Summary
Chapter 1: introduction

Theory-driven research was hardly used in the field of physical rehabilitation. In this thesis I took on the endeavour of applying theory-driven methodology to chronic low back pain (CLBP) rehabilitation. CLBP can lead to activity limitations and can have great personal, financial and societal impact. To counter these problems, chronic (low back) pain rehabilitation is used. The focus of this type of rehabilitation is not so much on restoring health by solving the underlying problem, but on restoring normal life despite the persistence of the problem.

The word ‘rehabilitation’ was used in this thesis to denote: the actions taken by dedicated teams of rehabilitation physicians, paramedics and psychologists to restore someone to normal functioning in daily life as far as this is possible. This is also referred to as multidisciplinary rehabilitation.

Theory-driven methodology was developed in reaction to disappointing results of outcome studies. In particular the small effects and the lack of information for improvement of clinical practice were criticized. The label ‘theory-driven research’ was used in this thesis to denote: research in which the theories that are incorporated in treatment play an important role in the design of scientific research studies of that treatment. These theories give shape to the treatment content and working mechanism, help to define the optimal participants and the optimal implementation environment. Theory-driven research is therefore not just a matter of technical and methodological expertise, also thorough knowledge of the treatment is needed.

Theory-driven research was applied in this thesis to develop and study a new treatment for CLBP. Both the research methodology and the treatment were innovative. The treatment was an addition to the available pain rehabilitation treatments by focussing on illness perceptions (the patient’s personal thoughts about the problem). The treatment was developed using Leventhal’s Common Sense Self-Regulation Model (CSRM) as a main theory. This is a well researched theory from the field of health psychology. Illness perceptions were demonstrated to be predictive of, for example, behaviour. Applying this theory for treatment, and not for prediction, was again innovative. The treatment that resulted from this was called Cognitive Treatment of Illness Perceptions (CTIP). CTIP was used to demonstrate how theory-driven methodology was applied and what knowledge and results were gained from it.
Chapter 2: systematic description of the treatment content of CTIP

This chapter described how Cognitive Treatment of Illness Perceptions (CTIP) was developed in a theory-driven way, and demonstrated how theories gave shape to its content. CTIP, a rehabilitation treatment for patients suffering from chronic low back pain (CLPB), served as an illustrative example. The word ‘theories’ was defined as: sets of interrelated assumptions that are made in order to explain important processes. In the case of ‘treatment theory’ we refer to the interrelated assumptions of a treatment.

By studying treatment theories it became clear the ‘the problem in the low back’ was defined differently in the acute phase of the problem and in the more chronic phase. In the more acute phase the back problem of patients was predominantly defined as a biomedical problem, whereas in the chronic phase the back problem evolved in a biopsychosocially explained problem. CTIP, in turn, redefined the biopsychosocial CLBP problem into ‘limitations in the performance of daily activities for which the main explanation was maladaptive illness perceptions’.

Systematic description of the content of CTIP resulted in two important treatment ingredients: mental and physical experimentations. Cognitive theories served as the guiding principles for mental experimentation, while motor learning theories were identified as the guiding principles for physical experimentation. The description and specification showed that CTIP incorporated a complex set of theoretical principles, ingredients and related techniques. Such complexities are often overlooked or ignored in both clinical practice and research. Our primary aim was to uncover these complexities and to make this knowledge available to clinicians and their patients as well as researchers.

Benefits of the systematic description and specification of CTIP for clinicians are: (1) that they enable them to articulate how and why they give such content to cognitive treatment; (2) that they provide a framework for refinement and improvement of the treatment; and (3) that they provide a basis for referring patients to CTIP, based on their personal characteristics. The advantages for researchers are: (1) that they enable them to shape inclusion and exclusion criteria for outcome studies according to the types of patients that may benefit; (2) that they assist in choosing outcome measures that closely match with the treatment’s potential impact; and (3) that they provide a clear description for assessing the process of treatment fidelity, that is, the extent to which treatments are in fact delivered, received and used as intended in outcome research.

The role of theory in rehabilitation practice is a topic of much discussion. These discussions are usually focussed on describing the problems surrounding, or
the potential purposes of theory development. In this chapter we did not aim to just add comments to the discussions: we not only indicate what the role of theory can be in rehabilitation, we also demonstrated means to tackle them.

Chapter 3: integrating theory and methodology in the research design
In this chapter treatment theory was used as a guide for designing clinically research that is of assistance in the clinical decision-making process. The starting point for the design of an explanatory trial was the treatment (CTIP). Treatment theory was helpful in identifying essential treatment components, the optimal choice of a control group and the selection of outcome measures. Treatment theory was valuable in defining the best candidates for CTIP, thus assisting the selection of patient characteristics. In the case of CTIP, important characteristics were language, reasoning, and discussion skills. Skills that are important for the patient’s ability to engage in, understand, and co-operate with CTIP. Such characteristics should therefore be studied, and not be randomized and diluted.

Regarding outcome measures the focus in this chapter was on those measurement instruments that assessed the extent to which CTIP achieved its own aims. Such instruments should not only match with conventional methodological standards such as the reliability and validity, from a theory-driven perspective they should also match precisely with the specific treatment aims. For example, the questionnaire to measure illness perceptions (IPQ-R) was selected because it was especially designed to measure changes in illness perceptions. Despite its methodological strengths the IPQ-R results may be misleading if one assumed that the IPQ-R is suitable for the measurement of the in-depth changes in maladaptive illness perceptions that were hypothesized in CTIP. The misinterpretation stems from the fact that the IPQ-R is only able to indicate whether or not global changes occurred. Similar concerns were articulated with respect to generic measures of physical activity limitations, such as the Quebec Back Pain Disability Scale (QBPDS). Not all the items that are included in the QBPDS have personal relevance, therefore the instrument does not closely match with CTIP in which patient relevant physical activities are targeted. Consequently, the QBPDS might present misleading results by diluting or not reflecting those activities that are relevant to the patient. Specific treatment effects of CTIP might therefore be missed.

In this chapter we took a stance in the discussion on Evidence Based Medicine (EBM). EBM is criticized in literature for being methodology based, favouring pragmatic trials and meta-analysis and for focusing on patient populations with a specific medical diagnosis, rather than on sub-groups of
patients that are suitable candidates for rehabilitation treatment. In rehabilitation, EBM is therefore, considered to be an insufficiently specific method to support clinical decision-making. However, with help of CTIP as an illustrative example, we show that treatment theory could be integrated with EBM methodology based procedures. As a result, CTIP was a source of information for the design of a trial that assists in clinical decision-making. Our stance in the discussion is therefore that criticism should not be aimed at EBM itself, but at the strict procedures involved.

Chapter 4: comparing CTIP with two other cognitive behavioural treatments
In this chapter we present the results of a comparative content analysis of three cognitive behavioural painrehabilitation treatments. We demonstrated how specification of treatment theory can contribute to a better understanding of research findings and related choices of treatment in painrehabilitation. The content and theoretical underpinnings were compared and contrasted for the treatments: Graded Activity (GA), Gradual Exposure in Vivo (GEiV), and Cognitive Treatment of Illness Perceptions (CTIP).

From the comparative analysis GA come to the fore as the most behavioural of the three treatments, since it attempts to change pain behaviour by means of operant conditioning techniques in a time-contingent approach. CTIP was detected as the most cognitive treatment, because it tries to change maladaptive illness perceptions by means of mental experiments, including Socratic dialogues. GEiV was positioned more towards the middle of the behavioural-cognitive spectrum, as it attempts to change fear of pain by exposing patients to cognitive-behavioural experiments.

The comparative analysis suggested that a fair comparison of these treatments would be complicated. First, because of the treatments have both overlapping and unique components, and second because the treatments are likely to be most effective for different sub-groups of CLBP patients. With this knowledge at their disposal therapists can explain the range of treatment choices to their patients giving patients a more informed choice. Therapists can now take into consideration the degree to which a patient has the skills that are required for successful participation in one of the treatments. Therapists may also consider in which techniques they are already skilled and for which they need more training. However, one may want to consider whether therapists should be expected to be able to provide all three types of treatment or that it is best for therapists to be specialised in only one treatment.
Chapter 5: a study of treatment effectiveness

The results of a randomized controlled trial investigating the effectiveness of CTIP are presented in this chapter. CTIP was compared with a waiting list control group in one out-patient rehabilitation centre. Eligible patients (18-70 years) experienced back pain (> 3 months), and met the diagnostic criteria for CLBP. Patients (n=156) were randomly assigned to treatment or a waiting list; follow-up was at 18 weeks. The primary outcome measure was patient-relevant physical activities. Researchers and assessors were blinded to group allocation. Analysis was according to intention-to-treat.

Treatment was more effective than waiting list: a statistically significant (p=0.013) difference was found between the groups on patient relevant physical activity. The change in the CTIP group was a clinically relevant effect (19.1 mm) on patient-relevant physical activities. The NNT is 4, indicating that 4 patients had to be treated for one to achieve a clinically relevant improvement in physical activities in comparison to the waiting list group. Statistically significant changes were also found for the following illness perception dimensions timeline cyclical (p=0.007), consequences (p=0.048), personal control (p=0.001) and coherence (p=0.022), indicating that the illness perceptions changed. These changes were related to changes in patient-relevant activities and explained 14.4% of the variance, which seems to support the working mechanism of CTIP. No significant differences were found for generic physical activities (QBPDS), which is in line with our expectations and might reflect the strong focus of CTIP on patient-relevant physical activities.

The statistically significant effect and clinically relevant change found in this study are very encouraging, as no effort was made to specifically select the best candidates for CTIP (for example patients with maladaptive illness perceptions). It seems likely that larger effects can be achieved when such sub-groups of best candidates for CTIP can be identified. For this first study on the effectiveness of CTIP the use of a WTL group as the control group was a suitable choice. In order to separate specific effects of CTIP from non-specific effects, future studies could consider different types of (active) control groups (for example other painrehabilitation treatments or placebo groups which receive an equal amount of attention as the treated group). Further studies are also needed to determine for whom and under what circumstances CTIP can best be implemented in clinical practice. A study on the longer term effectiveness of CTIP has already been conducted, but data are not yet analyzed and described in a publication.
Chapter 6: a study of best candidates

This chapter presents the results of a theory-driven prognostic study exploring determinants for best candidates of CTIP. First-generation studies have helped to legitimize CLBP rehabilitation. First-generation outcome studies provided proof of the (cost-) effectiveness by answering the questions “Is the treatment effective?”, and first-generation prognostic studies by answering the question “Which patients are at risk for developing chronic complaints?”. Second-generation studies should focus on improving rehabilitation treatment by addressing questions such as “What treatments work best for whom?”. Rehabilitation research should, therefore, include more deliberate tests of theoretically driven a priori hypotheses.

We suited the action to the word and studied three, theory-derived, treatment-specific predictors in CLBP patients receiving CTIP in a prognostic study. The central question in this study was: ‘Who are best candidates for CTIP?’ The three predictors under study were: rational approach to problem-solving, discussion skills, and verbal skills. Hierarchical linear regression analysis was used to assess their predictive value. Short-term changes in patient-relevant physical activity (measured with PSFL), was the primary outcome measures for CTIP effect. In the study 156 patients with CLBP participated.

Rational problem-solving was found to be a significant predictor for the change in physical activity. Discussion skills and verbal skills were found to be non-significant predictors. Rational problem-solving explained 3.9% of the total variance. This theory-driven predictor study therewith generated clinically relevant information to be used to select the appropriate candidates for CTIP. A minimum score of 44 on the Rational Problem Solving scale (SPSI-RPS) can assist clinicians in selecting appropriate candidates for CTIP. A strength of this predictor study was that we identified and tested variables that, without the use of treatment theory, would otherwise not have been investigated.

The results of first-generation predictor studies have added to our knowledge concerning suitability for rehabilitation treatment in general by focusing on demographic variables and other variables that are generic for the CLBP population. The accumulation of treatment-specific predictor studies may create a body of knowledge that can assist clinicians in their everyday decisions concerning ‘what treatment works for whom’. Such deliberate tests of theory-driven hypotheses may, indeed, help to generate knowledge and understanding of the working mechanisms underlying different treatments.
Chapter 7: a study of fidelity to treatment protocol
The subject of this chapter was treatment fidelity. Treatment fidelity refers to the degree to which a treatment was provided as planned. Demonstrating fidelity is a key requirement for drawing valid conclusions from trial results. In clinical trials it is evident that it is the actual practice that is evaluated, which is not necessarily identical to the planned treatment as described in the treatment protocol. In this study fidelity was assessed independently by two raters in all available patient files (n=125). Therewith the study was focused on the permanent products of treatment, i.e. the notes and forms in the patient files. A priori we set a level of at least 50% to demarcate satisfactory fidelity to treatment protocol.

The primary aim of this study was to describe the fidelity to the CTIP treatment protocol, a physical rehabilitation treatment for patients with chronic low back pain. The treatment structure included three phases (mapping, disputing and applying). The fidelity to the structure of the protocol was generally found to be very satisfactory (67-100%), except for the use of the application form (21%). The treatment content was verified by assessing whether illness perceptions were indeed targeted and not perceptions, ideas or beliefs in other matters. The fidelity to treatment content was somewhat less satisfactory (44-56%). The set minimum of 50% was not achieved for formulating alternative illness perceptions. Assessing the fidelity to content is rarely done and provided valuable insights for future improvement of the fidelity to the treatment protocol. The results indicated that identifying maladaptive illness perceptions and formulating alternative illness perceptions was a challenging task for professionals and may warrant careful consideration in future implementation.

The description of the fidelity showed that the actual treatment provided had a close resemblance to the planned treatment, i.e. the treatment protocol. Therefore it is likely that the results found in the RCT (i.e. statistically significant changes in both physical activity and illness perceptions) can be attributed to CTIP. However, fidelity was not perfect and, therefore, this leaves potential for improvement of the treatment delivery. In the predictor study rational problem-solving was found to be the only predictor of physical change in CTIP. The fidelity scores for content may indeed indicate that the treatment did not call upon the patients' rational problem-solving skills as much as was expected. Therefore, this predictor may have proved to be a stronger predictor if this skill was called upon more frequently. Possibly, other predictors have not reached significance for the same reason. This fidelity study thus assisted in the interpretation of trial results and pointed towards potential directions for increasing effectiveness and establishing stronger predictors.
The second aim of this study was to explore associations between (variables related to) fidelity to the treatment protocol and outcome (change in physical activity). No significant associations were found for the patient-related variables (duration of CLBP, complexity of CLBP and treatment length) using logistic regression. Therapist-related associations were explored using their relative ranks for fidelity to both structure and content. Three therapists with the highest fidelity (i.e. highest ranks) were contrasted to three therapists with the lowest fidelity scores (lowest ranks). The main observation is that the three therapists with the highest fidelity scores scored consistently high on both structure and content whereas the three therapists with the lowest fidelity scores scored inconsistent ranks on structure and content. Thus, the role of therapist-related variables in reaching high fidelity scores seems larger than that of patient-related variables. Finally, the relation between fidelity to treatment protocol and outcome was examined using independent sample t-tests. No significant effects were found. Therefore, this study cannot confirm the direct relevance of treatment fidelity for outcome (change in physical activity).

In conclusion, this fidelity study generally showed satisfactory fidelity to the structure of the treatment protocol, which is a positive finding. Improvement of CTIP fidelity is best sought in the content of the treatment protocol: in making sure that the treatment focus is on illness perceptions (instead of perceptions that are more generally related to problems with their CLBP). The assessment fidelity to content was shown to be a valuable addition to the commonly used assessment of the fidelity to structure. The study was shown to be of value for the interpretation of both the trial on CTIP effectiveness and the predictor study: by highlighting how potentially higher fidelity and stronger predictors may be established in future. Therefore we call for the wider report on fidelity as a means to interpret and understand research results as well as to gain better understanding of the treatment processes.

**Chapter 8: discussion and epilogue**

The main findings of this thesis are that CTIP is effective in increasing patient-relevant activity in patients with CLBP and that a relevant patient characteristic for CTIP treatment is rational problem-solving. The patients that participated in the studies were representative of CLBP patients visiting rehabilitation physicians in the Netherlands. The therapists in the study were specifically trained to treat according to the CTIP protocol and were experienced therapists in a multidisciplinary treatment team treating patients that suffered from chronic pain. Provided that supervision is available, we think that the treatment can be
implemented and the results can be generalized for other rehabilitation settings in the Netherlands.

A clinical implication of the study is that CTIP is best applied to CLBP patients who have a rational problem-solving style. On average, patients scoring more than 43 points on the rational problem solving scale (SPSI-RPS) showed a clinically relevant change in physical activity. The results of this thesis invite both therapists and those who are involved in prescribing treatments to add criteria for selecting patients 'suitable for a specific treatment' to their existing list of criteria to select patients that are 'suitable for (multidisciplinary) rehabilitation'.

A third implication of this thesis is for clinicians to reflect critically upon the content of their treatment and to apply the knowledge that was gained from this reflection to their selection criteria and procedures. A fourth implication is that we urge therapists to reflect on the ingredients that make up their multidisciplinary treatment and to make rational choices about what to apply and to whom. We urge them to consider the timing and interaction of treatments in these reflections. For the ingredients of treatments might be like pills in this respect that one cannot simply say: more is better. In addition, some combinations have better results than others. For these reasons, we do not recommend including CTIP in existing treatments without careful consideration of how and where CTIP fits with the existing treatment ingredients. In general, the results of this thesis are encouraging for the (future) clinical application of CTIP.

In general, the results of the thesis are encouraging for the (future) clinical application of CTIP. However, some caution is warranted because these are the initial results from a single series of studies. More knowledge on how to optimize the treatment, relevant patient characteristics and interaction with other treatments is required.

Recommendations for future research include studies of longer term effectiveness, cost-effectiveness and comparison to active control treatments. Further studies of CTIP treatment components and working mechanism are strongly recommended. These studies may not only benefit CTIP, but will also assist in building theory and evidence for other rehabilitation treatments. Other recommendations for future research are the application of CTIP to other problems and illnesses and further studies of efficient delivery of the treatment, such as tele-rehabilitation. All this, of course, is to be applied in the most theory-driven way possible.

By integrating theoretical, methodological and clinical considerations, we have tried to create a broad evidence base for CTIP. In applying these theory-driven methods to rehabilitation we were confronted with three dilemmas. The
The first dilemma was how to give primacy to theory without weakening the methodological quality of the study. The choice of outcome measures was an example of this dilemma. Measure that matched best with the treatment theory might not have the highest methodological standard. Vice versa did measures that had the best methodological quality not match closely to the treatment theory. In this thesis we balanced theory and methodology by including both types of outcome for physical activity in the RCT.

The second dilemma was how to choose between proving and improving treatment effectiveness. This problem was approached by integrating two studies into one research design. This resulted in including an RCT to provide proof of effectiveness and an explanatory predictor study to be able to improve effectiveness of CTIP. The third dilemma was balancing research needs and clinical practice needs in the study.

The third dilemma was how to balance research needs with clinical needs. This dilemma was approached by moving back and forth between research needs and clinical needs, while letting the one prevail over the other where appropriate. For example, clinical needs were allowed to prevail in the phase of implementing and fine-tuning the CTIP treatment protocol and research needs were allowed to prevail during the trial.

In the epilogue I reflected on what this thesis has added to human knowledge and I came to the conclusion that this thesis was best described as a careful attempt to touching around (using theory) in ‘the dark room of knowledge’, to be precise: in the corner of rehabilitation. By doing so, I have added some knowledge as to the direction in which knowledge may be found, but mostly I have pointed out where it cannot be acquired.