseline	6 Weeks	32 Weeks	$\eta^2_{partial}$	F	P
Self-efficacy for PA	78.1 ± 44.9	92.8 ± 37.7 §	92.8 ± 37.7 §	84.2 ± 37.2	79.8 ± 40.4	82.9 ± 38.8	.130	5.18	.008
Autonomous Motivation	5.9 ± 0.8 ‡	6.0 ± 0.8	6.1 ± 0.7 §	5.4 ± 1.2	5.2 ± 1.4	5.1 ± 1.2 §	.168	7.16	.001
Min/Week Leisure Time PA	216 ± 175	295 ± 204 §	303 ± 294 §	209 ± 211	224 ± 243	212 ± 285	.100	4.01	.022
Days/Week ≥ 30 min PA	2.7 ± 1.2	4.6 ± 1.5 §	4.3 ± 1.6 §	3.0 ± 1.1	3.5 ± 1.4 §	3.4 ± 1.6	.109	4.39	.016
Disease Activity, RADAI	2.9 ± 1.7 ‡	3.1 ± 1.7	3.2 ± 1.8	3.9 ± 2.0	3.7 ± 1.9	3.7 ± 2.1	.057	2.17	.121
Functional Status, HAQ	0.98 ± 0.73	0.99 ± 0.70	0.99 ± 0.72	1.25 ± 0.59	1.28 ± 0.58	1.29 ± 0.63	.018	0.64	.530
Depressive Symptoms, BSI	0.33 ± 0.46	0.26 ± 0.41 §	0.22 ± 0.36 §	0.27 ± 0.60	0.24 ± 0.56	0.27 ± 0.59	.039	1.35	.266
Total Fatigue, CIS-20	67.1 ± 24.8	62.5 ± 22.9 §	62.7 ± 24.2	76.9 ± 18.3	75.1 ± 17.2	75.2 ± 19.0	.012	0.43	.651

* Values are the mean ± SD unless otherwise indicated; $\eta^2_{partial}$ = Partial eta-squared effect size; PA = Physical activity; RADAI = Rheumatoid Arthritis Disease Activity Index; HAQ = Health Assessment Questionnaire; BSI = Brief Symptom Inventory; CIS = Checklist of Individual Strengths.

† Main effects of group x time interaction based on repeated measures mixed ANOVAs adjusted for age, gender, and baseline level of disease activity.

§ Value differs significantly from baseline value ($P_{within} < 0.05$).

‡ Value differs significantly from control group at baseline ($P_{between} < 0.05$).

Table 4.Percentage of patients in each group meeting the 5 x 30 recommendations for physical activity

.

Time	MI + SR group	Education group	P
Baseline	0/38 (0%)	0/40 (0%)	-
6 weeks	24/36 (67%)	9/39 (23%)	< .001
32 weeks	15/31 (48%)	9/36 (25%)	.046

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Chapter 5

Are aspects of a motivational interview related to changes in physical activity and regulatory style?

Examining relationships among patients with rheumatoid arthritis

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Submitted

Abstract

Objectives: To determine whether the integrity of motivational interviewing (MI) delivery relates to short-term changes in physical activity (PA) and regulatory style within a sample of patients with rheumatoid arthritis, and to examine whether therapist proficiency improves over time.

Methods: During a randomized controlled trial to promote PA, 27 patients received a MI from a physical therapist, which was coded with the Motivational Interviewing Treatment Integrity scales (MITI). Pearson correlations examined associations between MITI scores and changes in PA and regulatory style. Linear regression examined therapist proficiency over time.

Results: MIs with greater reflection-to-question ratios and higher MI proficiency scores were related to increases in PA. MIs higher in global spirit and with a greater percentage of MI-adherent behaviors were associated with decreases in introjected regulation. Therapist proficiency in MI delivery tended to improve over time.

Conclusions: Characteristics of MI sessions are related to favorable shifts in regulatory style and PA behavior. Although MI proficiency increases over time and with feedback, a 15-hour training course seems insufficient for physical therapists to obtain basic MI proficiency.

Practice Implications: Providing feedback to therapists new to delivering MI seems to improve MI proficiency and should help therapists to avoid using MI-non-adherent techniques.

According to self-determination theory, individuals engage in physical activity behavior for various reasons. These motivations are hypothesized to span a continuum from controlled, external motivations such as gaining rewards or avoiding punishments; to introjected motivations where one engages in behavior to avoid feelings of guilt or shame; and through to autonomous, intrinsic motivations where behavior has become integrated into an individual's daily routine and is initiated for enjoyment or pleasure [1]. Where one falls on this continuum is known as his or her regulatory style [2].

Within the literature, a more intrinsic and autonomous regulatory style has been associated with greater long-term commitment to behavior and to more positive cognitions relating to that behavior; whereas a more controlled, extrinsic regulatory style has been associated with a decreased likelihood of prolonged engagement and a sense of tension surrounding the behavior [3]. It may therefore be useful for those developing behavior change interventions to aid participants in developing an autonomous regulatory style, as this should lead to greater maintenance of behavioral change [4].

One intervention technique which may foster a more autonomous regulatory style is motivational interviewing (MI). MI is a client-centered form of counseling which aims to increase an individual's autonomous motivations for behavior change through an exploration of his or her ambivalence to change [5]. During the process of MI, counselors base their interactions with clients around three tenets constituting the spirit of MI: collaboration, evocation, and autonomy.

Briefly summarized, a MI high in spirit could be described by an interaction in which the counselor (a) does not provide reasons or arguments for the client to change, but instead allows these to come from the client his/herself (collaboration); (b) assumes that the client already has the knowledge and resources necessary to bring about change and attempts to incorporate the client's ideas, goals and values (evocation); and (c) affirms the client's choice in whether/how change should be brought about (autonomy). In other words, MI creates conditions which are "conducive rather than coercive to change" [5].

Since it's conceptualization in the 1990's, motivational interviewing has been used as an intervention to promote health behavior change in a variety of contexts, including physical activity. More than 70 randomized controlled trials (RCTs) have tested MI either alone or in combination with other intervention techniques, and in general, MI has greater effects upon behavioral outcomes than traditional information provision or similar control conditions [6].

Of these RCTs, very few have assessed whether interactions between counselors and clients adhere to the spirit of MI. Within studies targeting

increased physical activity (PA), a recent review identified only 5 studies which included any assessment of adherence to MI [7], and among those, only one used a validated tool to assess all MIs conducted in the trial [8]. Furthermore, none of the 5 studies assessing MI adherence attempted to link the content or quality of MI delivery to behavioral outcomes. To our knowledge, only one study has attempted to do so since. In that study, Van Keulen and colleagues [9] assessed a subset of telephone-delivered MIs to promote physical activity and healthy eating with the motivational interviewing treatment integrity (MITI) scales [10], and found that the percentage of MI-adherent therapist statements predicted PA after the intervention.

Building on their research, this study will not only investigate the link between MI treatment integrity and changes in physical activity, but also explore whether MI treatment integrity is related to changes in regulatory style. More specifically, this study will examine which characteristics of a MI are related to changes in autonomous regulation, introjected regulation, external regulation and physical activity during an intervention to promote PA among patients with rheumatoid arthritis (RA) who did not meet the recommended 5x30 minutes of PA per week. We hypothesize that MIs conducted in the spirit of MI will lead to increases in physical activity and autonomous regulation, and decreases in introjected and external regulatory styles. This study will also investigate whether therapist skills in MI delivery improved with practice and performance-related feedback.

Methods

Patients

Seventy-eight patients with RA who reported ≤ 4 days per week with at least 30 minutes of moderate intensity physical activity were randomly allocated to receive an educational session, a motivational interview and a self-regulation coaching intervention (treatment group), or the educational session alone (control group). As this study focuses solely on the process of motivational interviewing, it only includes those patients allocated to the treatment group.

Procedures

After allocation to the treatment group, patients received a questionnaire by mail (baseline) which was to be filled-in and brought along to an educational session one week later. The educational session was given in a small-group format and was led by a physical therapist who had delivered similar sessions for five years. The session provided information about the

importance of PA for people with RA, the importance of pacing when beginning a new activity, and focused on dispelling myths surrounding PA and RA.

One week later, patients took part in a motivational interview led by one of three physical therapists who had received a 15-hour training course in MI, and who had practiced MI with 3 simulation patients and at least 3 RA patients prior to the start of the trial, receiving feedback on their application of MI after each attempt. During the MIs, patients weighed the pros and cons of (re-)engaging in physical activity, and attempts were made to link a more physically active lifestyle with long-term goals that were important to the patient (e.g. maintaining independence, being able to spend time with grandchildren). Two weeks later, before beginning the self-regulation intervention, patients filled-in a questionnaire to assess the effects of the MI (post-MI).

Measures

Motivational interviewing treatment integrity. To assess the quality of MIs, the Motivational Interviewing Treatment Integrity (MITI) scale [10] was applied to audio recordings of MI sessions by two independent coders (KK and AM), each of whom had undergone training in the use of the MITI and who were blind to changes in participants PA levels and regulatory style. The MITI rates random 20-minute segments of MIs on five, 5-point scales: evocation, collaboration, autonomy/support, direction and empathy. The MITI also takes count of seven types of therapist behaviors which are further detailed in Table 1: information provision, open questions, closed questions, simple reflections, complex reflections, MI-adherent behaviors, and MI-nonadherent behaviors.

These behavior counts are used to calculate 5 summary scores. For each, the MITI puts forth a proficiency threshold which, when met, indicates that an MI was adequately delivered. Table 2 provides details on summary score calculations and proficiency thresholds. Each MI was assigned a MITI proficiency score based on how many of these individual thresholds it met (possible range 0-5).

After each MI was coded, the MITI scoring was used to provide the therapists with feedback on their performance, including suggestions about how they could better deliver MI in subsequent sessions.

Regulatory style. Regulatory style of participants was assessed at both Baseline and Post-MI using the autonomous regulation (3 items), introjected regulation (3 items) and external regulation (4 items) subscales of the treatment self-regulation questionnaire for physical activity [11]. Behavior is autonomous regulated when engaged in for enjoyment or pleasure, introjected regulated

when engaged in to obtain/avoid externally referenced approval/disapproval (e.g. shame, guilt), and external regulated when engaged in for external reinforcements such as gaining rewards or avoiding punishments. All items were scored using a 7-point Likert scale with anchors of completely disagree (1) and completely agree (7), and the subscales were calculated by taking the mean of the corresponding item scores.

Physical activity. At both the Baseline and Post-MI measurement points, PA was assessed using the Short Questionnaire to Assess Health-enhancing physical activity (SQUASH) [12]. The SQUASH assesses PA in the past 4 weeks in domains such as travel, work, household activities, free time, and sport. In each domain, participants indicate on how many days in a typical week they engaged in such activities, and on average, how many minutes they were busy with those activities per day. A total score of minutes/week is calculated by multiplying days/week times the minutes/day.

Statistical Analyses

Change scores in PA and regulatory style were calculated by subtracting baseline values from those obtained post-MI, and the significance of these changes were tested with paired t-tests. Pearson correlations examined relationships between variables from the MITI and change scores in PA and regulatory style. Linear regression was used to investigate whether MITI proficiency scores increased with the number of MIs a therapist had delivered. All analyses were conducted in SPSS version 19 against a significance level of $P < 0.05$.

Results

Characteristics of the Sample

All 38 patients allocated to the intervention condition received the educational session and MI in accordance with the protocol. Of the 38 MI sessions, 27 were recorded, coded with the MITI and included in this study. Of the 27 patients for whom an MI was recorded, 17 (68%) were female, and the mean age was 59 years (range 29-74).

Inter-Rater Reliability of MITI Coding

The MITI coding process was reliable, as the intra-class correlations (ICC) for all variables were either good (.60 - .74) or excellent (>.74), except for autonomy support and direction, where it was fair (.40 - .59)[13]. Reliability data and mean scores for the MITI variables are presented in Table 1.

MITI Summary and Proficiency Scores

Across the 27 MIs, the means of the five MITI summary scores fell below the corresponding thresholds for proficiency (Table 2). However, some individual MIs did meet one or more proficiency thresholds: eight MIs exceeded the thresholds for percentage of open questions and global spirit rating; seven exceeded the threshold for percentage of complex reflections; five exceeded the threshold for percentage of MI-adherent behaviors; and three exceeded the threshold for the ratio of reflections to questions. Ten MIs did not meet any of the proficiency thresholds, nine met one threshold, two met two thresholds, four met three thresholds, and two met four thresholds. None of the 27 MIs met all 5 proficiency thresholds. The average number of thresholds met (MITI proficiency score) was 1.2.

Changes in Outcomes and Correlations with MITI Scores

Two weeks after the MI, there were no significant changes in physical activity (+39.5 minutes; SD = 136.4; p = .161) or autonomous (+0.22; SD = 1.62; p = .527), introjected (-0.59; SD = 1.69; p = .095) or external (+0.12; SD = 1.24; p = .632) regulatory styles.

Pearson correlations between changes in outcome variables (physical activity, and autonomous, introjected and external regulatory styles) and each of the MITI summary scores revealed some significant associations (Table 2). First, greater reflection to question ratios and higher proficiency scores were associated with increases in PA. Second, longer MI sessions were associated with increases in autonomous regulation. Third, higher global spirit ratings and MIs with a greater percentage of MI-adherent statements were associated with decreases in introjected regulation. Finally, contrary to our hypothesis, a higher percentage of open questions was associated with increases in external regulation.

Progression of Therapist Proficiency over Time

To examine whether therapist skill in MI delivery improved over time, MITI proficiency score was regressed on the number of MIs that that therapist had conducted (i.e. each therapist's first MI would be 1, second would be 2, etc.). This univariate model significantly fit the data, with number of MIs conducted explaining 29.2% of the variance in MI proficiency score ($Y = 0.233X – 0.043$; $F(1, 25) = 10.33$; $p = .004$). Figure 1 presents the progression of MITI proficiency scores over time.

Discussion and Conclusion

Discussion

This study revealed several significant relationships between components of motivational interviews and subsequent changes in PA among sedentary patients with RA. Namely, MI sessions with higher MITI proficiency scores and greater reflection to question ratios were associated with increases in PA. These findings are in line with those of Gaume and colleagues [14], who linked the concept of an 'MI gestalt,' similar to our MI proficiency score, to reduction in alcohol consumption 12 months after a MI intervention; and also with those of Cox et al [15] who found that MI-consistent techniques were associated with increases in exercise following an intervention.

In an attempt to illuminate one possible mechanism of behavior change, this study also investigated whether characteristics of MI delivery were related to changes in participants' regulatory styles. Indeed, changes in regulatory style were significantly associated with several characteristics of the coded MI sessions. Specifically, decreases in introjected regulation (i.e. the extent to which an individual engages in physical activity to avoid external sources of disapproval or gain external approval, including avoidance of associated guilt or shame) were related to MIs with higher global spirit ratings and greater ratios of MI-adherent behaviors to MI-non-adherent behaviors. These findings correspond with those of Martino and colleagues [12] who found a relationship between therapist adherence to basic MI principles (spirit) and increases in client motivation to change, and are similar to those of Moyers & Martin [16], who demonstrated that MI-inconsistent behaviors were more likely to lead to client statements arguing against change. Because of the negative association between introjected regulation and sustained engagement in PA [17, 18], and in light of other research which suggests that avoiding MI-inconsistent responses might actually be more important than utilizing MI-consistent ones [10], a focus on global MI spirit, as well as avoiding the use of MI-non-adherent behaviors, are recommended for physicians/therapists targeting sustained increases in PA.

Contrary to our hypotheses, increases in external regulation were related to MIs with an increased percentage of open questions during MI sessions. Open questions allow patients to reflect on their own situation and have been shown to lead to more contemplation of behavior change [19]; both of which should lead to an internalization of regulatory style [20]. However, one might speculate that as this study was conducted among individuals who were only minimally physically active, the open questions resulted in self-reflection upon a perceived inability to be physically active, thereby increasing

participants' perceptions of being coaxed into PA by their therapist. This relationship warrants further exploration in interventions utilizing MI.

Finally, longer MI sessions contributed to increases in autonomous regulation. As autonomous regulation has been shown to predict PA among patients with RA [18], this lends further support to a review which concluded that longer or additional MI sessions may have a beneficial effect upon behavior change outcomes [7].

Despite the relationships between MI components and within-person changes in PA and regulatory style, no significant within-group changes in these variables occurred after the MI. This might have resulted from the generally low levels of MI treatment integrity as evidenced by our coding process, or the very short period of time between measurements (3 weeks). Better quality MI sessions might have produced more favorable outcomes, as has been demonstrated in other studies [21, 22], and a longer amount of time between measurements might allow for the process of internalization of PA behavior to better unfold within patients.

Over the course of the intervention, there was a tendency for MI proficiency scores to improve. This is likely attributable to the effects of both practice and the tailored feedback provided to therapists after each MI [23]. Although all therapists took part in the same 4-day training course and had practiced MI with patients prior to the start of this intervention, there were significant differences in their MITI proficiency scores throughout the intervention. As pointed out in earlier research, therapists' personalities, previous experiences, or strength of counseling habits can impact upon MI fidelity [14, 24]. Future interventions utilizing MI should ensure that all therapists meet a predefined standard of MI proficiency before delivering MIs within a research setting, and as stated elsewhere, therapists should be provided with regular feedback on their performance [25].

Limitations and Conclusions

This study provides a novel examination of the relationships between MI delivery and changes in physical activity and regulatory style. However, the strength of its conclusions should be tempered by the small number of MIs and patients included. Future studies examining the effects of MI content upon outcomes should include more patients, and record and code all MI sessions to provide a more complete picture of treatment fidelity. Additionally, this study only looked at therapists', and not clients', statements during the MI sessions. As patient utterances during MIs (i.e. change talk) have previously been linked

with behavior change [26], future research in this area should account for this, perhaps using the motivational interviewing skills code [25].

In conclusion, therapist proficiency in MI delivery tends to improve over time with feedback, and this proficiency is related to increased PA two weeks after a MI. Additionally, patients' regulatory styles for sustained PA may be favorably affected by longer-lasting MI sessions delivered in the spirit of MI, which utilize more MI-adherent than MI-inconsistent therapist behaviors. Due to the importance of regulatory style in PA maintenance [18, 27], future research should investigate these relationships on a larger scale and take patient utterances into account.

Practice Implications

When delivering motivational interviews to promote physical activity, therapists should pay particular attention to the overall spirit of the MI consultation (i.e. collaboration, evocation, supporting autonomy). While working collaboratively with patients and supporting their autonomy may be second nature to experienced therapists, these skills take time to develop among those who are new to delivering MI. Providing therapists with iterative feedback as they develop competency is therefore of vital importance in achieving and maintaining MI proficiency [21]. Feedback which identifies sections of a recorded MI consultation that do not match with the spirit of MI, and particular therapist utterances which are MI non-adherent, can be followed up by prompts for the therapist to brainstorm alternative ways of traversing the problematic areas within subsequent consultations.

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Table 1. Mean Global Ratings and Behavior Counts of 27 coded MI conversations coded with the MITI scales.

MITI Variable	Description	M (SD)	ICC
Global Ratings			
Evocation	Understanding of clients motivation for change	2.88 (.93)	.72
Collaboration	Therapist acts as patients equal	2.63 (.79)	.65
Autonomy Support	Therapist fosters clients perception of choice	3.05 (.63)	.56
Direction	Therapist stays focused on target behavior	3.83 (.71)	.40
Empathy	Therapist grasps the clients perspective and feelings	3.03 (.83)	.61
Behavior Counts			
# Giving information	Therapist provides information	11.9 (7.3)	.74
# Open questions	Therapist asks an open-ended question	12.7 (5.0)	.89
# Closed questions	Therapist asks a yes/no questions	19.1 (7.9)	.83
# Complex reflections	Therapist gives a reflection which deepens clients original meaning	7.3 (4.2)	.63
# Simple reflections	Therapist simply restates what the client has said	14.6 (4.7)	.84
# MI-adherent	Therapist asks permission, affirms the client, or emphasizes control	2.4 (1.6)	.63
# MI-non-adherent	Therapist provides unsolicited advice, or assumes the expert role	2.5 (2.3)	.84

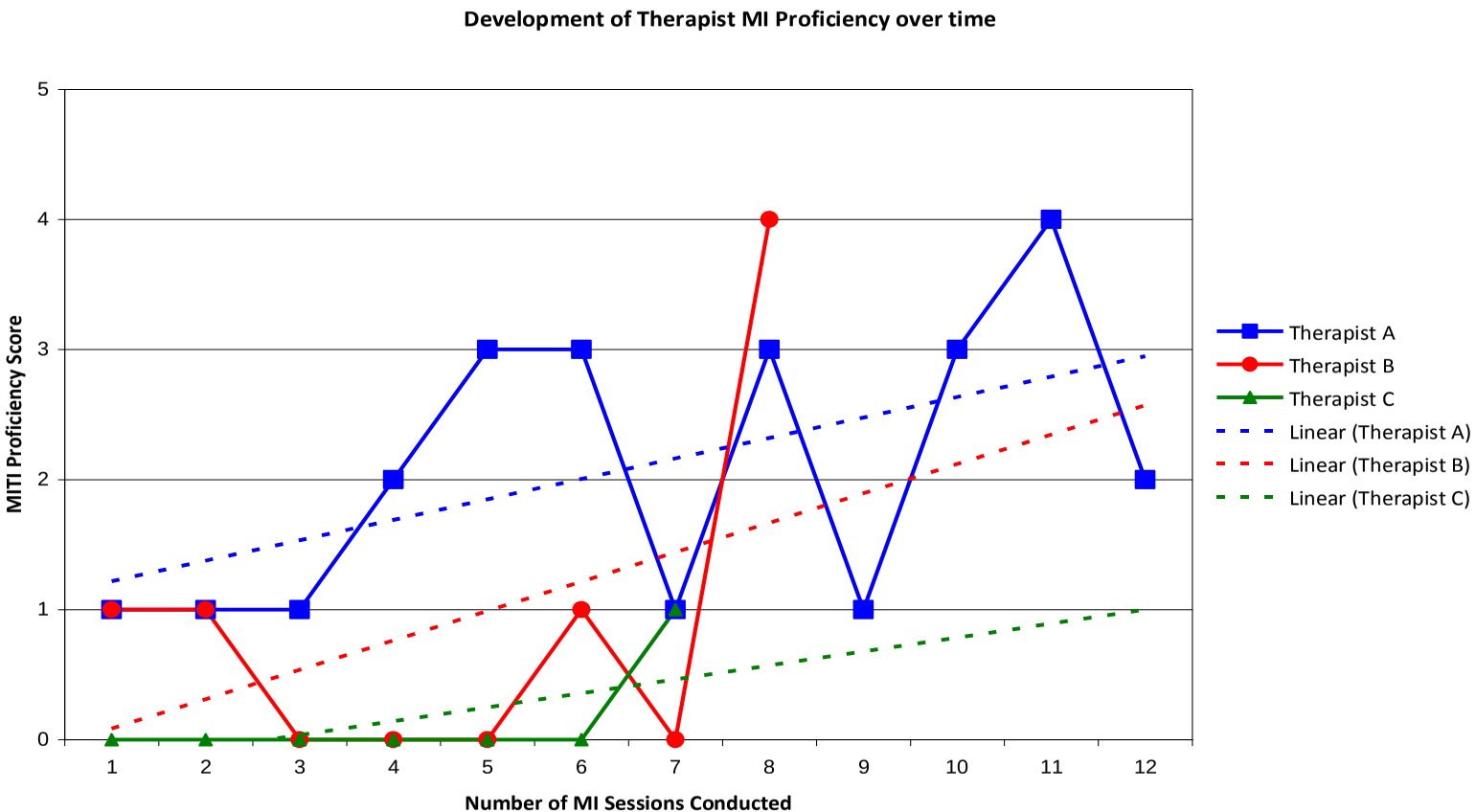
Note. M (SD) = Mean (Standard deviation); ICC – Intra-class coefficient measure of coding reliability.

Table 2. MITI Summary Scores of 27 coded MI conversations coded with the MITI scales, and correlations of these ratings with change scores in PA and measures of regulatory style.

				Pearson correlations (r) with change scores of			
MITI Summary Score	**Description**	**(MITI Proficiency Threshold)**	**M (SD)**	**Total Physical Activity**	**Autonomous Regulation**	**Introjected Regulation**	**External Regulation**
Global Spirit Rating	(Evocation + Collaboration + Autonomy Support) / 3	(> 3.5)	2.7 (.67)	.120	-.013	-.463 *	.089
Reflections/Questions	# Total Reflections / # Total Questions	(> 1.0)	.72 (.22)	.539 **	.059	.177	.304
% Open questions	# Open Questions / # Total Questions	(> .50)	.41 (.15)	.214	-.058	.259	.505 **
% Complex reflections	# Complex Reflections / # Total Reflections	(> .40)	.32 (.13)	.126	.001	-.162	.235
% MI-adherent	# MI-adherent / (# MI-adherent + # MI-non-adherent)	(> .90)	.56 (.29)	.143	.048	-.396 *	.025
Proficiency Score	# of MITI Summary Scores meeting its corresponding threshold		1.2 (1.3)	.509 **	-.029	-.028	.249
Duration	Length of MI consultation in minutes		33.1 (9.5)	.310	.406 *	.214	.088

Note. * P < 0.05; ** P < 0.01; M (SD) = Mean (Standard deviation).

Figure 1. Graphical representation of the MI proficiency scores of 3 physical therapists and their progression over time.



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Chapter 6

Investigating mediation within a self-regulation intervention to promote physical activity among patients with rheumatoid arthritis

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Submitted

Abstract

Objectives: This study aimed to examine mediation within a randomized controlled trial of a combined motivational interviewing and self-regulation coaching intervention. And more specifically, whether increased autonomous motivation, self-efficacy for physical activity and use of self-regulation skills predict increased physical activity (PA) and PA goal achievement at post-treatment and follow-up.

Methods: 78 individuals with rheumatoid arthritis were randomly assigned to receive a patient-education session, or the patient-education session plus one motivational interview and two self-regulation coaching sessions. Multiple-mediation models examined the effects of group allocation on PA and PA goal achievement through the intermediate intervention targets autonomous motivation, self-efficacy, and use of self-regulation skills. Analyses predicting PA at post-treatment and follow-up were controlled for age, gender, and levels of the dependent variable at baseline or post-treatment respectively.

Results: At post-treatment, the intervention group reported significantly higher levels of autonomous motivation and a greater use of self-regulation skills. PA goal achievement at post-treatment was mediated by use of self-regulation skills. Increases in PA at post-treatment were not mediated by any intermediate intervention targets. However, at 32-weeks follow-up, maintenance of PA was mediated by autonomous motivation and use of self-regulation skills.

Conclusions: Greater autonomous motivation and self-regulation skills appeared to drive maintenance of PA gains after the intervention. In promoting PA among patients with rheumatoid arthritis, healthcare providers should support patient autonomy, and teach self-regulation skills which direct sustained attention toward the achievement of PA goals.

Rheumatoid arthritis (RA) is a chronic, progressive inflammatory condition which affects the joints of the body, and is prevalent in roughly 1% of the population [1]. Symptoms of RA include fatigue, pain, swelling and stiffness in the affected joints, as well as redness, tenderness and inflammation of the tissues surrounding them. As the disease progresses, individuals with RA may develop functional deficits which limit their ability to work or care for themselves. Although there is no cure for RA, recent advances in the pharmacological management of the disease have contributed to better clinical outcomes and physical function for patients with RA [2].

In addition to medication, physical activity (PA) may also benefit patients with RA. Apart from strengthening muscles, increasing flexibility, and improving pain and physical function [3-4], PA may also reduce risk for cardiovascular disease [5], a leading cause of death among patients with RA [6]. Despite these benefits, however, a large proportion of individuals with RA do not engage in the recommended 5 x 30 minutes of PA each week (5 x 30 recommendation)[7].

In recent years, several interventions have been developed to increase PA among patients with RA. Such programs generally lead to increases in PA behavior, and often utilize behavior change techniques derived from self-regulation theory [4]. Self-regulation theory posits that (health) behavior is goal-directed, and that utilizing certain self-regulation skills underlies behavior change and increases the likelihood of goal achievement [8]. Self-regulation skills include setting goals and planning the actions necessary to achieve them, monitoring and obtaining feedback about one's progress toward those goals, and solving problems which may arise during goal pursuit.

Among patients with RA, interventions utilizing self-regulation techniques have been shown to lead to large increases in PA [9], and in the general population, to larger increases in PA than interventions not using such techniques [10]. Despite this, there is a need for more research demonstrating that interventions not only increase participants' use of self-regulation skills, but also that this increased use of self-regulation skills indeed explains the effects of interventions upon PA behavior [11].

In addition to self-regulation skills, interventions to increase PA among patients with RA often target changes in cognitions related to PA. One such PA-related cognition is self-efficacy for physical activity, which is derived from social cognitive theory, and has repeatedly been identified as a predictor of physical activity [12], including some studies among individuals with RA [13, 14]. Increasing self-efficacy, or one's belief in his or her capabilities to engage in a particular behavior or obtain a desired outcome [15], has therefore been a

primary goal of many interventions to increase PA. Although numerous studies have demonstrated increases in self-efficacy for PA following an intervention, there is only limited evidence that such increases in self-efficacy lead to changes in PA [11, 16]; none of it among patients with RA.

Recently, autonomous motivation for physical activity has been identified as another cognition which predicts PA among patients with RA [17]. Autonomous motivation for PA is derived from self-determination theory, and describes the motives which underlie individuals' engagement in PA; namely, the extent to which an individual engages (or would engage) in PA because it is deemed intrinsically enjoyable and beneficial, as opposed to doing so to achieve external rewards or to avoid feelings of guilt [18]. Although autonomous motivation predicts engagement in PA [12], few PA interventions have measured autonomous motivation as an outcome, and there is therefore little evidence of mediation effects of autonomous motivation upon PA [11].

In a recently completed randomized controlled trial among patients with rheumatoid arthritis not meeting the 5 x 30 recommendation for PA, our research group tested an intervention which specifically targeted increases in self-regulation skills, and the PA-related cognitions self-efficacy and autonomous motivation as predecessors of PA behavior change and maintenance. The intervention included techniques which were theoretically assumed to change each of these intermediate constructs and to increase the likelihood that patients receiving the intervention would achieve their PA goals; an outcome which has been linked to improvements in pain and quality of life in RA patients [13]. When compared to a control group over the course of 32 weeks, the intervention led to significant increases in the PA-related cognitions autonomous motivation and self-efficacy, and to increases in PA behavior [Chapter 4 of this thesis].

The present study aims to determine whether the combined motivational interviewing and self-regulation coaching intervention led to an increased use of self-regulation skills, and to determine which intermediate intervention targets (self-regulation skills, autonomous motivation, self-efficacy), when increased at post-treatment, best explain the increases in leisure-time PA reported by individuals who took part in the trial. More specifically, this study will use several multiple mediation models to examine the effects of intervention condition upon leisure-time PA and PA goal achievement, through self-regulation skills, self-efficacy and autonomous motivation for PA. We hypothesize that each of these indirect effects will significantly explain PA goal achievement and leisure-time PA at post-treatment, and due to the importance of self-regulation in the maintenance of behavior changes [8], that the indirect

effect upon leisure-time PA will be stronger at 6 months follow-up than at post-treatment.

Methods

Trial Design

The data for this study were collected during a randomized controlled trial to test the effects of a combined motivational interviewing and self-regulation coaching intervention to increase physical activity among patients with rheumatoid arthritis who were not meeting the 5 x 30 minutes recommendations for healthy PA [19]. A protocol for this trial is on file with the Netherlands Trial Register (www.trialregister.nl; NTR2240).

After providing informed consent, patients were randomly allocated to receive a groups patient-education session (control group), or the patient-education session plus a motivational interview and two self-regulation coaching sessions over a period of 5 weeks (treatment group).

The patient-education sessions were delivered by a physical therapist to small groups of between 3 and 7 participants, and provided patients with information about the benefits of PA for people with RA, about how to slowly build-up PA levels, and about some myths surrounding PA for people with RA. The groups also received some information about patient organizations and various opportunities for PA in the region.

The motivational interviews were delivered to the intervention group in week two of the intervention and were conducted by one of three physical therapists who had previously been trained in this counseling style. Motivational interviewing (MI) is a client-centered, directive form of counseling which acknowledges that in order to create lasting change, individuals must come up with their own reasons for doing so [20]. The interactions between patients and counselors during motivational interviews are therefore not instructive, but rather collaborative, creating conditions which are “conducive rather than coercive to change” [21]. At the end of the motivational interview, which could last up to 45 minutes, participants stated a long-term goal which could be achieved through physical activity, and were provided with a seven day physical activity log to be filled in on seven consecutive days before attending the first self-regulation coaching session.

In the weeks after the MI sessions, participants in the treatment group attended two one-on-one self-regulation coaching sessions led by a rheumatology nurse, one week apart. These sessions lasted between 40 and 60 minutes, and were facilitated using a workbook based on the principles of self-regulation theory [8]. In the first session, the nurse and the participant reviewed

the physical activity log the participant had completed in the previous week. Using this information, the nurse provided patients with feedback on their progress, and helped the patient to set a short-term, realistic PA goal and create a corresponding action plan for the coming week (i.e. what, when, where, and for how long). At the end of each session, patients were again asked to complete a physical activity log for the following week. Additional workbook components covered in the sessions included barrier identification and problem solving (coping planning), breaking large goals down into smaller ones, activating social support, maintaining a positive outlook despite setbacks, self-reward, and the use of prompts/cues as reminders to be physically active.

Participants

Participants who had received a clinical diagnosis of RA were recruited from the patient databases of Leiden University Medical Center; HAGA hospital, Den Haag; and Reinier De Graaf Gasthuis, Delft. Patients were included if they were diagnosed with RA according to the American College of Rheumatology criteria [22], older than 18 years of age, and reported engaging in physical activity for ≥30 minutes on fewer than 5 days per week. Patients who had received physical therapy for their RA within the last six months, who had difficulty ambulating, or who could not attend the treatment sessions due to scheduling or transportation issues were excluded.

Measures

Self-efficacy. Self-efficacy for PA was assessed with the 18-item scale developed by Bandura [23]. This scale assesses the extent to which individuals feel that they would be physically active in a number of situations (e.g. if tired, if busy, if the weather were bad). Participants responded to each item on a 0-10 scale with anchors of '*Certainly would not*' (0), and '*Certainly would*' (10). The 18 item scores were summed to create a total self-efficacy for physical activity score, ranging potentially from 0 to 180.

Autonomous motivation. Three items from the treatment self-regulation questionnaire [24] were used to assess autonomous motivation for PA. Each item presents participants with a reason why one is, or might be, physically active on a regular basis. Participants respond on a 7-point Likert scale with responses ranging from '*Strongly Disagree*' (1)to '*Strongly Agree*' (7). The autonomous motivation score is calculated by taking the mean of the three items.

Self-regulation skills. Self-regulation skills were assessed using the 40-item Self-regulation Skills Battery (SRSB) [25]. This questionnaire assesses the extent to which an individual has used each of eight self-regulation skills in pursuit of a previously stated physical activity goal. The eight self-regulation skills are action planning (4 items), problem solving and coping planning (4 items), self-monitoring (3 items), obtaining feedback (3 items), focusing attention on goal pursuit (3 items), remaining positive when faced with setbacks (2 items), using self-reward (3 items), and avoiding self-criticism (3 reverse-scored items). Each item is scored on a 5-point Likert scale with responses ranging from '*Strongly Disagree'* (1) to '*Strongly Agree'* (5). The score for each of the SR skills is calculated by taking an arithmetic mean of the answered items (possible range 1-5), and a total self-regulation score was calculated by summing the eight SR skill scores (possible range 8-40). With the exception of the feedback scale, Cronbach's Alphas for all SR skill scales including the total self-regulation score were in the 'acceptable' range or better ($\alpha > 0.70$; $\alpha_{feedback} = 0.65$).

Physical activity. The Short Questionnaire to Assess Health-Enhancing Physical Activity was used to assess leisure-time PA [26]. This questionnaire asks participants on how many days-per-week and many minutes-per-day they engaged in PA across a number of life domains including work, commuting, housework, walking, cycling and sporting activities. For each activity, a minutes-per-week score was calculated by multiplying minutes-per-day times days-per-week. Leisure-time PA was calculated by summing the minutes-per-week scores for walking, cycling and sporting activities.

Goal Achievement. Achievement of PA goals was assessed using the SRSB [25]. At baseline, participants specified a physical activity goal which they wished to pursue over the next six months. At post-treatment, six weeks later, participants were reminded of their goal from baseline, and were asked to indicate the extent to which they had achieved this goal by placing a line on a 10 cm visual analog scale with anchors of "I have not yet begun working on this goal" and "I have achieved this goal." Goal achievement was assessed by measuring the distance in millimeters from the left anchor to the line made by the participant.

Goal achievement ratings provided at follow-up (32 weeks after baseline) were not used in this study, because at post-treatment, participants had the option to either select a new PA goal to pursue or to continue pursuing their PA goal from baseline. Ratings of goal achievement would therefore not be

comparable across participants who stated a new goal or who had continued working on an old goal.

Data Analysis

At post-treatment, 2 participants (3%) had dropped out of the trial, and 8 remaining participants had failed to complete the questionnaires assessing self-regulation skills and self-efficacy for PA. At 32-week follow-up, an additional 9 participants had dropped out of the trial. The pattern of missing data within the dataset was analyzed, and it was determined that the missing cases and variables were missing at random (SPSS Missing Value Analysis 16.0). Missing data points were replaced using multiple imputation in five separate datasets. Each of these datasets was compared to the original data, and the multiple imputation dataset with parameters most similar to the original dataset was used for all subsequent analyses.

After this process, differences between the groups at baseline were assessed by means of independent samples t-tests or chi-square tests where appropriate. Post-treatment use of self-regulation skills autonomous motivation and self-efficacy were compared across conditions using t-tests. We adjusted for multiple comparisons at post-treatment using Holm's sequential Bonferroni adjustment [27].

To examine possible multicollinearity, correlations were calculated between the independent variable 'group allocation' (Intervention = 1; Control = 0); the proposed mediating variables autonomous motivation, self-efficacy, and total self-regulation score; and the dependent variables leisure-time PA, and PA goal achievement. Correlations above 0.80 would indicate potential multicollinearity[28].

Each mediation model presented in Figure 1 was tested using a separate run of the indirect.sps macro for SPSS [29]. Mediation models 1 and 2, which predicted post-treatment values of PA goal achievement and leisure-time PA, were controlled for age, sex, and the baseline level of the dependent variable (DV). Mediation model 3, which predicted follow-up values of leisure-time PA, was controlled for age, sex and post-treatment values of leisure-time PA. The indirect.sps macro produces bootstrap estimates of the effects of the independent variable on the mediator variables (*a* path*s*), and of the mediator variables on the DV (*b* path*s*). The products of these effects (*a x b* paths) estimate the indirect effects (mediation) of the independent variable on the DV, through each of the mediators. Mediation is said to occur at $p < 0.05$ if the 95% confidence interval for the indirect effect (*a x b* path) does not include zero, and

likewise, at the $p < 0.01$ level if the 99% confidence interval does not include zero.

Results

At baseline, the intervention group contained significantly more women than the control group, but did not differ on any other demographic variables (Table 1).

Effect of the Intervention upon Self-regulation Skills and PA-related Cognitions

At post-treatment, the intervention group reported using the self-regulation skills action planning, problem solving and coping planning, self-monitoring, obtaining feedback, focusing attention on goal pursuit, remaining positive when faced with setbacks and using self-reward more often than the control group, indicating a significant effect of the intervention upon these skills. The groups did not differ significantly in their avoidance of self-criticism (Table 2). At follow-up, six months later, the intervention group continued to use each individual self-regulation skill more than the control group, with the exception of self-reward, which was no longer significant.

At post-treatment the intervention group also reported significantly higher total self-regulation skill use and more autonomous motivation for PA than the control group. The groups did not significantly differ on their ratings of self-efficacy for PA. These results are presented in Table 3.

Mediation Analyses

None of the correlations between variables exceeded the 0.80 threshold (Table 3), so multicollinearity would likely not influence the results of the mediation analyses.

Predicting PA goal achievement. In the mediation model predicting levels of PA goal achievement at post-treatment (Model 1), the intermediate variables self-efficacy for PA and self-regulation skills both had significant effects upon PA goal achievement(*b* paths), and a significant indirect effect (*a x b* path) of the intervention upon PA goal achievement was found through self-regulation skills. See Figure 1.

Predicting leisure-time PA. In the model predicting leisure-time PA at post-treatment (Model 2), none of the proposed mediators had significant effects upon leisure-time PA (*b* paths), and there were no significant indirect effects of the intervention upon leisure-time PA through any of the proposed mediators (*a x b* paths).

In the mediation model predicting leisure-time PA at follow-up (32 weeks after baseline), none of the mediator variables had a significant effect upon leisure-time PA (*b* paths), however, significant indirect effects (*a x b* paths)

of the intervention on leisure-time PA were found through both autonomous motivation and use of self-regulation skills (See Figure 1).

Discussion

This study explored several possible mechanisms of the effects upon leisure-time physical activity and physical activity goal achievement demonstrated by a combined motivational interviewing and self-regulation coaching intervention. The intervention specifically targeted increases in participants' use of self-regulation skills and in the physical activity related cognitions autonomous motivation and self-efficacy, assuming that increases in these variables would predict greater levels of physical activity and greater achievement of physical activity goals.

As hypothesized, participants who had received the motivational interviewing and self-regulation coaching intervention reported significantly greater use of self-regulation skills at post-treatment than did participants allocated to the patient-education control condition. These differences in total self-regulation skill use persisted at follow-up, 32 weeks after baseline. On the whole, this indicates that most self-regulation skills, once learned, can be integrated into individuals' daily routines and maintained for at least six months. As there has been very little research on maintenance of self-regulation after the end of behavior change interventions, future research might investigate whether engagement in self-regulatory processes explains behavioral maintenance over a longer period of time than was investigated here. Furthermore, it may be worthwhile to examine the effects of follow-up prompts (e.g. text messages, phone calls or emails)on the maintenance of self-regulatory processes – in particular upon self-monitoring, goal setting and action planning – as these skills are crucial to the process of self-regulation and in (re-)focusing attention on behavior [10, 30-32].

In our first mediation model, achievement of PA goals was predicted by increased levels of self-efficacy and a greater use of self-regulation skills. The relationship between self-efficacy and PA goal achievement is one that has been demonstrated previously among individuals with RA [13], and indicates that confidence in one's abilities often leads to successful goal pursuit. Although not tested in this study, it is assumed that goal achievement subsequently reinforces self-efficacy beliefs and facilitates further goal achievement [15, 33]. As a whole, the mediation model revealed a significant indirect effect of the intervention upon PA goal achievement through the use of self-regulation skills. As PA goal achievement has been linked with improved arthritis pain and quality of life among patients with RA [13], clinicians may wish to help facilitate PA goal

achievement by assisting patients in setting short-term realistic goals and educating them in the use self-regulation skills when pursuing these goals.

In the mediation model predicting leisure-time PA at post-treatment, no significant indirect effects of the intervention were found. When examining this relationship at follow-up however, the indirect effects were of a greater magnitude, and higher levels of both autonomous motivation and self-regulation skills predicted increased engagement in leisure-time physical activity. These findings indicate the importance of ownership and self-regulatory processes in maintaining and building upon initial changes in physical activity behavior. As has been found elsewhere, autonomous motivation appears to be important in sustaining behavior change in the long term among patients with RA [17]. Clinicians looking to promote long-term gains in physical activity should therefore work with patients to come up with activities that are not only safe and beneficial, but also enjoyable to the patient [34]. In addition, providing patients with tools they can use to set goals, make action and coping plans, and monitor goal progress may also help to maintain PA behavior.

While we found significant indirect effects of the intervention through both autonomous motivation and use of self-regulation skills, we did not find any such indirect effects through self-efficacy for physical activity as was hypothesized. Although self-efficacy increased significantly from baseline to post-treatment within the intervention group [Chapter 4 of this thesis], there was no significant difference in self-efficacy between groups at post-treatment, which meant that the *a*-paths toward self-efficacy within our mediation models were non-significant. As there were indeed significant differences between groups for the other intermediate variables in the model (i.e. autonomous motivation and self-regulation skills), the amount of variance in the dependent variables left to be explained by the indirect effect through self-efficacy was diminished. Had more patients been included in the study (i.e. n=60 in each group based on post-hoc calculations), the increased statistical power would have yielded a significant between-groups difference in self-efficacy at post-treatment, and perhaps also significant mediations through this variable. Additional studies testing mediation in this manner should be advised to conduct power calculations for both outcomes and potential mediators thereof.

Several limitations of the present study should be discussed. First, leisure-time PA was assessed by means of a self-report questionnaire. Although this method of assessment is not inherently flawed, social desirability in the context of the face-to-face intervention delivery might have led participants in the treatment condition to report more PA than they had actually undertaken [35]. Conversely, shorter bouts of PA which are captured by more objective PA

measurement tools (e.g. accelerometer, pedometer) might have been under-reported or disregarded as unimportant among some individuals in this trial. Future interventions targeting increases in PA behavior should supplement self-report measures with at least one validated objective measure of PA.

Second, despite a robust randomization procedure, the intervention groups differed significantly in levels of autonomous motivation at baseline. As a result, the *a*-paths of our mediation models, between treatment condition and autonomous motivation, might have overestimated the effect of the intervention upon this variable at post-treatment. Since all three potential mediating pathways were examined simultaneously in our models, the baseline differences between groups in autonomous motivation may have taken away from the explanatory power of self-regulation skills and self-efficacy. The significant indirect effect of the intervention through autonomous motivation upon leisure-time PA at follow-up must therefore be interpreted with caution, and merits further investigation in subsequent randomized controlled trials.

Finally, as only 78 individuals took part in this study, we were only able to include the total self-regulation skills score in our mediation analyses. Larger studies in this domain might consider examining each of the eight self-regulation skills as independent mediators of sustained changes in behavior. Such studies might reveal whether some self-regulation skills are more effective than others, and through the use of moderated mediation models, whether particular self-regulation skills have greater benefits for certain subgroups of participants or at various stages in the process of behavior change [36].

Conclusions

By testing mediation within this randomized controlled trial to promote physical activity, this study has helped to fill a recognized gap in the health behavior change literature[37]. In order to properly test and refine theory, intervention studies need to measure - and examine the indirect effects of interventions through - the cognitions and skills which are thought to precede and maintain shifts in behavior [38].

This study did precisely that, and demonstrated that at 6 months follow-up, the sustained increases in leisure-time physical activity brought about by a motivational interviewing and self-regulation coaching intervention were attributable to patients' levels of autonomous motivation and use of self-regulation skills at post-treatment. As maintenance of physical activity may be vital to achieving prolonged benefits of PA for patients with rheumatoid arthritis [39], practitioners may wish to work with patients to set personally meaningful physical activity goals, and to teach patients how to use core self-regulation skills

such as goal setting, self-monitoring and action planning. More research on factors which predict sustained engagement in these self-regulatory processes is also warranted.

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Table 1. Demographic characteristics of study participants at baseline

Characteristic	Intervention (n = 38)	Control (n = 40)	P
Age	60.7 ± 11.9	64.7 ± 11.5	.141
Women, n (%)	30 (79%)	22 (55%)	.024
Body Mass Index	27.7 ± 4.3	26.3 ± 3.6	.122
Employed, n (%)	13 (34%)	9 (23%)	.317
Education			
Primary, n (%)	18 (47%)	16 (42%)	.648
Secondary, n (%)	14 (37%)	15 (40%)	.999
Tertiary, n (%)	6 (16%)	7 (18%)	.999

Table 2. Between-groups comparisons on self-regulation skill use at T2 and T3.

Self-regulation Skill	Time	Intervention Group n=38	Control Group n=40	P
Making action plans	T2	3.61 ± 0.72	3.12 ± 0.76	.006 †
	T3	3.61 ± 0.81	2.74 ± 0.78	< .001 †
Problem solving/coping planning	T2	3.48 ± 0.57	3.07 ± 0.53	.003 †
	T3	3.41 ± 0.49	2.84 ± 0.62	.009 †
Self-monitoring of progress	T2	3.39 ± 0.56	2.89 ± 0.63	< .001 †
	T3	3.29 ± 0.68	2.89 ± 0.67	.011 †
Obtaining feedback	T2	3.14 ± 0.59	2.73 ± 0.59	.005 †
	T3	3.23 ± 0.68	2.79 ± 0.61	.001 †
Focusing attention on progress	T2	3.52 ± 0.44	2.95 ± 0.63	< .001 †
	T3	3.31 ± 0.67	2.74 ± 0.87	.003 †
Staying positive despite setbacks	T2	3.45 ± 0.49	2.87 ± 0.76	.008 †
	T3	3.67 ± 0.86	3.04 ± 0.71	.003 †
Use of self-reward	T2	3.22 ± 0.74	2.46 ± 0.57	< .001 †
	T3	3.03 ± 0.77	2.46 ± 0.66	.017
Avoiding self-criticism	T2	2.95 ± 0.89	2.85 ± 1.73	.184
	T3	2.84 ± 0.87	2.83 ± 0.71	.312

* Values are presented as mean ± standard deviation. † P < 0.05 after Holm's adjustment.

Table 3. Between-groups comparisons of patients' physical activity-related cognitions, use of self-regulation skills, leisure time PA and PA goal achievement at baseline (T1), 6 weeks (T2), and 32 weeks (T3)*

Variable	Time	Intervention Group n=38	Control Group n=40	P
Autonomous motivation for PA	T1	5.92 ± 0.85	5.41 ± 1.19	.006 †
	T2	5.98 ± 0.82	5.18 ± 1.37	.002 †
Self-efficacy for PA	T1	78.19 ± 44.27	84.51 ± 36.27	.492
	T2	93.84 ± 37.13	79.80 ± 40.44	.115
Total use of self-regulation skills	T2	26.77 ± 2.34	22.92 ± 2.21	< .001 †
	T3	26.71 ± 2.84	22.67 ± 3.05	< .001 †
PA Goal achievement	T2	59.74 ± 19.21	48.37 ± 26.33	.037
Leisure time PA	T1	215.8 ± 175.1	208.5 ± 210.7	.871
	T2	293.8 ± 198.7	223.5 ± 243.5	.175
	T3	315.5 ± 287.2	221.0 ± 285.1	.157

* Values are presented as mean ± standard deviation. † P < 0.05 after Holm's adjustment.

Table 4. Pearson correlation coefficients between variables included in the mediation models (n = 78).

	1	2	3	4	5	6	7
1. Group allocation	--						
2. Age	-.169	--					
3. T2 Autonomous motivation	.336*	-.311*	--				
4. T2 Self-efficacy for PA	.180	-.254	.235	--			
5. T2 Self-regulation skills	.590*	-.024	.291*	.213	--		
6. T2 PA Goal achievement	.180	-.129	.242	.332*	.382*	--	
7. T2 Leisure time PA	.158	-.100	.297*	.364*	.199	.211	--
8. T3 Leisure time PA	.165	.001	.261	.285	.262	.282	.543*

Note. Variables 3 through 7 measured at post-treatment (6 weeks), and variable 8 was measured at follow-up (32 weeks); * $p \leq 0.01$.

Table 4. Summary of mediation analyses predicting levels of physical activity goal achievement and leisure-time PA.

Model	a paths Condition[a] → MV	Post-treatment Mediator variable (MV)	b paths MV → DV	Dependent variable (DV)	a x bpaths Indirect effect	95% Confidence Interval of a x b
1[b]	a_1 = 0.59*	T2 Autonomous Motivation	b_1 = 2.42	T2 PA Goal Achievement	$a_1 \times b_1$=1.42	(-1.57 – 6.26)
	a_2 = 8.18	T2 Self-Efficacy for PA	b_2 = 0.15*		$a_2 \times b_2$=1.25	(-0.77 – 6.42)
	a_3 = 3.63**	T2 Self-Regulation Skills	b_3 = 2.91**		$a_3 \times b_3$ =10.55	(2.36 – 19.77)††
2[b]	a_1 = 0.62*	T2 Autonomous Motivation	b_1 = 13.03	T2 Leisure time PA	$a_1 \times b_1$=8.09	(-6.25 – 33.25)
	a_2 = 9.67	T2 Self-Efficacy for PA	b_2 = 0.56		$a_2 \times b_2$=5.45	(-2.98 – 33.10)
	a_3 = 3.92**	T2 Self-Regulation Skills	b_3 = 0.05		$a_3 \times b_3$ =0.18	(-46.56 – 54.21)
3[c]	a_1 = 0.56*	T2 Autonomous Motivation	b_1 = 25.45	T3 Leisure time PA	$a_1 \times b_1$=14.26	(0.75 – 59.48)†
	a_2 = 6.54	T2 Self-Efficacy for PA	b_2 = 0.65		$a_2 \times b_2$=4.24	(-3.67 – 35.40)
	a_3 = 3.84**	T2 Self-Regulation Skills	b_3 = 13.99		$a_3 \times b_3$ =53.54	(0.73 – 126.51)†

Note. Confidence intervals presented are bias corrected and accelerated, and based on 5000 bootstrap re-samples.[a]Treatment group = 1, control group = 0. [b]Controlled for age, gender and baseline level of the dependent variable. [c]Controlled for age, gender and T2 level of Leisure time PA. Model 1: R^2 = 0.238, p = 0.0034; Model 2: R^2 = 0.493, p < 0.0001; Model 3: R^2 = 0.333, p = 0.0003; * p < 0.05; ** p < 0.01; † -The 95% CI does not include zero; †† - Neither the 95% CI nor the 99% CI includes zero.

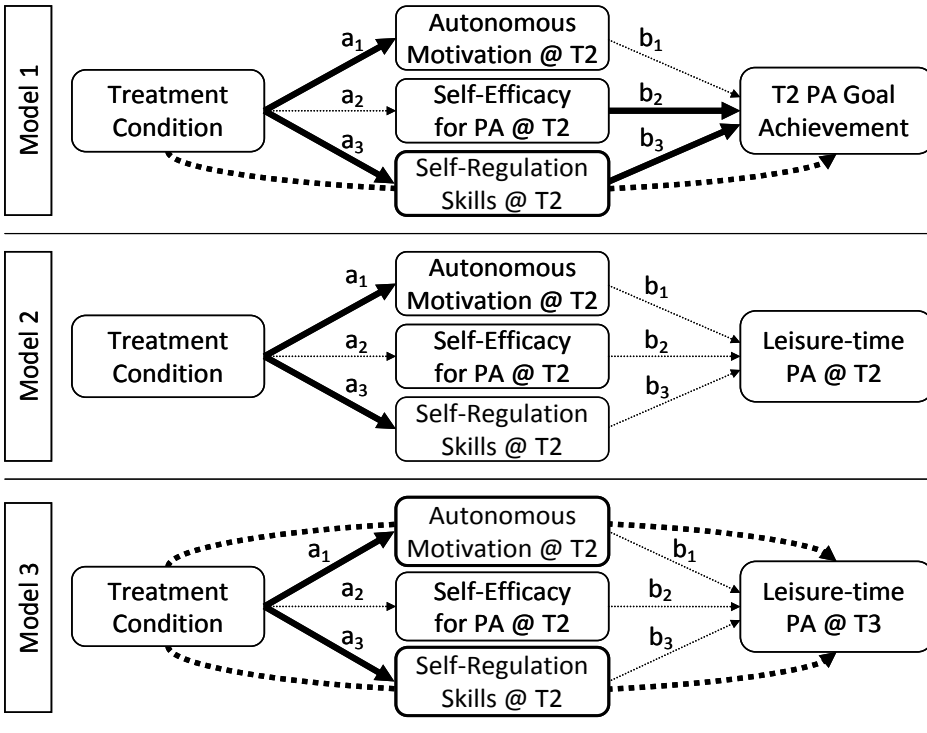

Figure 1. Mediation models examining the effects of the intervention upon physical activity goal achievement and leisure-time physical activity through autonomous motivation, self-efficacy and self-regulation skills. Solid bold lines represent a significant effect from one level of the mediation model to the next ($p < 0.05$ for a path or b path). Dashed bold lines indicate significant indirect effects (a x b paths) of the intervention upon the outcome variable, through the indicated mediator variable.

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Chapter 7

General Discussion

7

Physical activity (PA) has been shown to benefit individuals with rheumatoid arthritis (RA). Moderate-intensity PA may reduce the risk of coronary heart disease, which is the leading cause of death among individuals with RA, and more intense, dynamic forms of PA have been shown to increase muscle strength and reduce disease activity, without deleterious consequences to articular structures [1]. As individuals with RA are largely sedentary, and therefore miss out on the benefits associated with a physically active lifestyle, the purpose of this dissertation project was to develop and pilot-test an intervention to increase PA among less-active patients with RA, which could be delivered within the context of existing outpatient-based RA treatment plans.

Based on a review of the literature, we wished to investigate the effects of this intervention, not only upon physical activity, but upon changes in fatigue, psychological distress, disease activity, and functional ability as well. Furthermore, as there is a gap in the literature in explanatory processes within behavior change and self-management interventions [2, 3], we wished to investigate, as fully as possible, the chain of mediations between intervention delivery and fidelity, changes in PA-related cognitions and self-regulation skills, changes in PA behavior, and changes in psychological and disease-related outcomes.

Identifying Intermediate Targets and Intervention Content

In order to identify intervention techniques and intermediate intervention targets which would best foster increases in physical activity among patients with RA, and which would potentially have knock-on effects on psychological and disease related variables, we conducted a number of preliminary investigations which are presented in chapters 2 and 3 of this dissertation.

Self-regulation skills

In chapter 2, we describe a systematic review and meta-analysis of 27 randomized controlled trials which tested psychological interventions among patients with rheumatoid arthritis. As a whole, this set of interventions had a significant medium-sized effect upon physical activity behavior, and had significant small effects upon the disease related variables pain and disability and the psychological variables anxiety and depressive symptoms.

In an effort to determine which intervention techniques were associated with improvements in these outcomes, we assessed all included studies for their use of 5 techniques derived from self-regulation theory: goal setting, action planning, self-monitoring, feedback and coping planning. In comparative analyses, we found that those studies which utilized more of these

self-regulation techniques had larger effects upon anxiety and depressive symptoms than those using fewer of those techniques. In addition, studies which produced increases in physical activity tended to include most of the self-regulation techniques we assessed. Based on these findings, and the well-documented role of self-regulatory processes in behavioral activation and maintenance [4, 5], we decided to target individuals' use of self-regulation skills as a predecessor of PA behavior and PA goal achievement.

To do so, we selected self-regulation coaching as a key component of the intervention. Self-regulation coaching engages individuals in behavioral goal setting, action planning and self-monitoring, and provides individuals with feedback as they pursue their goals. A number of meta-analyses indicate that the use of such techniques is vital in increasing physical activity [6, 7], and as such we developed a workbook for patients which incorporated these strategies.

Autonomous Motivation for PA

In a cross-sectional study which analyzed baseline data from the same study presented in Chapter 3 of this thesis, our research group identified autonomous motivation as an important predictor of physical activity in the short-term [8]. Autonomous motivation, or the extent to which one engages in behavior for personal as opposed to external reasons, is derived from self-determination theory [9] and is akin to the concept of goal ownership within self-regulation theory [5]. Across a number of chronic conditions and within healthy individuals, greater levels of autonomous motivation have been linked with important changes in health behaviors, including medication adherence, self-management behaviors, weight loss and physical activity [10-12]. Additionally, greater levels of autonomous motivation are believed to predict long-term engagement in leisure-time physical activity, as enjoyment is important in maintenance of physical activity behaviors [13].

To target increases in autonomous motivation, we included a motivational interview as one component of the intervention. Motivational interviewing (MI) is a client-centered form of counseling which has its roots in the treatment of alcoholism and drug addiction, but within the last decade, it has been frequently applied in interventions designed to change other health behaviors, including physical activity [14, 15]. There is also a growing body of (mainly theoretical) literature which links certain components of MI delivery (e.g. MI spirit) to changes in constructs derived from self-determination theory: Among them, autonomous motivation [16, 17].

Self-efficacy for PA

In Chapter 3 of this thesis, we analyzed longitudinal data from 271 individuals with RA and identified self-efficacy for physical activity as an important predictor of physical activity, in both the short- and long-term. Self-efficacy, or one's belief in his/her capabilities to achieve a desired state or perform a specific task, is derived from social cognitive theory [18], and is an important predictor of intention and behavior across several theories of behavior change [19]. The link we demonstrated between self-efficacy and physical activity behavior is congruent with the findings of many similar studies over the past decades [19].

To foster increases in self-efficacy for PA, we included intervention components designed to target Bandura's four sources of self-efficacy: past experience, vicarious experience, persuasion, and interpretations of somatic states [20]. According to Bandura, the strongest source of self-efficacy evaluations is an individual's own previous experience with a behavior. That is: positive and successful experiences with a behavior increase self-efficacy for subsequent performance of the behavior. We therefore included concrete action planning for short-term, realistic, personally relevant and enjoyable physical activity goals, which would increase the likelihood of positive experiences (i.e. enjoyment and achievement) with PA occurring.

To provide vicarious experiences with PA, the self-regulation workbook provided to patients contained quotes from patients with RA which indicated that other individuals similar to the reader (i.e. with RA) have become physically active in the past. Such quotes highlighted benefits individuals with RA had perceived after increasing their levels of PA, the ease with which they were able to integrate PA into their daily routines, and the value patients placed on using self-regulation techniques in relation to physical activity. Vicarious experiences were also provided through group discussions about PA facilitated in the patient education sessions during the first week of the intervention.

No efforts were made to increase self-efficacy through direct persuasion, as this technique may be counterproductive, decreasing the likelihood of behavior change and maintenance [21-23].

Finally, patients' interpretations of somatic states were targeted by teaching patients to differentiate between the types of sensations one might normally expect to experience when becoming physically active (e.g. muscle soreness, tightness, mild joint pain), and types of pain which indicate that joints may be incurring damage (e.g. severe pain, pain which persists longer than 90 minutes after activity).

Achievement of PA Goals

In addition to its link with increased self-efficacy evaluations, goal achievement is also linked directly to increases in physical activity behavior, provided of course that the goal targeted PA behavior. In Chapter 3 of this dissertation [24], we linked increased levels of self-efficacy and physical activity goal achievement to improved pain and quality of life among patients with RA. That is, the greater an individual perceived his or her ability to achieve a physical activity goal, the greater the likelihood that goal was eventually achieved, and the greater the chance of improvements in arthritis pain and quality of life. We hypothesized that these mediation effects through goal achievement operated in conjunction with patients' beliefs about the controllability of their RA through physical activity (i.e. treatment control)[25]. As goal achievement is linked to pain and quality of life outcomes, behavior, and as stated previously, to increases in self-efficacy, we included it as an additional target of the intervention.

To increase the likelihood of physical activity goal achievement, we developed the self-regulation coaching workbook to include an emphasis on realistic goal setting, goal laddering, action planning and coping planning, and trained nurse practitioners in ways to optimally provide feedback on goal progress, as these techniques have each previously been linked with goal achievement [5, 26].

Examining the Effects of the Intervention

Main Effects

In chapter 4 of this thesis, we report the results of a randomized controlled trial of our combined motivational interviewing and self-regulation coaching intervention. This study compared the effects of a group-patient education session, similar in content to what is already delivered in standard outpatient care for RA, to the effects of that same group education session plus one motivational interview delivered by a physical therapist and two self-regulation coaching sessions delivered by a rheumatology nurse practitioner with the aid of a workbook.

Based on power calculations conducted using data from a meta-analysis of physical activity interventions among individuals with arthritis and a randomized controlled trial conducted among sedentary individuals with RA, we recruited 78 patients to take part in the trial. Over the full 32-week course of the intervention (6 weeks for intervention delivery plus a follow-up of 6 months), there were significant effects of the intervention on the intermediate outcomes self-efficacy for PA and autonomous motivation for PA. In other

words, patients allocated to the intervention group improved these variables significantly more over the course of 32 weeks than did patients allocated to the control group. This confirmed that the techniques we systematically selected to comprise our intervention indeed had the intended effects upon these important cognitions which were thought to underlie sustained increases in physical activity.

The intervention also led to significant increases in minutes of leisure time PA and days per week with at least 30 minutes of moderate intensity PA. Patients in the intervention group increased their levels of leisure-time physical activity by an average of 90 minutes per week over the course of the intervention, compared to an average increase of only 5 minutes in the control group. The intervention group also reported being physically active for at least 30 minutes on 1.5 more days per week than they did at baseline. These changes are equivalent to the increases in physical activity demonstrated within our meta-analysis in chapter 2 of this thesis [6], and represent changes in behavior which would substantially reduce cardiovascular disease risk within these individuals [27].

At both post-treatment and follow-up, a significantly greater percentage of individuals in the intervention group met the 5 x 30 minutes recommendation for physical activity than within the control group. Two-thirds of patients in the intervention group met this recommendation at post-treatment, and fully half continued to do so at the six-month follow-up. This six-month level of physical activity maintenance is an improvement on the rate of PA maintenance achieved by an internet-based physical activity intervention (38%), which provided patients with a structured exercise regimen which they were told had to be completed 5 times per week [28]. The contrast between the instructive and controlled nature of that intervention, and the autonomy supportive nature of the one tested here, lends further support to the assertion that coercion and persuasion might be ineffective at creating lasting behavioral change [29].

In comparison to other interventions targeting increases in physical activity among patients with rheumatoid arthritis, the intervention developed and tested here is relatively brief. With roughly 4 hours of total contact time, including follow-up phone calls, the intensity of this intervention is less than half of some previous interventions in this area [30-33], yet the effects of the interventions on physical activity are of a similar magnitude. This leads us to believe that targeting both the motivation and action phases of behavior change provides added value, as several more resource-intensive interventions, which targeted only the action phase of behavior change, have produced only minimal

or null findings [31, 34, 35]. The significant effects of the intervention on both self-efficacy and autonomous motivation, as well as the previously demonstrated synergistic effect of combined motivational and volitional interventions [36], seem to indicate that these phases interact in producing the maintained increases in PA achieved here. The source of this interaction might be the long-term outcome goals set at the end of the motivational interviews, which were subsequently linked to the short-term behavioral goals set during the self-regulation coaching sessions, as this linking of outcome and behavioral goals has previously been linked to the efficacy of behavior change programs [37, 38].

Secondary Effects.

In addition to its effects on physical activity behavior, the intervention also led to short-term improvements in depressive symptoms and self-reported fatigue. At post-treatment, the intervention group had significantly reduced their levels of both depressive symptoms and fatigue from baseline, while levels within the control group remained roughly the same. Although these effects did not remain significant at the 32 week follow-up, the initial shift in these variables after 3 hours of contact time is promising, particularly when considering the probable floor effects which arose from the low levels of fatigue and depressive symptoms reported by both groups at baseline. In previous, more-intensive, intervention studies among patients with RA with high levels of fatigue, both a 12-week low-impact aerobic exercise program [39] and a 10-session regimen of cognitive behavior therapy [40] led to reductions in fatigue and improvements in mood. As both physiological and psychological pathways may lead to improvements in fatigue and depressive symptoms among patients with RA [41], more research would be necessary to determine which pathway was most responsible for the initial shift in these variables demonstrated by our relatively brief intervention.

Counter to our hypotheses, the combined motivational interviewing and self-regulation coaching intervention did not have any significant effects on disease activity or functional ability. Based on a meta-analysis of physical activity interventions among patients with arthritis [42], we had anticipated that changes in physical activity of the magnitude demonstrated by our intervention would be accompanied by at least small improvements in disease activity and functional ability. This lack of effect may have arisen from an incongruity between the types of PA participants undertook in this study (self-chosen, enjoyable, fun, and which they were autonomously motivated to do), and the types of PA that have led to improvements in these variables during more

structured PA interventions (suggested by others, possibly difficult or strenuous, and perhaps more likely to improve disease activity and functional ability). As this study was unable to provide any evidence for a link between increases in leisure time PA and improvements in disease related variables, further research is needed to approximate a dose-response relationship for leisure-time PA among patients with RA: both in general and across varying individual and disease-related characteristics (e.g. age, gender, disease duration, severity).

Investigating Processes within the Intervention

To gain insight into underlying intervention processes which contributed to the effectiveness of the intervention, we conducted two process evaluation studies: one investigating the effects of motivational interview treatment integrity upon regulatory style and physical activity, and the other investigating whether changes in cognitions following the intervention explained behavior change and maintenance.

Effects of MI Treatment Integrity

In chapter 5, we describe an evaluation of the quality of motivational interviews delivered within the context of this intervention, and how several indicators of MI treatment integrity related to changes in patients' regulatory style (motivation) and total physical activity one week after the MI session. Although the sample size for this study was small, it was novel, in that only two studies had previously investigated how MI treatment integrity affects physical activity outcomes [43, 44], and none had investigated whether MI treatment integrity is linked with variables derived from self-determination theory.

Prior to the start of the trial, three physical therapists received a training course of four 4-hour sessions, wherein the basic principles of MI were outlined and opportunities for practice and feedback were allotted before the beginning of the main trial. All participants received the Dutch version of the book Motivational Interviewing in Health Care [45], and the course largely followed the recommendations for progressive skills training in MI set forth by Miller and Rose [46]. Despite these efforts however, the MIs delivered during the intervention consistently fell short of proficiency levels suggested in the Motivational Interviewing Treatment Integrity (MITI) evaluation instrument [47], with only two of the 27 MI sessions coded with the MITI having been adjudged as adequately delivered. This lack of treatment integrity might be attributable to the long period of time (6 months) between the training course and the start of the trial, as the involved physical therapists had few opportunities to practice and maintain their MI skills with patients in the interim.

Despite the low levels of MI proficiency at baseline, we found that over the course of the intervention there was a trend for each physical therapist to improve his or her proficiency in the delivery of MI. This tendency toward improvement is likely attributable to the effects of practice, and to performance-related feedback given to the physical therapists after each MI session [48]. This feedback included the MITI scores from the coded MI session, as well as specific examples of MI-inconsistent behaviors and statements from the session, including instances where the therapist provided unsolicited advice to the patient, where change talk on the part of the patient went unrecognized, or where a patient's preferences were not adequately taken into account.

Although the physical therapists involved in the trial generally stated that the performance related feedback was helpful, it may have had unintended negative consequences on performance as well. Despite making efforts to emphasize and positively reinforce successfully delivered MI components, a majority of the feedback given to the therapists pointed out problems with the delivered MIs. This consistent negative reinforcement may have undermined the therapists perceived self-efficacy for delivering MI and reduced motivation for use of MI adherent techniques. When providing feedback to individuals new to delivering MI interventions, efforts should be made to ensure that feedback is framed in a way which promotes self-confidence. Future researchers may also wish to apply theory to the training of health professionals (in MI), as this may improve fidelity of delivered behavior change interventions [49].

When investigating relationships between characteristics of the delivered MIs and outcomes, we found that certain aspects of MI delivery were related to increases in physical activity. Individuals who received an MI which was more proficiently delivered and which had a greater percentage of reflections to questions were more likely to have increased their level of total physical activity following the MI session. These findings are in line with those of previous researchers who found that MI-consistent techniques were associated with increases in exercise following an intervention [44].

Finally, we found that characteristics of the delivered MIs were also related to changes in regulatory style, and in particular to introjected regulation (i.e. the extent to which an individual engages in physical activity to avoid external sources of disapproval or gain external approval, including avoidance of associated guilt or shame)[50]. Decreases in introjected regulation were associated with MIs with higher global spirit ratings and greater ratios of MI-adherent behaviors to MI-non-adherent behaviors. As introjected regulation is associated with adverse behavioral outcomes [51], those delivering MIs to

patients might consider focusing on global MI spirit, and on the avoidance of MI-non-adherent behaviors.

Mediation of Intervention Effects through Intermediate Targets

In a subsequent study which we describe in chapter 6, we investigated whether more favorable PA-related cognitions (autonomous motivation and self-efficacy for PA) and greater use of self-regulation skills led to increased achievement of PA goals and to changes in, and maintenance of, leisure-time PA behavior. Such investigations are vital in determining how complex psychological interventions impact upon outcomes, and to test whether theoretical predictors of behavior change indeed underlie such changes [52].

At post-treatment, individuals in the intervention group reported using the self-regulation skills action planning, problem solving and coping planning, self-monitoring, obtaining feedback, focusing attention on goal pursuit, remaining positive when faced with setbacks and self-reward more often than individuals in the control group. These results serve as a proof of concept for the utility of the self-regulation coaching sessions, as they fostered increased self-regulation of PA behavior which continued at six months follow-up.

To determine whether these between-groups differences in the use of self-regulation skills were responsible for the significant effects of the intervention upon physical activity behavior, we conducted mediation analyses which investigated the contributions of self-regulation skills, autonomous motivation and self-efficacy for PA to changes in goal achievement and leisure time PA. At post-treatment, higher levels of PA goal achievement were attributable to an increased use of self-regulation skills in the intervention group, but not to increases in autonomous motivation or self-efficacy. This finding corroborates those of previous researchers, who have indicated the importance of self-regulation strategies in achieving personally important (physical activity) goals [4, 5, 26, 53-56].

When investigating mediation effects upon changes in physical activity behavior, no significant relationships with leisure-time PA were found at post-treatment. However, at 6 months follow-up, the indirect effects of the intervention upon PA became stronger, as was hypothesized, with sustained levels of leisure time PA significantly attributable to both higher levels of autonomous motivation and an increased use of self-regulation skills. This finding indicates that individuals who had internalized their motivations for physical activity and had more often utilized strategies to focus on staying physically active were the ones who maintained their new physical activity patterns six months after the intervention. As maintenance of physical activity

may be crucial in reaching improved fitness and physical and psychological well-being [57], future research should investigate factors which contribute to continuation of the self-regulatory processes which appear to underlie PA maintenance. This might involve a focus on follow-up prompts [58] and additional research on social context of behavioral internalization [29].

Strengths and Limitations

Throughout the preliminary, intervention development, pilot-testing and evaluation stages of this project, efforts were made to understand and work within the constraints of existing outpatient care. By doing so, we have developed a minimally resource-intensive program which appears to be successful at increasing the proportion of patients with RA who meet the Dutch recommendations for healthy PA. As such, this program could be readily integrated into outpatient care across many RA outpatient treatment programs in the Netherlands, and with additional funding, could be modified and tailored to expand its reach even further. Before such broader implementation takes place however, the cost-effectiveness of this intervention will need to be assessed, particularly in light of the lack of effects the intervention had upon functional and disease related variables.

The intervention developed within this dissertation also benefits from the strong theoretical base upon which it was developed, and the efforts which were taken to test the underlying theory in its evaluation. Based on suggestions from Michie and Prestwich [52], we selected the intermediate targets of the intervention (i.e. cognitions, skills) using the findings of existing literature and data from our preliminary investigations, which demonstrated these variables as predictors of physical activity. After selecting the intermediate targets, we developed the content of the intervention by selecting techniques which were either assumed to have an impact on these intermediate variables, or which had had a demonstrable effect upon these variables in previous research. We avoided including intervention techniques which were not thought to have an impact upon the intermediate intervention targets. Finally, after having implemented the intervention, we made efforts to determine whether the mediating effects assumed during intervention development were present in vivo. While the intervention study was perhaps not adequately powered to properly test mediation, by doing so, we carried out many of the range of procedures suggested by Michie and Prestwich and others in developing and testing theory-based behavior change interventions [52].

Despite its practicality, capability for broad ranging application and solid theoretical base, this dissertation has several limitations: mostly with

regard to processes within the intervention study. First, while adequately powered to detect changes in physical activity and changes in the proportion of individuals meeting the NNGB recommendations, the 158 patients who took part in the intervention meant that our testing of the full chain of mediations we had hypothesized, including the investigations in Chapters 5 and 6 of this thesis, were underpowered. While we had initially intended to recruit a larger sample of patients to take part in the study, thereby increasing our capability to test such mediations, our stringent inclusion criteria meant that we excluded nearly half of the 1251 patients we initially approached to participate. Future research should be adequately powered to detect whether intervention participation leads to changes in skills and cognitions, which leads to increases in physical activity behavior and subsequently to improvements in disease related variables. After conducting power calculations, preliminary proof of concept and feasibility studies can be used to test and refine materials and recruitment strategies in order to identify any necessary changes to processes and to determine whether enough participants are available within a particular setting, or whether the pool of potential participants needs to be expanded by involving additional institutions.

Within the study described in Chapter 5, a number of issues limit the reach of our findings. First, of the 36 motivational interviews conducted as part of the intervention, we were only able to analyze the content of 27 (75%) of them due to device malfunctions, user errors, and the voice recorders being misplaced. The low number of coded motivational interviews coupled with the primarily exploratory nature of the study meant that multiple comparisons greatly increased the chance of Type I error (i.e. finding significant correlations between characteristics of the MI sessions and changes in patients' PA behavior where none actually exist). While the findings from this study are novel, some of the significant correlations we found could be due to chance. Future investigations in this important area should be adequately powered for multiple comparisons. Furthermore, the fact that some of the MI sessions were not coded meant that the physical therapists were not able to receive feedback on their performance from these sessions. As a majority of the unrecorded MI sessions were in the early phases of the trial, it is unclear whether receiving more feedback at an earlier stage would have accelerated the rate at which therapists improved their skills in MI delivery, or would have increased MI fidelity at the end of the trial. Future research in this area should pay attention to recording the full set of patient-provider interactions so that the unfolding process of learning MI can be uninterrupted and more adequately and accurately assessed.

The problems with MI treatment integrity outlined in Chapter 5 lead one to question the extent to which the motivational interviews contributed to the effects of the intervention upon autonomous motivation and physical activity. We cannot rule out the possibility that the MI sessions were wholly ineffective, and that gains in physical activity and motivation were due only to the self-regulation coaching components of the intervention. At the same time however, we cannot rule out the possibility that motivational interviews which do not meet predefined standards of fidelity might still have an effect upon behavior and/or cognitions, and the possibility also remains that a component of the motivational interviews not accounted for in our coding process is actually responsible for the efficacy of the intervention. In future studies investigating the use of a specific set of counseling techniques, the uniformity and fidelity of delivery across a number of providers should be attained before proceeding to a larger scale trial. This issue has been cited as particularly problematic when behavior change programs are more broadly implemented outside of academic settings [59].

Future Directions

This dissertation outlined the development and testing of a theoretically derived intervention, which increased leisure time physical activity among individuals with rheumatoid arthritis who did not meet public health recommendations for physical activity. While this is promising, many questions regarding the ideal methods for physical activity promotion among patients with RA remain unanswered.

The randomized controlled trial presented in chapter 4 of this dissertation compared the effects of patient education, motivational interviewing and self-regulation coaching to patient education alone. While this study design provided some evidence for the importance of motivation in promoting PA, further research should investigate the importance of the motivation phase in a full-factorial design in order to determine whether either motivational interviewing or self-regulation coaching alone are sufficient to create lasting behavioral change, or rather, as has been hinted at elsewhere [36], that it is indeed the combination of the two which is necessary to do so. Only through the extended use of such methodologies can the science of behavior change advance beyond its history of so-called 'black box' experimentation in trials testing multicomponent behavioral interventions [60].

While the intervention developed and tested here did increase leisure-time PA and the percentage of individuals achieving the recommend 5 x 30 minutes of PA per week, it did little to investigate which types of physical activity are most likely to improve functional and disease-related outcomes within

individuals with RA. As there were minimal shifts in disease activity or functional ability resulting from the combined motivational interviewing and self-regulation coaching intervention, we were unable to identify modalities and patterns of PA engagement (e.g. daily walking, intensive cycling, or occasional low-intensity sport) which might have correlated with improved function or disease activity. As developing a dose-response relationship for the alleviation of symptoms and improvement of functional outcomes through physical activity is vital in determining the cost-effectiveness of such interventions, future research should investigate this in a controlled way, particularly among physical activity modalities which patients with RA most often find enjoyable. This is important in ensuring that individuals expend effort toward increasing activities which will not only produce measurable gains, but will also be enjoyed, and therefore better maintained in the long term.

With regard to long-term maintenance of physical activity, future research in this area should consider additional ways to increase use of self-regulatory processes after face-to-face components of interventions end. Within this study, we utilized three follow-up phone calls spaced at six-week intervals to prompt individuals to continue setting goals, making plans and self-monitoring their behavior. This led to a maintained use of nearly all self-regulation skills we examined (self-monitoring, action planning, coping planning, obtaining feedback, and attention and emotion control). Recent advances in technology might allow individuals to continue self-regulating their behavior even longer after the treatment period ends. Such advances include smartphone applications which allow users to continually track their physical activity via on-board and/or external accelerometers, and can subsequently provide users with feedback and prompt users to set goals and create action and coping plans. While some applications like this are presently available, further refinement of these devices is needed to increase usability and to ensure consistency and accessibility across various firmware platforms, as well as to verify the quality of the physical activity data such applications collect. In addition, future researchers may wish to include some sort of training in the use of these materials for patients involved in trials, and should test these applications against traditional pen and paper self-regulation materials to determine whether the mobile versions are indeed better at increasing maintenance.

As healthcare resources continue to be stretched, and the time healthcare practitioners are allotted to treat each patient is further constrained [61], brief and internet-based interventions will become the new standard of care. While brief and internet-based volitional interventions as described above have received considerable attention within the literature [62], the same is not

true of motivational interventions. Research into brief and online motivational interventions, including motivational interviewing [63], is therefore a necessary prerequisite to developing interventions which target both phases of behavior change, and which are compatible with this approaching wave of limited resources.

Finally, when training health care professionals or laypersons to deliver behavior change interventions, researchers would be well served to place a greater emphasis on the process of behavior change within the individuals being trained. The theoretical constructs which underlie behavior change in health-related domains (e.g. smoking cessation, physical activity engagement) likely also underlie changes in professional behavior [49]. A more dedicated theory based approach to training programs which involves measuring constructs related to intervention delivery (e.g. self-efficacy, motivation), as well as thorough and detailed investigations of actual behavior during patient-provider interactions, could do much to shed light on the full chain of mediations between aspects of the training, aspects of intervention delivery and eventual changes in patient behavior [64].

Conclusions

Within this dissertation, we found that an intervention which combined group patient education, motivational interviewing and self-regulation coaching produced greater gains in leisure-time physical activity and adherence to Dutch physical activity recommendations than did patient education alone. The intervention also led to improvements in autonomous motivation, self-efficacy for physical activity, and to an increased use of self-regulation skills over the course of the intervention – changes which are most likely responsible for the initial and sustained effects upon physical activity.

By integrating information about the existing nature of outpatient care, and by conducting preliminary research to establish a full chain of hypothesized relationships from intervention techniques, to cognitions and skills, and through to shifts in PA behavior, the brief intervention we developed is both theoretically sound and ready for the real world. While many questions remain unanswered about the types of physical activity which most benefit patients with rheumatoid arthritis, this dissertation has laid the foundation for potential integration of self-regulation based leisure-time physical activity interventions in existing outpatient care, and can be further modified and adapted in light of changing circumstances and new insights into the relationships between physical activity modalities and improvements in disease-related variables among individuals with rheumatoid arthritis.

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Nederlandse Samenvatting

Algemene Achtergrond

Reumatoïde artritis (RA) is een chronische reumatische aandoening, die leidt tot zwelling, pijn en stijfheid in de gewrichten. Patiënten met RA kampen meestal met afnemende functionele capaciteit, wat in sommige gevallen leidt tot immobiliteit van gewrichten en invaliditeit. Daarnaast hebben mensen met RA vaak last van depressie en een verhoogd risico voor het ontwikkelen van hart en vaatziekten.

Medicijnen vormen de eerste mogelijkheid tot de behandeling van reumatoïde artritis. Ziekte modificerende anti-reumatische geneesmiddelen (DMARD's) kunnen worden gebruikt om de progressie van de ziekte te controleren en vertragen, en hoe eerder met deze behandeling wordt begonnen, hoe beter de prognose. Niet-steroïdale anti-inflammatoire medicijnen (NSAID's) worden gebruikt om pijn en zwelling, de meest voorkomende symptomen van RA, te verminderen. Hoewel deze geneesmiddelen een goede controle van de symptomen bieden, en de lange termijn vooruitzichten van de ziekte kunnen verbeteren, zijn er ook substantiële bijwerkingen van DMARDs, zoals het verlagen van het immuunrespons, waardoor het risico voor infecties wordt vergroot. Langdurig gebruik van NSAID's verhoogt het risico voor hart en vaatziekten, wat problematisch is omdat het risico voor deze aandoeningen bij RA patiënten al is verhoogd.

Naast medicatie, kan RA ook behandeld worden door middel van niet-medicamenteuze therapie. Deze therapieën hebben tot doel het huidige niveau van functioneren van RA patiënten te behouden en de kwaliteit van leven te verbeteren. De drie meest voorkomende vormen zijn ergotherapie, patiëntenvoorlichting en zelfmanagement programma's, en lichaamsbeweging.

Ergotherapie richt zich op bescherming van gewrichten door het aanpassen van bewegingen en gespecialiseerde hulpmiddelen, op het vergroten van patiënt vaardigheden om dagelijkse activiteiten uit te kunnen blijven voeren en pijn te verminderen. Patiëntenvoorlichting en zelfmanagement programma's bieden patiënten informatie over het ziektebeeld en over de controle (zelfmanagement) van de medische, sociale en emotionele gevolgen van RA. Deze programma's helpen patiënten ook om (potentiële) problemen in het omgaan met RA te identificeren en op te lossen. De programma's proberen patiënten vaardigheden aan te leren, zoals het stellen van realistische doelen,

actieplanning, en het oplossen van problemen. Potentiële onderwerpen van zelfmanagement programma's zijn energiebesparing en vermoeidheid, medicatiegebruik, ontspanning, fitness en beweging, het omgaan met negatieve emoties, en het stimuleren van sociale contacten.

De meeste patiënten voorlichting en zelfmanagement interventies leggen een sterke nadruk op regelmatige lichaamsbeweging. Dit betreft vrijetijd activiteiten zoals fietsen en wandelen, maar ook gestructureerde trainingsprogramma's gericht op aerobe inspanning en / of krachttraining. Het Nederlands Instituut voor Sport en Bewegen (NISB) raadt volwassenen aan minimaal 30 minuten, vijf dagen per week, lichaamsbeweging van matig intensiteit na te streven om zo de gezondheid te bevorderen en onderhouden. De naleving van deze richtlijnen vermindert het risico op hart en vaatziekten, wat vanwege het verhoogde risico op cardiovasculaire incidenten voor patiënten met RA van groot belang is. In verschillende onderzoeken naar patiënten met RA, is een grotere mate van lichaamsbeweging ook in verband gebracht met een betere mentale en fysieke kwaliteit van leven, en verminderde pijn. Bij RA patiënten kunnen dynamische trainingsprogramma's (aerobe oefening en / of spierkracht training) helpen pijn te verminderen, functionele en aerobe capaciteit of spierkracht verbeteren, zonder schadelijke gevolgen voor gewrichten.

Lichaamsbeweging is daarom van essentieel belang voor mensen met RA, maar een relatief nieuwe benadering voor de behandeling van RA. Er is nog weinig bekend over (a) de dosis-respons relatie tussen lichaamsbeweging en RA uitkomsten, (b) welk soort lichaamsbeweging het meest nuttig is voor patiënten met RA, en (c) of lichaamsbeweging kosteneffectief is in het vertragen van de progressie van de ziekte en in het verbeteren van kwaliteit van leven. Ondanks het feit dat lichaamsbeweging veilig is voor de meeste mensen met RA, is deze groep meestal minder actief dan door de NISB is aanbevolen. Eerdere interventies zijn succesvol gebleken in het verhogen van lichaamsbeweging, en in het verbeteren van psychologische en ziekte gerelateerde uitkomsten op de korte termijn. Het is echter niet voldoende onderzocht hoe deze effecten tot stand komen, noch welke factoren het continueren van lichaamsbeweging op de lange termijn bevorderen. Daarnaast zijn bestaande lichaamsbeweging interventies bijna uitsluitend gericht op de 'actie fase' van gedragsverandering, terwijl te weinig aandacht bestaat voor de 'motivatie fase' en de fase van het gedragsbehoud.

Doel van het onderzoek:

Vanwege de beperkingen van huidige lichaamsbeweging interventies richt dit proefschrift zich op de ontwikkeling en het testen van een op theorie gebaseerde interventie om lichaamsbeweging bij mensen met RA te bevorderen gedurende alle fasen van gedragsverandering. Daarbij ligt de nadruk op de volgende onderzoeksvragen:

1. In welke mate verklaart het gebruik van zelfregulatie technieken de effectiviteit van bestaande psychologische interventies voor patiënten met RA?
2. Welke rol spelen self-efficacy, lichaamsbeweging en het bereiken van lichaamsbeweging doelen in het voorspellen van pijn en kwaliteit van leven bij patiënten met RA?
3. Leidt de combinatie van motiverende gespreksvoering en zelfregulatie coaching tot een hoger niveau van lichaamsbeweging dan alleen maar informatie verstrekken?
4. Hebben de kwaliteit en inhoud van motiverend gesprekken effecten op veranderingen in lichaamsbeweging of motivatie bij patiënten?
5. Verklaren toenames in motivatie, self-efficacy en het gebruik van zelfregulatie technieken de toename van lichaamsbeweging na deelname aan motiverende gespreksvoering en een zelfregulatie coaching interventie?

Samenvatting van de hoofdstukken in dit proefschrift:

In hoofdstuk 2 beschrijven we een meta-analyse van 27 gerandomiseerde gecontroleerde studies, die psychologische interventies bij patiënten met RA hebben geëvalueerd. Deze interventies hadden een middelgroot effect op lichaamsbeweging, en kleine, maar significante effecten op pijn, functionele capaciteit, en op angst en depressie. Wij hebben alle 27 studies geanalyseerd op het gebruik van 5 zelfregulatietechnieken: het stellen van doelen, actieplanning, self-monitoring, feedback en coping planning. Uit vergelijkende analyses bleek dat interventies die meer van deze zelfregulatie technieken omvatten, grotere effecten op lichaamsbeweging, angst en depressieve symptomen hadden dan interventies die minder gebruik hadden gemaakt van deze technieken. Op basis van deze resultaten hebben wij daarna gekozen om zelfregulatie componenten in onze (nieuwe) interventie te verwerken.

In hoofdstuk 3 van dit proefschrift, analyseren we longitudinale data van 271 personen met RA. Uit die data blijkt dat self-efficacy voor lichaamsbeweging een belangrijke voorspeller is van lichaamsbeweging, zowel op de korte als op de lange termijn. Self-efficacy is het geloof bepaalde doelen te kunnen bereiken of specifieke taken te kunnen uitvoeren, en is in verschillende theorieën een belangrijke voorspeller van intentie en gedragsverandering. De link tussen self-efficacy en lichaamsbeweging is congruent met de bevindingen van vele soortgelijke studies in de afgelopen decennia [19]. Om verhoging van self-efficacy te bevorderen, hebben we voor interventie componenten gekozen, die gebaseerd zijn op de theorie van Bandura: een focus op concrete actie planning voor de korte termijnen het stellen van realistische, persoonlijk relevante en plezierige lichaamsbewegingsdoelen, wat de kans vergroot dat lichaamsbeweging gekoppeld wordt aan positieve ervaringen (d.w.z. plezier en prestatie).

Hoofdstuk 3 toonde ook een verband aan tussen verhoogde niveaus van self-efficacy en het bereiken van lichaamsbewegingsdoelen, het verlagen van pijn en het verhogen van de kwaliteit van leven bij patiënten met RA. Om de kans op het bereiken van lichaamsbewegingsdoelen te verhogen, hebben wij een zelfregulatie werkboek ontwikkeld met een nadruk op realistische doelen stellen, self-monitoring, actieplanning en coping planning. Deze technieken waren in eerdere onderzoeken in verband gebracht met doelrealisatie.

In een cross-sectionele studie (waar de zelfde basisgegevens uit het onderzoek gepresenteerd in hoofdstuk 3 zijn geanalyseerd), werd autonome motivatie als een belangrijke voorspeller van lichaamsbeweging op de korte termijn geïdentificeerd. Het concept autonome motivatie (de mate waarin lichaamsbeweging iemands eigen doel is, in tegenstelling tot een doel gesteld door anderen) komt voort uit zelfdeterminatie theorie, en is vergelijkbaar met het concept ´goal ownership´ binnen zelfregulatie theorie. Wij hebben voor een motiverend gesprek als een centrale component van onze interventie gekozen, om zo de autonome motivatie bij patiënten te bevorderen. Motiverende gesprekvoering (MI) is een cliëntgerichte vorm van begeleiding, die in de laatste tien jaar binnen veel gedragsveranderingsinterventies is toegepast. In steeds meer onderzoek worden bepaalde componenten van MI (bv 'MI spirit') gerelateerd aan veranderingen in cognities zoals autonome motivatie.

Op basis van de bevindingen uit hoofdstukken 2 en 3 hebben we een gecombineerde interventie ontworpen, die bestaat uit motiverende gespreksvoering en zelfregulatie coaching om lichaamsbeweging te bevorderen

door middel van veranderingen in autonome motivatie, self-efficacy en het gebruik van zelfregulatie vaardigheden. In hoofdstuk 4 van dit proefschrift worden de resultaten van een gerandomiseerde, gecontroleerde trial gepresenteerd, waarin de effecten van deze interventie (één motiverende gesprek uitgevoerd door een fysiotherapeut, en twee zelfregulatie coaching sessies uitgevoerd door een reumatologie verpleegkunde) zijn vergeleken met de effecten van een controle groep die enkel een patiëntenvoorlichting sessie had gekregen. De inhoud van deze patiëntenvoorlichting is vergelijkbaar met de standaard voorlichting, die bij poliklinische zorg aan RA patiënten wordt gegeven.

We hebben 78 mensen met RA die niet voldeden aan de aanbevolen lichaamsbewegingsnorm geworven om deel te nemen aan het onderzoek. Na de volledige 32-weekse cursus (6 weken voor interventie en een follow-up van 6 maanden) werden significante effecten gevonden qua verhoging van self-efficacy en autonome motivatie, en een aanzienlijke toename van lichaamsbeweging in de vrije tijd. Patiënten in de interventiegroep verhoogden hun lichaamsbeweging gemiddeld met 90 minuten per week in vergelijking met een gemiddelde toename van slechts 5 minuten in de controlegroep.

Naast de effecten op lichaamsbeweging, heeft de interventie op een korte termijn ook geleid tot een vermindering van depressieve klachten en zelf gerapporteerde vermoeidheid. Er waren echter geen significante verbeteringen in ziekte activiteit of functionele capaciteit - veranderingen die wel zijn aangetoond in meer gestructureerde lichaamsbeweging programma's bij patiënten met RA. Dit gebrek aan effecten kan voortkomen uit incongruentie tussen het soort lichaamsbeweging dat deelnemers in dit onderzoek hebben gedaan (zelf gekozen, leuk, en waarvoor zij zelf gemotiveerd waren) en de soorten lichaamsbeweging, die in meer gestructureerde lichaamsbeweging interventies worden aangeboden (vooraf, extern bepaalde programma's, moeilijk of inspannend).

In hoofdstuk 5 beschrijven we een evaluatie van de kwaliteit van de motiverende gesprekken (MI)en hoe de kwaliteit van MI´s veranderingen in patiënten veranderingen in motivatie en lichaamsbeweging beïnvloedt één week na de MI sessie. Patiënten met wie een kwalitatief betere MI gesprek werd gevoerd hadden een grotere kans om hun niveau van lichaamsbeweging als gevolg van de MI-sessie te verhogen. Er waren ook effecten van MI kwaliteit op motivatie.

In hoofdstuk 6 hebben we onderzocht of verbeterde autonome motivatie, self-efficacy voor lichaamsbeweging en meer gebruik van zelfregulatie vaardigheden, tot het bereiken van lichaamsbewegingsdoelen en tot meer lichaamsbeweging in de vrije tijd leidde. Na de interventie waren hogere niveaus van lichaamsbeweging in de interventiegroep te verklaren door een toename in het gebruik van zelfregulatie vaardigheden, maar niet door een toename van autonome motivatie of self-efficacy. Zes maanden na de interventie, waren de indirecte effecten op het niveau van lichaamsbeweging in de vrije tijd sterker, zoals werd verondersteld. Het niveau van lichaamsbeweging in de vrije tijd was significant toe te schrijven aan zowel hogere niveaus van autonome motivatie als aan een groter gebruik van zelfregulatie vaardigheden. Deze bevinding geeft aan dat zes maanden na de interventie, personen die hun motivatie voor lichaamsbeweging hadden geïnternaliseerd en vaker gebruik maakten van zelfregulatie strategieën de vooruitgang in lichaamsbeweging konden doorzetten.

Curriculum Vitae

Keegan Phillip Knittle was born on November 23rd, 1982 in Houston, Texas in the United States of America. After graduating cum laude from Deer Park High School in 2001, he received a full scholarship to study Electrical Engineering at The University of Texas at Dallas (UTD). While at UTD, he co-founded a student-run radio station (radio.utdallas.edu), for which he served as programming director and as station manager. After changing study direction away from engineering, he graduated cum laude from UTD in 2005 with a B.A. in Psychology and a Minor in Spanish.

From 2005 to 2006, Keegan worked as a secondary school teacher in the Deer Park Independent School District, before moving to The Netherlands to further his study. In 2007 he received a M.Sc. in Health Psychology from Leiden University (cum laude), conducting a meta-analysis of psychological treatments for irritable bowel syndrome. From 2007-2011 Keegan was a Ph.D. student in Health Psychology at Leiden University where he developed and pilot-tested an intervention to increase physical activity among patients with rheumatoid arthritis within the Leiden University Medical Center.

Since March of 2012 Keegan has worked at Newcastle University in the UK as a research associate within the MoveLab physical activity and exercise research group. His current project is focused on improving patient-provider consultations in the context of physical activity promotion among patients with an increased risk of cardiovascular disease.

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