Maria Elvén is a registered physiotherapist. She has worked in the Physiotherapy programme at Mälardalen University, Västerås, Sweden, since 2005. Her main interest lies in the integration of a behavioural medicine approach in physiotherapy, particularly with regard to student learning and curriculum development. Her urge for a more profound understanding of students’ competencies in health-focused practice and health-related behavioural changes when entering the profession was the starting point for her PhD project. Her research focus is clinical reasoning in physiotherapy with an emphasis on the incorporation of behavioural change strategies in the reasoning process and the assessment of such professional competencies. Her research contributes to the development of the physiotherapy education and the profession, thereby creating possibilities for clients to meet highly competent physiotherapists. Maria is a member of the research group BeMe-Health (Behavioural medicine, health and lifestyle), School of Health, Care and Social Welfare, Mälardalen University.
CLINICAL REASONING FOCUSED ON CLIENTS’ BEHAVIOUR CHANGE IN PHYSIOTHERAPY

DEVELOPMENT AND EVALUATION OF THE REASONING 4 CHANGE INSTRUMENT

Maria Elvén

2019

School of Health, Care and Social Welfare
CLINICAL REASONING FOCUSED ON CLIENTS’ BEHAVIOUR CHANGE IN PHYSIOTHERAPY
DEVELOPMENT AND EVALUATION OF THE REASONING 4 CHANGE INSTRUMENT

Maria Elvén

Akademisk avhandling

som för avläggande av filosofie doktorsexamen i fysioterapi vid Akademin för hälsa, vård och välfärd kommer att offentligen försvaras fredagen den 24 maj 2019, 09.30 i Beta, Mälardalens högskola, Västerås.

Fakultetsopponent: Professor Lena Nilsson-Wikmar, Karolinska Institutet
Abstract

With the recognition of the impact of lifestyle behaviours on health and the evidence of incorporating behavioural considerations in physiotherapy, there is a need to advance the clinical reasoning of physiotherapists. Clinical reasoning encompasses the thinking and decision-making processes guiding client management and is a core competency of physiotherapists. Enabling clinical reasoning advancements requires investigations in practice and education, which in turn require robust assessments. The overall aim of this thesis was to develop and evaluate an instrument to study physiotherapy students’ clinical reasoning focused on clients’ activity-related behaviour and behaviour change.

In study I, a conceptual model was developed based on exploration of existing research, theory and views of physiotherapists and students. The data resulted in the clinical reasoning model focused on clients’ behaviour change with reference to physiotherapists (CRBC-PT). Studies II and III included instrument development and evaluation in four phases. Phase 1 included determination of the instrument structure and item generation based on the CRBC-PT model, evidence in clinical reasoning assessment and existing measures. Phase 2 included cognitive interviews with students to assess item understanding and resulted in revisions of item problems and approval of feasibility. Phase 3 included a Delphi study with physiotherapists with expertise in behavioural medicine to evaluate item relevance. The findings demonstrated a high level of consensus regarding content relevance. The final version of the Reasoning 4 Change (R4C) instrument included four domains, namely, Physiotherapist, Input from client, Functional behavioural analysis, and Strategies for behaviour change. In phase 4, the reliability and validity of the instrument were evaluated. Physiotherapists with expertise in behavioural medicine and students responded to the web-based R4C instrument and the Pain Attitudes and Beliefs Scale for Physiotherapists. The analyses showed excellent inter-rater reliability, satisfactory construct validity, internal consistency and test-retest reliability. In study IV, final-semester students (n=151) from all physiotherapy programmes in Sweden completed the R4C instrument. Hierarchical multiple regression analyses were conducted with three dependent variables, namely, input from client, functional behaviour analysis, and strategies for behaviour change. All included independent variables explained 37% of the variance in input from client. Cognitive and metacognitive skills explained 22%, attitudes 15% and curriculum with behavioural medicine competencies 3%. Only the variable curriculum with behavioural medicine competencies explained the variance in functional behaviour analysis (4%) and strategies for behaviour change (5%).

In conclusion, the in-depth description of clinical reasoning focused on clients’ behaviour change may contribute to expanded understanding of the complexity and multidimensionality in reasoning processes that incorporate factors related to human behaviours, analyses of what factors motivate or hinder behaviours, and interventions to support behaviour change. Such knowledge is valuable for the teaching of and learning clinical reasoning. The R4C instrument helps fill the need for well-tested instruments and can support investigations and evaluations in physiotherapy education and research. To develop students’ clinical reasoning competence, cognitive and metacognitive skills, positive attitudes and the incorporation of behavioural medicine competencies into physiotherapy curricula should be targeted. Further attention to complex reasoning, including analysis and intervention, is warranted.
To Vilgot and Nellie

*Every ending is the beginning of something else. Every exit is an entry somewhere else.*

Marc Chernoff
Abstract

With the recognition of the impact of lifestyle behaviours on health and the evidence of incorporating behavioural considerations in physiotherapy, there is a need to advance the clinical reasoning of physiotherapists. Clinical reasoning encompasses the thinking and decision-making processes guiding client management and is a core competency of physiotherapists. Enabling clinical reasoning advancements requires investigations in practice and education, which in turn require robust assessments. The overall aim of this thesis was to develop and evaluate an instrument to study physiotherapy students’ clinical reasoning focused on clients’ activity-related behaviour and behaviour change.

In study I, a conceptual model was developed based on exploration of existing research, theory and views of physiotherapists and students. The data resulted in the clinical reasoning model focused on clients’ behaviour change with reference to physiotherapists (CRBC-PT). Studies II and III included instrument development and evaluation in four phases. Phase 1 included determination of the instrument structure and item generation based on the CRBC-PT model, evidence in clinical reasoning assessment and existing measures. Phase 2 included cognitive interviews with students to assess item understanding and resulted in revisions of item problems and approval of feasibility. Phase 3 included a Delphi study with physiotherapists with expertise in behavioural medicine to evaluate item relevance. The findings demonstrated a high level of consensus regarding content relevance. The final version of the Reasoning 4 Change (R4C) instrument included four domains, namely, Physiotherapist, Input from client, Functional behavioural analysis, and Strategies for behaviour change. In phase 4, the reliability and validity of the instrument were evaluated. Physiotherapists with expertise in behavioural medicine and students responded to the web-based R4C instrument and the Pain Attitudes and Beliefs Scale for Physiotherapists. The analyses showed excellent inter-rater reliability, satisfactory construct validity, internal consistency and test-retest reliability. In study IV, final-semester students (n=151) from all physiotherapy programmes in Sweden completed the R4C instrument. Hierarchical multiple regression analyses were conducted with three dependent variables, namely, input from client, functional behavioural analysis, and strategies for behaviour change. All included independent variables explained 37% of the variance in input from client. Cognitive and metacognitive skills explained 22%, attitudes 15% and curriculum with behavioural medicine competencies
3%. Only the variable curriculum with behavioural medicine competencies explained the variance in functional behavioural analysis (4%) and strategies for behaviour change (5%).

In conclusion, the in-depth description of clinical reasoning focused on clients’ behaviour change may contribute to expanded understanding of the complexity and multidimensionality in reasoning processes that incorporate factors related to human behaviours, analyses of what factors motivate or hinder behaviours, and interventions to support behaviour change. Such knowledge is valuable for the teaching of and learning clinical reasoning. The R4C instrument helps fill the need for well-tested instruments and can support investigations and evaluations in physiotherapy education and research. To develop students’ clinical reasoning competence, cognitive and metacognitive skills, positive attitudes and the incorporation of behavioural medicine competencies into physiotherapy curricula should be targeted. Further attention to complex reasoning, including analysis and intervention, is warranted.

**Key words:** Assessment; Behaviour change; Clinical reasoning; Education; Functional behavioural analysis; Physiotherapy, Reliability; Scale development; Validity
Svensk sammanfattning

Idag finns omfattande kunskap om hur vår livsstil, d.v.s. våra beteenden, påverkar hälsa samt evidens för att integrera ett biopsykosocialt perspektiv och metoder som stödjer beteendeförändring i undersökning och behandling i fysioterapi. Det finns således ett behov av att utveckla fysioterapeutes kliniska resonemang från ett traditionellt fokus på klienters fysiska funktioner till att också inkludera psykosociala faktorer och klienters beteenden. Kliniskt resone-mang omfattar hur fysioterapeuter tänker och fattar beslut i undersökning, analys och behandling och är en kärnkompetens hos fysioterapeuter. För att möjliggöra utveckling av fysioterapeutes kliniska resonemang krävs studier i praktisk verksamhet och utbildning, vilka i sin tur kräver väl testade mätin-
strument. Det övergripande syftet med denna avhandling var att utveckla och utvärdera ett instrument för att undersöka fysioterapeutstudenters kliniska re-
sonemang med fokus på klienters aktivitets-relaterade beteende och beteendeförändring.

I studie I utvecklades en begreppsmodell som beskriver kliniskt resonem-
ang med fokus på klienters beteendeförändring baserad på existerande forskning, teori samt fysioterapeutes och studenters uppfattningar om kliniskt resonemang. Data resulterade i ‘the clinical reasoning model focused on cli-

ts’ behaviour change with reference to physiotherapists’ (CRBC-PT). Studie II och III omfattade instrumentutveckling och utvärdering i fyra faser. I fas 1 utvecklades instrumentets struktur och frågor baserat på CRBC-PT mo-
dellen, evidens för undersökning av kliniskt resonemang och existerande mät-
instrument. I fas 2 genomfördes kognitiva intervjuer med studenter för att undersöka förståelse av instrumentets frågor. Svårigheter identifierades och åtgärdades och instrumentet bedömdes ha god genomförbarhet. Fas 3 omfat-
tade en Delphistudie där fysioterapeuter med expertkompetens inom beteendemedicine värderade frågornas relevans. Experterna var i hög grad samstä-
miga i bedömningen att instrumentets frågor var relevanta. Den slutliga ver-

tionen av bedömningsinstrumentet Reasoning 4 Change (R4C) bestod av fyra domän: Fysioterapeuten, Undersökning av klientens besvär, Funktionell beteendeanalyt och Strategier för att stödja beteendeförändring. I fas 4 utvärder-
rades instrumentets reliabilitet och validitet. Fysioterapeuter med expertkom-

petens inom beteendemedicine och studenter besvarade det webbaserade R4C instrumentet samt frågeformuläret Pain Attitudes and Beliefs Scale for Physio-

otherapists. Analyserna visade utmärkt interbedömreliabilitet samt god inre överensstämmelse, begreppvaliditet och test-retest reliabilitet. I studie IV
besvarade sista-terms-studenter \(n=151\) från Sveriges samtliga fysioterapeutprogram R4C. Hierarkisk multipel regressionsanalys genomfördes med tre beroende variabler: undersökning av klientens besvär, funktionell beteendeanalyser och strategier för att stödja beteendeförändring. Samtliga inkluderade oberoende variabler förklarade 37% av variansen i undersökning av klientens besvär. Kognitiva och metakognitiva färdigheter förklarade 22%, attityder 15% och utbildning innehållande beteendemedicinska kompetenser 3%. Endast varibeln utbildning innehållande beteendemedicinska kompetenser förklarade variansen i funktionell beteendeanalyser (4%) och strategier för att stödja beteendeförändring (5%).

Slutsatserna är att den ingående beskrivningen av kliniskt resonemang med fokus på klienters beteendeförändring kan bidra till ökad förståelse om komplexiteten och multidimensionaliteten i den tanke- och beslutsprocess som fysioterapeuter använder för att undersöka faktorer relaterade till mänskligt beteende, analysera vilka faktorer som motiverar eller hindrar beteenden och välja åtgärder som stödjer beteendeförändring. Denna kunskap är värdefull för undervisning och lärande i kliniskt resonemang. R4C bidrar till att fylla ett uttalat behov av väl testade instrument och kan stödja undersökningar och utvärderingar i fysioterapeututbildning och forskning. För att utveckla studenter kliniska resonemang bör insatser fokusera på studenters kognitiva och metakognitiva färdigheter, positiva attityder samt utbildningsplaners innehåll av beteendemedicinska kompetenser. Dessutom behöver det mer komplexa kliniska resonemanget som ingår i analys och behandling, ges mer uppmärksamhet.

**Nyckelord:** Bedömning; Beteendeförändring; Funktionell beteendeanalyse; Fysioterapi; Instrumentutveckling; Kliniskt resonemang; Utbildning; Reliabilitet; Validitet
List of Papers

This thesis is based on the following papers, which are referred to in the text by their Roman numerals.


Reprints were made with permission from the respective publishers.
Contents

Introduction ........................................................................................................................................... 15

Background ........................................................................................................................................... 16
  Health and welfare .......................................................................................................................... 16
  Health and welfare and its relation to a behavioural medicine approach in physiotherapy ................ 17
  Activity-related behaviours and behaviour change ........................................................................ 19
  Clinical reasoning ............................................................................................................................ 21
    Learning and clinical reasoning ...................................................................................................... 21
    Clinical reasoning in physiotherapy practice .................................................................................. 22
    Clinical reasoning in physiotherapy education ............................................................................... 24
  Assessment of clinical reasoning ...................................................................................................... 25
  Instrument development to assess clinical reasoning ................................................................. 26

Rationale ............................................................................................................................................... 28

Aim ...................................................................................................................................................... 29

Methods ............................................................................................................................................. 30
  Context ............................................................................................................................................ 30
  Participants and settings .................................................................................................................... 31
    Model development (Study I) ......................................................................................................... 31
    Instrument development and evaluation (Studies II and III) ....................................................... 31
    Physiotherapy students’ clinical reasoning (Study IV) ................................................................. 32
  Data collection .................................................................................................................................. 34
    Model development (Study I) ......................................................................................................... 34
    Instrument development and evaluation (Studies II and III) ....................................................... 35
    Physiotherapy students’ clinical reasoning (Study IV) ................................................................. 39
  Data analysis .................................................................................................................................... 40
    Model development (Study I) ......................................................................................................... 40
    Instrument development and evaluation (Studies II and III) ....................................................... 40
    Physiotherapy students’ clinical reasoning (Study IV) ................................................................. 42
  Ethical considerations ..................................................................................................................... 43

Results ................................................................................................................................................. 44
  The clinical reasoning model focused on clients’ behaviour change with reference to physiotherapists ......................................................................................................................... 44
Reasoning 4 Change instrument .................................................................47
Contributions of physiotherapy students and experts in a behavioural medicine approach in physiotherapy ........................................47
Instrument structure, items, response scales and scoring .....................47
Criterion scores .................................................................................50
Psychometric properties ...................................................................50
Physiotherapy students’ clinical reasoning focused on clients’ behaviour change .................................................................52

Discussion .............................................................................................55
Summary of results .............................................................................55
The clinical reasoning model focused on clients’ behaviour change with reference to physiotherapists ..................................................56
Reasoning 4 Change instrument .............................................................58
Physiotherapy students’ clinical reasoning focused on clients’ behaviour change ..........................................................................62
Learning in clinical reasoning .............................................................64
Developing physiotherapy students’ clinical reasoning focused on clients’ behaviour change ..........................................................67
Methodological considerations ............................................................68

Conclusions ...........................................................................................71
Implications for education and profession ...........................................72
Future research ....................................................................................73

Tackord/Acknowledgements ...............................................................74
References .............................................................................................76

Appendix .................................................................................................101
The web application of the Reasoning 4 Change instrument: accessibility and examples of screenshots ..................................................102
Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVI</td>
<td>Content validity index</td>
</tr>
<tr>
<td>CRBC-PT</td>
<td>Clinical reasoning model focused on clients’ behaviour change with reference to physiotherapists</td>
</tr>
<tr>
<td>D</td>
<td>Domain</td>
</tr>
<tr>
<td>D-CVI</td>
<td>Domain content validity index</td>
</tr>
<tr>
<td>FBA</td>
<td>Functional behavioural analysis</td>
</tr>
<tr>
<td>IC</td>
<td>Input from client</td>
</tr>
<tr>
<td>ICC</td>
<td>Intraclass Correlation Coefficient</td>
</tr>
<tr>
<td>ISBM</td>
<td>International Society of Behavioural Medicine</td>
</tr>
<tr>
<td>PT</td>
<td>Physiotherapist or Physiotherapy</td>
</tr>
<tr>
<td>R4C</td>
<td>Reasoning 4 Change</td>
</tr>
<tr>
<td>SBC</td>
<td>Strategies for behaviour change</td>
</tr>
<tr>
<td>WCPT</td>
<td>World Confederation for Physical Therapy</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
</tbody>
</table>
Introduction

Learning and development are key to addressing the needs of society, healthcare and clients. Accordingly, health professionals’ competence needs to evolve as society and the health panorama evolve. In my work as a physiotherapy educator, I have had the opportunity to contribute to both students’ learning development and the development of the physiotherapy profession. It is my true belief that entry-level education has a great impact on professional role-formation and thus is uniquely positioned to affect health and welfare.

When the undergraduate physiotherapy programme at Mälardalen University commenced in 2004, of its kind, it was unique in integrating a behavioural medicine approach consistent with holistic, client-centred care and best practices. My years as an educator and as the director of this physiotherapy programme provided me with valuable experiences in student learning and curriculum development but also with an important insight – there were many unanswered questions regarding students’ knowledge, capabilities and skills in applying a behavioural medicine approach in physiotherapy. Despite efforts to redesign the conventional entry-level curriculum and provide students with skills in health-focused practice and behavioural change, questions remained regarding the students’ competence and readiness to use such skills when entering the profession. My urge for a more profound understanding was the starting point for this thesis.

My goal with this thesis is to support the development of physiotherapy education and the profession, nationally and internationally, thereby creating possibilities for clients to meet highly competent physiotherapists.

The overall aim of this thesis was to develop and evaluate an instrument to study physiotherapy students’ clinical reasoning focused on clients’ activity-related behaviour and behaviour change. To fulfil this aim, the thesis comprises three focus areas, tightly linked and conducted in a step-by-step process. As a first step, a conceptual model to guide physiotherapists’ clinical reasoning focused on clients’ behaviour change was developed. As a second step, an instrument to assess physiotherapists’ and students’ clinical reasoning was developed and evaluated. Finally, as the third step, the instrument was used to assess physiotherapy students’ clinical reasoning.
Background

Health and welfare

Health can be understood as a multidimensional concept involving physical, psychological and social aspects (World Health Organization [WHO], 1948). Health should be viewed as a resource for every-day life, not the overall goal of living (WHO, 1986). According to this view, health represents different meanings for different individuals, which emphasises the need to grasp individuals’ perceptions of their health and life situation together with their mental and bodily status from a healthcare perspective.

Participation is about being involved in life situations (WHO, 2001), where care, treatment and physiotherapy could be considered such situations. Clients’ rights to self-determination and participation in their care and treatment are even regulated in the law (SFS 2014:821). However, clients often report insufficient participation, an opinion that has increased in recent years (Swedish Agency for Health and Care Services Analysis, 2017). Holistic and client-centred care is emphasised to reverse this trend (Swedish Agency for Health and Care Services Analysis, 2016), and health education and healthcare providers are urgently required to improve health professionals’ competencies in using such an approach (Swedish Agency for Health and Care Services Analysis, 2017). Client participation is ubiquitous in a clinical reasoning process, i.e., assessment, analysis and intervention, which focuses on support for clients’ behavioural change. Additionally, however, an essential goal of such reasoning is to support clients’ participation in daily life activities (Åsenlöf, Denison, & Lindberg, 2005), which in turn can contribute to welfare.

Welfare is a broad concept embracing both personal and societal aspects. Actions and approaches that strengthen participation, promote the well-being of individuals and reduce health inequities are favourable for welfare (Raphael, 2014). Modern welfare includes social services that are offered according to specific needs and social investments that use the most efficient methods and sound evaluations (Aili & Hjort, 2010). Accordingly, health professionals who are educated for health-focused practice including support of health-related behaviour change in accordance with evidence (Dean, 2009) are in favour of individual and population health and well-being as a profitable investment for society. In addition, to evaluate investments in education and health-care and guide future improvements, well-tested measures are necessary.
Health and welfare and its relation to a behavioural medicine approach in physiotherapy

Unhealthy lifestyle behaviours, such as physical inactivity, associated with chronic diseases and non-communicable diseases, e.g., cancer, stroke, chronic lung disease and diabetes, have become a major worldwide problem (WHO, 2014). In addition, the rapidly ageing population, who are at high risk of disabilities and diseases, are pointed out as contemporary health challenges (WHO, 2011). To address these challenges, health educators, healthcare systems and health professionals, including physiotherapists, are required to adjust and renew their methods (Dean, Moffat, et al., 2014; Frenk et al., 2010).

Physical inactivity is one of the leading risk factors for premature death. In 2016, 27.5% of the global adult population was not sufficiently physically active (Guthold, Stevens, Riley, & Bull, 2018). Regular physical activity can prevent many chronic conditions, with a risk reduction of 20-30% (Rhodes, Janssen, Bredin, Warburton, & Bauman, 2017). To achieve the global targets of reducing insufficient physical activity (WHO, 2013) and premature mortality from non-communicable diseases (United Nations, 2015), inter-professional collaboration is required. The physiotherapy profession has an essential role in such a partnership (World Confederation for Physical Therapy [WCPT], 2015b), as this profession is committed to exploiting non-pharmacological interventions such as health education and lifestyle behaviour change to manage health (Dean, de Andrade, et al., 2014). Engagement in such client care implies that physiotherapists need to possess specific clinical reasoning skills.

The health and well-being of individuals and populations are determined by circumstances related to the individual and the context (Åkerlind & Schunder, 2007). Predominantly, health outcomes and health inequities reflect structural and social determinants of health (e.g., public policies and socioeconomic conditions) and need to be addressed to improve health (Hubinette, Dobson, Scott, & Sherbino, 2017). According to a WHO framework of determinants of health (WHO, 2010), social determinants operate through a set of intermediary, more-immediate determinants of health to affect health outcomes. These determinants include psychosocial factors (e.g., coping and social support), behavioural factors (e.g., behavioural skills and physical activity) and biological factors (e.g., strength and genetic factors) (WHO, 2010). In the clinical context, the main role of physiotherapist practice is individual client interaction and support for clients to act and participate in their social context (WCPT, 2015a). The relationship among social and intermediary determinants highlights that physiotherapists equipped with skills to address clients’ psychosocial characteristics and behaviours in their clinical reasoning may also impact health and equity in health in a wider context. However, such skills presuppose knowledge development among physiotherapists towards
core competencies in health- and behavioural-focused assessment and management (Dean, Moffat, et al., 2014).

From a biopsychosocial perspective (Engel, 1977), individuals’ behaviours, health and illness are understood as complex interactions between biomedical (e.g., pathophysiological and physical), psychological (e.g., emotions and cognitions), social (e.g., family and community support), environmental (e.g., workplace), and personal factors (e.g., gender and age) (Gatchel, Peng, Peters, Fuchs, & Turk, 2007). Behavioural medicine, based on a biopsychosocial perspective, is defined as an interdisciplinary field dealing with the integration of psychosocial, behavioural, and biomedical knowledge that is relevant for health promotion, disease prevention, diagnosis, treatment, and rehabilitation (International Society of Behavioural Medicine [ISBM] n.d.). The interaction of biomedical processes and behavioural factors for health and illness is central, implying that individuals’ behaviours could affect their bodily functions, and biological and disease-related processes could affect individuals’ behaviours (Dekker, Stauder, & Penedo, 2017). For instance, insufficient physical activity behaviours could contribute to the development of chronic diseases; additionally, diseases or injuries (e.g., stroke, low back pain and knee injuries) could cause modifications of individuals’ behaviours in daily life activities (e.g., getting dressed, gardening and playing tennis). A behavioural medicine approach in physiotherapy is connected to the behavioural medicine definition provided by the ISBM, thus implying an individually tailored and health-focused practice in which the clients’ life-situation, experiences, behaviours and goals are central. Such an approach is related to but distinct from only assessing and targeting biopsychosocial factors in client management. A behavioural medicine approach in physiotherapy considers the complexity of factors related to human behaviours, includes an analysis of what factors motivate, sustain or hinder behaviours and focuses on interventions that support behavioural change (Äsenlöf et al., 2005). Based on evidence and expert agreement, health-focused practice is a professional priority (Dean, 2009), and physiotherapists must be better equipped with competencies regarding psychosocial aspects and behavioural considerations in client management (Dean, de Andrade, et al., 2014; Driver, Kean, Oprescu, & Lovell, 2017; Foster & Delitto, 2011; Hall et al., 2018; Jensen, 2011). To enable such professional development, these aspects need to be more fully integrated in the entry-level physiotherapy education (Dean, de Andrade, et al., 2014; Driver et al., 2017; Foster & Delitto, 2011; Kigin, Rodgers, & Wolf, 2010; Singla, Jones, Edwards, & Kumar, 2015; Synnott et al., 2015). Physiotherapists focusing on health emphasise the need for capabilities and skills in clinical reasoning to target psychosocial, behavioural, physical, and medical factors in assessment, analysis, goal setting, intervention and evaluation.
Activity-related behaviours and behaviour change

Movement, a central construct in physiotherapy (Cott, Finch, Gasner, & Yoshida, 1995; Wikström-Grotell & Eriksson, 2012; WCPT, 2015a), can be defined as movement behaviour, including physical and physiological aspects, and how and why movements are performed in a specific situation or task (Schmidt, 1999). Movement, conceptualised as behaviour, is influenced by internal and external factors such as cognitions and the social and physical contexts (Sundel & Sundel, 2017), which is a statement that applies to a behavioural medicine approach in physiotherapy. Human behaviours include overt behaviours, e.g., movements and verbal expressions, and covert behaviours, e.g., cognitions and emotions, often intertwined in sets of concurrent behaviours (Baldwin & Baldwin, 2001). An activity-related behaviour can be understood as a comprehensive set of behaviours (e.g., movements, cognitions and emotions) associated with a specific task linked to important activities in the client’s daily life, influenced by physical and social contexts. Activity-related behaviours, key in a behavioural medicine approach in physiotherapy (Cederbom et al., 2014; Sandborgh, Lindberg, Åsenlöf, & Denison, 2010; Thunborg, 2015; Åsenlöf et al., 2005), include behaviours that need to be modified or maintained to increase the client’s participation in important daily life activities and, correspondingly, improve their health and well-being. For example, activity-related target behaviours comprise behaviours that are challenging to perform because of pain, illness or disability such as transfer out of bed or independently get dressed, and life-style related behaviours such as performing regular physical activity by cycling to work. Functional behavioural analysis (FBA) (Haynes & O'Brien, 1990) is a means of identifying and analysing the relationships among factors believed to affect an activity-related target behaviour. The purpose of FBA is to provide information that will guide the physiotherapist and the client in targeting the identified behavioural factors in interventions and selecting the most effective behaviour change strategies according to the client’s needs and possibilities. Thus, functional behavioural analysis identifies facilitators and barriers for effective modification of the activity-related target behaviour and provides a platform for client-centred goal-setting and shared decision-making in the clinical reasoning process, thereby optimising client outcomes.

Theories and models applied in behavioural medicine seek to explain when, how and why behaviours, e.g., activity-related behaviours, do or do not occur, change or maintain (Glanz, Rimer, & Viswanath, 2008b). The theories and models are comprehensive; only the most relevant for the present project are presented. How the body affects activity-related behaviours is explained in theories of movement and motor control (Shumway-Cook & Woollacott, 2011) and theories of pain and exercise physiology (Melzack, 1999; Powers & Howley, 2012). Respondent learning is described as associative learning and concerns behaviours that elicit automatic biological responses. Operant
learning theory describes how antecedents, i.e., internal factors of the individual and external factors, build a platform for behaviours. Reinforcing or punishing factors as a consequence of behaviour leads to either sustaining or extinguishing that behaviour (Sarafino, 2001). According to social cognitive theory (Bandura, 1986, 2004), behaviours exist within a constant, ongoing, dynamic interplay between the individual and the environment, referred to as reciprocal determinism. A change in behaviour is regarded as a consequence of the interaction between these factors (Bandura, 1991). Furthermore, behaviours are determined by individuals’ beliefs, i.e., outcome expectations and self-efficacy (Bandura, 1977), and may be controllable by self-regulation (Bandura, 1991).

The theoretical understanding of behavioural determinants and mechanisms for change provides a helpful basis for designing interventions to change or maintain behaviours (Michie, Johnston, Francis, Hardeman, & Eccles, 2008; Michie, van Stralen, & West, 2011). Additionally, the evidence of the impact of contextual (Carpenter, 2010; Rhodes et al., 2017; van Achterberg et al., 2011), psychological (Linton & Shaw, 2011; Rhodes et al., 2017; van Achterberg et al., 2011; Williams, Eccleston, & Morley, 2012), physical and behavioural factors (Friedrich, Gittler, Arendasy, & Friedrich, 2005; Michie, Abraham, Whittington, McAttee, & Gupta, 2009; Rhodes et al., 2017; Söderlund & Lindberg, 2001a; van Achterberg et al., 2011; Åsenlöf, Denison, & Lindberg, 2009) in behavioural change and health improvement supports the incorporation of these factors into a clinical reasoning process focused on clients’ behaviour change. The literature describes a range of interventions (Rhodes et al., 2017) and behaviour change techniques (Michie et al., 2013) that can be used to address an activity-related target behaviour and support behaviour change. Strategies to support behaviour change refer to actions, which may include behaviour change techniques, that the physiotherapist applies in client management with the purpose of supporting and/or maintaining behaviour change. The inclusion of combinations of strategies is likely to enhance the effectiveness of interventions designed to support behavioural change (Michie et al., 2009; Rhodes et al., 2017; van Achterberg et al., 2011). A behavioural medicine approach in physiotherapy proposes a mix of interventions targeting physical, psychological, social and behavioural factors to support behaviour change. This approach has demonstrated better client outcomes (e.g., physical activity level, disability level, self-efficacy and working ability) compared to physiotherapy without such an approach, in both short-term (Cederbom et al., 2014; Sandbohr et al., 2010; Söderlund & Lindberg, 2001b) and long-term follow ups (Brick, Åsenlöf, & Söderlund, 2016; Friedrich et al., 2005; Hall et al., 2018; Silva Guerrero, Maujean, Campbell, & Sterling, 2018; Söderlund, 2011; Von Korff et al., 2005; Åsenlöf et al., 2009). According to the necessary mix of strategies to support behavioural change, advanced clinical reasoning skills in information interpretation and prioritisation of interventions are essential.
Clinical reasoning

Generally, clinical reasoning refers to the health professionals’ thinking and decision-making process that guides practical actions (Higgs & Jones, 2008). Cognitive activities and intentions to act in a certain way, which are key in clinical reasoning, have been demonstrated to strongly predict the clinical practice of health professionals (Godin, Bélanger-Gravel, Eccles, & Grimshaw, 2008). Contemporary clinical reasoning focuses on the client and his or her problem and situation in relation to the wider healthcare context, whereas interactive reasoning occurs at the micro, macro and meta levels. Important dimensions are knowledge, cognition, reflective inquiry and metacognition (Higgs & Jones, 2008). Thus, clinical reasoning is versatile, complex and multidimensional. Currently, no established definition of the nature, relevant components or boundaries of health professionals’ clinical reasoning exists, neither in the literature (Gruppen, 2017) nor according to scholars in the field (Young, Thomas, et al., 2018). The co-existence of multiple definitions stresses the importance of delineating the conceptualisation of clinical reasoning that is adopted within a research study (Young, Thomas, et al., 2018).

Learning and clinical reasoning

Learning can be considered a process and as an outcome, but it should not be considered separated entities but rather intrinsically linked to each other. Illeris (2007) has described a comprehensive and coherent view of learning including three dimensions, namely, the content dimension, answering the question what, which may be any kind of human capacity, such as knowledge, skills, and understanding; the incentive dimension, answering the question why, which refers to motivation and emotions that drives the learning process; and the interaction dimension, which answers the question how and encompasses the interaction between the learner and the context, initiating and supporting learning. Learning is about not only acquiring knowledge but also about being able to apply it and adjust it to new situations. Thus, understanding, i.e., to gain new insights in relation to something, and the search for meaning are in focus in more-complex forms of learning (Marton & Booth, 2009). Similarly, learning of clinical reasoning relies on the application of knowledge, methods that challenge existing knowledge, encouragement and centrality of context (Eva, 2004; Jessee, 2018). From a comprehensive view of learning, an understanding of students’ clinical reasoning focused on behaviour change must be sought in their learning outcomes and in their process to acquire relevant knowledge, capabilities and skills.

The understanding of clinical reasoning can be based upon theoretical viewpoints encompassing both cognitive processes belonging to the physiotherapist and cognitive and behavioural processes that are shared between the physiotherapist, client and environment.
The cognitive perspective, explained in the dual process theory of cognition and metacognition (Marcum, 2012; Pelaccia, Tardif, Triby, & Charlin, 2011), focuses on the organisation of and accessibility to knowledge and the resulting non-analytical and analytical cognitive processes. The non-analytical process is a rapid and an almost non-conscious process often used by experienced practitioners (Patel, Evans, & Kaufman, 1990). It depends upon the ability to recognise patterns stored in memory (Barrows & Feltovich, 1987) and make associations with similar knowledge networks, referred to as scripts (Charlin, Boshuizen, Custers, & Feltovich, 2007; Schmidt, Norman, & Boshuizen, 1990). Accumulation of experience results in the reorganisation of stored knowledge to benefit future thinking (Charlin et al., 2007). Analytical processes are slower and comprise more-structured cognitive components. In clinical reasoning, the professional interprets information, compares and contrasts various options, and tests hypotheses, which results in specific conclusions and the selection of optimal interventions. During these processes, metacognition operates to monitor the clinical reasoning and serves to reinforce or alter the immediate process and optimise future cognitive behaviours (Marcum, 2012). Analytical reasoning is observed more commonly in novice practitioners but also in experienced practitioners when they deal with complex, ill-defined problems (Patel et al., 1990). How the non-analytical and analytical processes interact and whether they are separated or more of a continuum is not well-understood (Eva, Hatala, Leblanc, & Brooks, 2007).

Situativity theory argues that knowledge, thinking and learning are situated in experience. Experience includes the individual and his or her social and physical environment where thinking and learning occur. Thinking (e.g., reasoning) is nested in the specific situation which shifts the focus from the individual to the social setting within which the cognitive activities occur (Durning & Artino, 2011). From this perspective, non-analytical and analytical clinical reasoning processes entail consideration of the evolving interaction between the client, the physiotherapist and the context. Furthermore, due to this complex interplay, clinical reasoning is likely a non-linear recursive cognitive process (Durning, Artino, Schuwirth, & van der Vleuten, 2013).

Based on these theoretical viewpoints, the cognitive perspective and the interactive and context-dependent perspectives should not be viewed as opposed to each other (Edwards, Jones, Carr, Braunack-Mayer, & Jensen, 2004), rather, their intrinsic relationships should inform clinical reasoning learning and assessment (Durning et al., 2013).

Clinical reasoning in physiotherapy practice
Clinical reasoning is the core of physiotherapists’ clinical practice (Ajjawi & Higgs, 2008; WCPT, 2015a). Early research on clinical reasoning in physiotherapy described a process of testing hypotheses and establishing a diagnosis (Payton, 1985; Rothstein, 1986). Later, this professional-centred approach
evolved to embrace client collaboration (Jensen & Givens, 1999). More recently, clinical reasoning has been portrayed as an interactive process between multiple spaces related to the client, the physiotherapist and the clinical problem, all dependent upon the context (Higgs & Jones, 2008). A biopsychosocial approach (Jones, Jensen, & Edwards, 2008) and the precedence of cognitive-based rational reasoning together with meaning-based reasoning based on the client’s situation and needs are emphasised in the contemporary clinical reasoning of physiotherapists (Edwards, Jones, Carr, et al., 2004).

In physiotherapy practice, clinical reasoning implies a reflexive thinking and decision-making process in which the physiotherapist gathers, synthesises and analyses findings from the assessment to identify the client’s problem, generate hypotheses and consequently select appropriate interventions and evaluate their effectiveness (Edwards, Jones, Carr, et al., 2004; Holdar, Wallin, & Heiwe, 2013; Smith, Higgs, & Ellis, 2008). The reasoning is a collaborative process between the physiotherapist and the client with the process overall being influenced by the context (Edwards, Jones, Higgs, Trede, & Jensen, 2004; Holdar et al., 2013; Masley, Havrilko, Mahnensmith, Aubert, & Jette, 2011; McGlinchey & Davenport, 2014).

Qualitative studies, based on observations and interviews of physiotherapists, have revealed a diverse spectrum of internal and external factors associated with physiotherapists’ clinical reasoning, presented in table 1.

Table 1. Examples of internal and external factors associated with physiotherapists’ clinical reasoning

<table>
<thead>
<tr>
<th>Influencing factors</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge and experience</td>
<td>(Holdar et al., 2013; Langridge, Roberts, &amp; Pope, 2015;</td>
</tr>
<tr>
<td></td>
<td>Masley et al., 2011; McGlinchey &amp; Davenport, 2014;</td>
</tr>
<tr>
<td></td>
<td>Smart &amp; Doody, 2007; Wainwright, Shepard, Harman, &amp;</td>
</tr>
<tr>
<td></td>
<td>Stephens, 2011)</td>
</tr>
<tr>
<td>Analytical and reflective</td>
<td>(Doody &amp; McAtee, 2002; Edwards, Jones, Carr, et al., 2004;</td>
</tr>
<tr>
<td>capabilities</td>
<td>Karvonen, Paatelma, Laitinen-Väännïnen, &amp;</td>
</tr>
<tr>
<td></td>
<td>Pirainen, 2017; Smith et al., 2008; Wainwright et al.,</td>
</tr>
<tr>
<td></td>
<td>2011)</td>
</tr>
<tr>
<td>Biomedical or biopsychosocial perspectives of</td>
<td>(Cruz, Moore, &amp; Cross, 2012a; Daykin &amp; Richardson,</td>
</tr>
<tr>
<td>health and illness</td>
<td>2004; Edwards, Jones, Carr, et al., 2004; Josephson,</td>
</tr>
<tr>
<td></td>
<td>Bülow, &amp; Hedberg, 2011)</td>
</tr>
<tr>
<td>Physiotherapist- or client centred</td>
<td>(Cruz et al., 2012a; Edwards, Jones, Carr, et al., 2004; Holdar et al.,</td>
</tr>
<tr>
<td></td>
<td>2013; McGlinchey &amp; Davenport, 2014; Smith et al., 2008)</td>
</tr>
<tr>
<td>Emotions</td>
<td>(Langridge, Roberts, &amp; Pope, 2016)</td>
</tr>
<tr>
<td>Beliefs and attitudes</td>
<td>(Daykin &amp; Richardson, 2004; Smith, Higgs, &amp; Ellis, 2007)</td>
</tr>
<tr>
<td>Personality</td>
<td>(Holdar et al., 2013)</td>
</tr>
<tr>
<td>Colleagues</td>
<td>(Masley et al., 2011; Wainwright et al., 2011)</td>
</tr>
<tr>
<td>Time</td>
<td>(Langridge et al., 2015; Masley et al., 2011)</td>
</tr>
<tr>
<td>Organisational factors</td>
<td>(Holdar et al., 2013; McGlinchey &amp; Davenport, 2014)</td>
</tr>
<tr>
<td>Complexity of the problem</td>
<td>(Josephson et al., 2011; McGlinchey &amp; Davenport, 2014)</td>
</tr>
</tbody>
</table>

According to a meta-synthesis of the accumulated knowledge about factors influencing the clinical reasoning of physiotherapists, four representative
themes were presented: the physiotherapist, the client, the context and the elements of the reasoning process, with the individual physiotherapist being the most dominating factor (Elvén & Dean, 2017).

Even though biopsychosocial and collaborative approaches in clinical reasoning are advocated according to theory (Edwards, Jones, Carr, et al., 2004; Jones et al., 2008) and evidence (Foster & Delitto, 2011; Gatchel et al., 2007; Laisne, Lecomte, & Corbiere, 2012), these approaches are not fully incorporated into the contemporary clinical reasoning practice (Alexanders, Anderson, & Henderson, 2015; Cruz et al., 2012a; Daykin & Richardson, 2004; Synnott et al., 2015). The weighting of biomedical and psychosocial elements varies, and goal-setting and factors promoting health-related behaviour change seldom influence the clinical reasoning process (Elvén & Dean, 2017). Thus, further knowledge and support are needed to advance the clinical reasoning of physiotherapists.

Clinical reasoning in physiotherapy education

Clinical reasoning is a cornerstone in entry-level physiotherapy education (Ajjawi & Smith, 2010; WCPT, 2011). However, there is a lack of consensus among physiotherapy educators on what constitutes clinical reasoning (Christensen et al., 2017). The World Confederation of Physical Therapy offers guidance about clinical reasoning content in entry-level education and requests educators to provide students with capabilities to integrate biopsychosocial and behavioural factors in the clinical reasoning process (WCPT, 2011). Universities have the autonomy to shape their own approach to achieving national and international education goals (European Association for Quality Assurance in Higher Education, 2015; Swedish Higher Education Authority, 2017b), which leads to various curricula among universities.

Physiotherapy students’ conceptualisation of clinical reasoning has been demonstrated to range from basic in form to more complex (Hendrick, Bond, Duncan, & Hale, 2009). At the end of the education, students’ clinical reasoning patterns display consistencies and variations (Gilliland & Wainwright, 2017). Studies have shown that students mostly focus on a biomedical analysis of factors contributing to the clients’ problem and less explicitly focus on the impact of psychosocial and behavioural components (Cruz, Moore, & Cross, 2012b; Doody & McAteer, 2002; Gilliland & Wainwright, 2017). Furthermore, students have limited ability to incorporate clients’ needs and experiences in the clinical reasoning process (Cruz et al., 2012b; Gilliland & Wainwright, 2017) and use reflection in-action in their clinical reasoning (Wainwright, Shepard, Harman, & Stephens, 2010). Of note is that variability exists on an individual level (Gilliland & Wainwright, 2017). Given this picture, extensive research has emphasised the need for improved education and training to help students and physiotherapists to incorporate psychosocial and behavioural considerations in client management (Alexanders et al., 2015;
Dean, de Andrade, et al., 2014; Foster & Delitto, 2011; Singla et al., 2015). Prior studies in the educational context have provided knowledge of students’ contemporary clinical reasoning; however, there is limited research specifically addressing what factors contribute to their clinical reasoning characteristics.

Assessment of clinical reasoning
Assessments of clinical reasoning are common in physiotherapy education and consist of evaluations of students’ clinical competencies (in which clinical reasoning is included) in the clinical setting, practical or written examinations and are often based on instruments designed by the educators themselves (Christensen et al., 2017). However, present methods have shortcomings in standardisation (Dalton, Davidson, & Keating, 2012; Lewis, Stiller, & Hardy, 2008; Meldrum et al., 2008; Wessel, Williams, Finch, & Gemus, 2003; Wu, Enskar, Lee, & Wang, 2015; Yeates, O’Neill, Mann, & K, 2013), are time consuming and imply a heavy workload on assessors (Ladyshewsky, Baker, Jones, & Nelson, 2000; Yeung, Woods, Dubrowski, Hodges, & Carnahan, 2015), are only applicable in a specific field of physiotherapy (Yeung et al., 2016) and lack elements proposed as essential in the design of clinical reasoning measures (Kreiter & Bergus, 2009). No clinical reasoning instrument that integrates behavioural considerations has been identified in the literature.

No golden standard instrument for health professionals’ clinical reasoning exists (Christensen et al., 2017; Kreiter & Bergus, 2009; van der Vleuten, Norman, & Schuwirth, 2008). Two reliable and valid clinical reasoning measures that are frequently used for medical students and to a limited extent by other health professionals (Dory, Gagnon, Vanpee, & Charlin, 2012; Farmer & Page, 2005) are the key feature approach (Bordage & Page, 2018; Page, Bordage, & Allen, 1995) and the script concordance test (Charlin, Leduc, Blouin, & Brailovsky, 1998). Studies have provided evidence for predictive associations between key feature-based and script concordance-based test scores and future practice performance (Brailovsky, Charlin, Beausoleil, Cote, & Van der Vleuten, 2001; Tamblyn et al., 2002; Wenghofer et al., 2009)

The key feature approach focuses on identification and interpretation of problem-solving stimuli (key features) in the management of a case, assessed by case scenarios representing the stimuli format, followed by items, linked to the key features, with a variety of response formats (Farmer & Page, 2005; Fischer, Kopp, Holzer, Ruderich, & Junger, 2005).

The script concordance test stems from script theory (Charlin et al., 2007) and focuses on the uncertainty that exists in clinical cases, the multiple judgements, based on data interpretation, that are made in the clinical reasoning process, and concordance with judgements of a panel of reference experts (Charlin et al., 1998). The test approach consists of presenting respondents with case scenarios and requesting the respondents to make decisions when
additional information is provided in the case (Charlin, Roy, Brailovsky, Goulet, & van der Vleuten, 2000; Fournier, Demeester, & Charlin, 2008). To capture a comprehensive appraisal of the characteristics of clinical reasoning, the use of complementary tests has been advocated (Amini et al., 2011; Groves, Dick, McColl, & Bilszta, 2013). Thus, a new standardised and effective instrument to assess clinical reasoning in the physiotherapy context is needed.

Instrument development to assess clinical reasoning

Effective measurement plays an essential role in scientific research to increase the accuracy of obtained information and the precision of decision-making. If meaningful interpretations are to be made from studies using measurement instruments, it is required that the instruments are rigorous measures of the variable they intend to quantify (Streiner & Norman, 2008).

The view of clinical reasoning as a cognitive process occurring in interaction with the context makes it latent in nature (Durning et al., 2013). As latent constructs cannot be observed and assessed directly (DeVellis, 2012), clinical reasoning should be measured indirectly through its indicators. Three core design elements have been proposed to capture measurable indicators of the cognitive activities included in clinical reasoning, namely, identification and collection of important information, assessment and decision of client management, and development of new knowledge organisation as revealed by how efficiently new client information is integrated within existing knowledge structures (Kreiter & Bergus, 2009). In addition to the cognitive processes, clinical reasoning encompasses behaviours exhibited and measured in terms of the professional’s decisions (Durning et al., 2013). The evidence of case specificity, also named context specificity (Dory et al., 2012; Gagnon, Charlin, Lambert, Carrière, & Van der Vleuten, 2009) (that an individual’s ability to successfully solve one case is not related to success on other cases) (Elstein, Shulman, & Sprafka, 1978), and the incorporation of multiple acceptable reasoning paths (Durning et al., 2013) have also been emphasised as important attributes of valid clinical reasoning instruments.

For an instrument measuring a latent constructs to have relevance, the instrument needs to be well-grounded in substantial theories (Netemeyer, Bearden, & Sharma, 2003), and the construct to be measured requires a clear definition (DeVellis, 2012). Based on the core of theories, Jaccard and Jacoby (2010) defined a theory as “a set of statements about the relationship(s) between two or more concepts or constructs” (p. 28). This definition, together with the description of models as being informed by several theories and empirical findings (Earp & Ennett, 1991), served as the basis for this project. The construct in focus in the present project, ‘physiotherapists’ clinical reasoning focused on clients’ activity-related behaviour and behaviour change’, has not been theoretically explained previously. When no theory is available, new
conceptual formulations prior to their operationalisation are necessary (DeVellis, 2012). Thus, a new conceptual model based on theories and empirical findings is needed to serve as a foundation for a new, valid clinical reasoning instrument.

Development of new instruments includes methods for developing and evaluating the new instrument, carefully performed in a stepwise process (DeVellis, 2012). Validity and reliability are important psychometric properties to target during the instrument development process (DeVellis, 2012; Streiner & Norman, 2008). Experts and the instrument target group are key in the process (DeVellis, 2012; Netemeyer et al., 2003), and the incorporation of a mix of quantitative and qualitative methods is recommended (Cook & Beckman, 2006; Luyt, 2012; Mastaglia, Toye, & Kirstjanson, 2003).
Rationale

Effectiveness in healthcare is determined, in part, by the competence of its practitioners. Thus, the education of health professionals plays an important role in preparing students for current and future client and healthcare needs. Clinical reasoning refers to the thinking and decision-making process that guides practical actions and is a core competence of physiotherapists and a cornerstone in entry-level education. Based on evidence and worldwide agreement among scholars, educators and practitioners, the physiotherapy profession has been called upon to embrace a biopsychosocial perspective and systematically apply methods that support clients’ behaviour change to improve client outcomes. However, the uptake of this evidence by physiotherapists and students has not been commensurate with the knowledge base, and the education is requested to better equip students with efficient clinical reasoning skills. A model or framework describing the integration of clinical reasoning and strategies to support behavioural change in clients may facilitate students’ learning and serve as a basis for research aimed at improving clinical reasoning in the profession. Currently, no such conceptual model exists.

Enabling clinical reasoning advancements requires investigations and evaluations in practice and education, which in turn require robust assessments, which has been challenging. Today, there is a lack of a valid and reliable instrument based on sound theory and evidence to assess physiotherapists’ and students’ clinical reasoning from a biopsychosocial perspective and to focus on clients’ behaviour change. Multiple internal and external factors have been identified to possibly influence the clinical reasoning of physiotherapists and students. However, these associations are based on qualitative studies, and no statistical correlations among key variables have been reported.

Consequently, there is a need to develop a theory- and evidence-informed, psychometrically sound instrument to assess clinical reasoning focused on clients’ behaviour change. Furthermore, identification of predictors of physiotherapy students’ clinical reasoning is needed to improve our understanding about primary factors to be targeted in future interventions. In turn, such interventions may improve students’ and physiotherapists’ clinical reasoning proficiency for the benefit of clients’ health and well-being.
Aim

The overall aim of this thesis was to develop and evaluate an instrument to study physiotherapy students’ clinical reasoning focused on clients’ activity-related behaviour and behaviour change.

The specific aims of the studies were:

I To develop and validate a conceptual model to guide clinical reasoning focused on clients’ behaviour change specifically related to the physiotherapy context.

II To develop an instrument, based on the conceptual model [the clinical reasoning model focused on clients’ behaviour change with specific reference to physiotherapists], to assess physiotherapy students’ and physiotherapists’ clinical reasoning focused on clients’ activity-related behaviour and behaviour change, and initiate its evaluation, including feasibility and content validity.

III To generate criterion scores and evaluate the reliability and construct validity of a web-based version of the Reasoning 4 Change instrument.

IV To explore the associations among the independent variables: knowledge, cognition, metacognition, psychological factors, contextual factors, and curriculum orientation vis-à-vis behavioural medicine competencies; and the dependent variables: outcomes of input from client, functional behavioural analysis, and strategies for behaviour change as levels in physiotherapy students’ clinical reasoning processes.
Methods

To accomplish the overall aim of the thesis, qualitative, quantitative and mixed methods were used. An overview of the focus, design, sample, data collection and data analysis of the four studies is presented in table 2.

Table 2. Overview of the different focus, design, sample, data collection and analysis methods of the studies

<table>
<thead>
<tr>
<th>Focus of studies</th>
<th>Design</th>
<th>Sample</th>
<th>Data collection</th>
<th>Data analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model development Study I</td>
<td>Exploratory</td>
<td>10 PT students</td>
<td>Phase 1: Literature review, experience and knowledge of the research team</td>
<td>Synthesis of data, deductive qualitative content analysis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9 PTs</td>
<td>Phase 2a: Two focus groups (PT students)</td>
<td></td>
</tr>
<tr>
<td>Instrument development and evaluation Study II</td>
<td>Exploratory and mixed methods</td>
<td>5 PT students</td>
<td>Phase 2b: One group discussion (PTs)</td>
<td>Synthesis of data, descriptive qualitative analysis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18 PTs</td>
<td>Phase 3: Cognitive interviews (PT students), Modified Delphi technique (PTs)</td>
<td>descriptive statistics</td>
</tr>
<tr>
<td>Study III</td>
<td>Cross-sectional</td>
<td>39 PT students</td>
<td>Phase 4: Web-based instrument, questionnaire</td>
<td>Descriptive statistics, psychometric analyses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14 PTs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PT students’ clinical reasoning Study IV</td>
<td>Cross-sectional</td>
<td>151 PT students</td>
<td>Web-based instrument</td>
<td>Descriptive statistics, multiple regression analysis</td>
</tr>
</tbody>
</table>

PT = Physiotherapist or Physiotherapy

Context

In Sweden, eight universities offer an educational programme in physiotherapy at the undergraduate level. Approximately 540 students graduate each year (Swedish Higher Education Authority [Universitetskanslerämbetet], 2017a). The duration of the education is three years, equals 180 ECTS and
leads to a Degree of Bachelor Science in Physiotherapy. After graduation, the students can apply for a license to operate as an independent practitioner (Häger-Ross & Sundelin, 2007). Clinical reasoning competencies are incorporated in the learning outcomes of entry-level education, as stated in the national degree requirements for physiotherapists (SFS 1993:100).

Participants and settings
Altogether, 166 physiotherapy students and 23 physiotherapists participated in the project. Thirty-nine of the students participated in both study III and study IV. Five of the nine physiotherapists in study I also participated in studies II and III. The same sample of physiotherapists was included in studies II ($n=18$) and III ($n=14$), except two physiotherapists who were newly recruited for study III.

The physiotherapy students studied at physiotherapy educations in Sweden and attended the last semester at the time of data collection. The physiotherapists were employed or affiliated with universities in Sweden and had knowledge and experience in physiotherapy with a behavioural medicine approach.

Demographic characteristics of participating physiotherapy students and physiotherapists are presented in tables 3 and 4.

Model development (Study I)
To refine and validate the first version of the conceptual model, physiotherapy students’ and physiotherapists’ views about the model were investigated. Students ($n=10$) were recruited from a physiotherapy programme with behavioural medicine competencies included in the curriculum based on a purposive sampling strategy. Physiotherapists ($n=9$) were recruited based on a convenience sampling strategy and constituted a pre-existing working group (Kitzinger, 1995) at the participating university.

Instrument development and evaluation (Studies II and III)
In study II, cognitive interviews with five physiotherapy students from three universities were conducted to evaluate the feasibility of the first version of the instrument. Purposive sampling was used to ensure variability in the participants’ knowledge and experience of a behavioural medicine approach in physiotherapy (Buers et al., 2014; Spark & Willis, 2014).

In addition, in study II, a Delphi study with 18 experts (Baker, Lovell, & Harris, 2006; Skulmoski, Hartman, & Krahn, 2007) in a behavioural medicine approach in physiotherapy was conducted to evaluate agreement on item relevance of the second version of the instrument. The inclusion criteria were
registered Physiotherapist in Sweden, holding a PhD or PhD student, conducts research in physiotherapy with a behavioural medicine approach, has academic qualifications of at least five weeks of full-time studies in behavioural medicine at the postgraduate level or corresponding teaching experience, and at least two years of experience in teaching clinical reasoning. The included experts were employed at six universities in Sweden.

In study III, experts in a behavioural medicine approach in physiotherapy and students responded to the items of the instrument to generate criterion scores and evaluate the psychometric properties of the instrument. In total, 14 experts participated on the first test occasion, and twelve participated in the test-retest reliability of the instrument. Convenience sampling was used for the students. Seventy-two students from two entry-level physiotherapy programmes in Sweden were invited to participate in the study. In total, 39 students (54%), 18 from university A and 21 from university B, participated in the study. Seventeen students from university A participated in the test-retest reliability of the instrument. There were no significant differences between the two student groups regarding demographic variables. Consequently, the 39 students were treated as one sample.

Physiotherapy students’ clinical reasoning (Study IV)
Predictors of physiotherapy students’ clinical reasoning were investigated. This population-based study invited final-semester students (N=369) from the eight entry-level physiotherapy programmes in Sweden to participate. In total, 151 students (41%) from all eight programmes participated in the study. Response rate of each university is presented in paper IV (Figure 1).
Table 3. Demographic characteristics of participating physiotherapy students

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Study I (n=10)</th>
<th>Study II (n=5)</th>
<th>Study III (n=39)</th>
<th>Study IV (n=151)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (female)</td>
<td>6 (60%)</td>
<td>4 (80%)</td>
<td>30 (77%)</td>
<td>98 (65%)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>26 (3.2)</td>
<td>25 (2.8)</td>
<td>24 (3.4)</td>
<td>25 (3.6)</td>
</tr>
<tr>
<td>Curriculum orientation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With behavioural medicine competencies</td>
<td>10 (100%)</td>
<td>3 (60%)</td>
<td>18 (46%)</td>
<td>61 (40%)</td>
</tr>
<tr>
<td>Without behavioural medicine competencies</td>
<td>0</td>
<td>2 (40%)</td>
<td>21 (54%)</td>
<td>90 (60%)</td>
</tr>
<tr>
<td>Work experience in the area of health and welfare</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work experience in other areas</td>
<td>9 (90%)</td>
<td>-</td>
<td>28 (72%)</td>
<td>107 (71%)</td>
</tr>
<tr>
<td>Studies other than physiotherapy (credits*)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>3 (30%)</td>
<td>-</td>
<td>20 (51%)</td>
<td>82 (54%)</td>
</tr>
<tr>
<td>&gt;0-30</td>
<td>5 (50%)</td>
<td>-</td>
<td>14 (36%)</td>
<td>43 (28%)</td>
</tr>
<tr>
<td>&gt;30-120</td>
<td>2 (20%)</td>
<td>-</td>
<td>4 (10%)</td>
<td>19 (13%)</td>
</tr>
<tr>
<td>&gt;120</td>
<td>0</td>
<td>-</td>
<td>1 (3%)</td>
<td>7 (5%)</td>
</tr>
</tbody>
</table>

*1.5 credits correspond to one week of full-time studies

Table 4. Demographic characteristics of participating physiotherapists

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Study I (n=9)</th>
<th>Study II (n=18)</th>
<th>Study III (n=14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (female)</td>
<td>8 (89%)</td>
<td>16 (89%)</td>
<td>12 (86%)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>46 (11.1)</td>
<td>51 (8.7)</td>
<td>50 (9.6)</td>
</tr>
<tr>
<td>Time from graduation in physiotherapy (years)</td>
<td>23 (13.5)</td>
<td>25 (10.3)</td>
<td>25 (11.9)</td>
</tr>
<tr>
<td>Academic qualification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PhD student</td>
<td>2 (22%)</td>
<td>6 (33%)</td>
<td>5 (36%)</td>
</tr>
<tr>
<td>PhD</td>
<td>5 (56%)</td>
<td>8 (44%)</td>
<td>7 (50%)</td>
</tr>
<tr>
<td>Associate professor</td>
<td>0</td>
<td>1 (6%)</td>
<td>1 (7%)</td>
</tr>
<tr>
<td>Professor</td>
<td>2 (22%)</td>
<td>3 (17%)</td>
<td>1 (7%)</td>
</tr>
<tr>
<td>Current clinical practice</td>
<td>2 (22%)</td>
<td>7 (39%)</td>
<td>4 (29%)</td>
</tr>
<tr>
<td>Current teaching practice</td>
<td>9 (100%)</td>
<td>15 (83%)</td>
<td>13 (93%)</td>
</tr>
<tr>
<td>Experience in teaching clinical reasoning (years)</td>
<td></td>
<td>9(6.6)</td>
<td>11 (9.5)</td>
</tr>
<tr>
<td>Experience in research in physiotherapy with a</td>
<td>-</td>
<td>8 (4.4)</td>
<td>8 (4.2)</td>
</tr>
<tr>
<td>behavioural medicine approach (years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Studies in behavioural medicine at post-graduate level</td>
<td></td>
<td>15 (12.7)</td>
<td>16 (13.3)</td>
</tr>
</tbody>
</table>

*1.5 credits correspond to one week of full-time studies
Data collection

Model development (Study I)

The methods for developing the model were based on the model-building procedure presented by Jaccard and Jacoby (2010). In this thesis, the model-building process was conducted in two main phases: phase 1 and phase 2a and 2b, addressing steps 1–3 according to Jaccard and Jacoby (2010).

Phase 1

The aim of this phase was to identify the specific theories, models and concepts that underpin clinical reasoning and strategies needed by physiotherapists to support clients’ behaviour change. Exploration of existing research was conducted by identifying prominent scientific studies and theoretical works related to the topic (Cooper & Hedges, 2009). The selection of the included behavioural learning theories and health psychology theories was informed by studies describing frequently used and evidence-based theories and models (Glanz, Rimer, & Viswanath, 2008a; Painter, Borba, Hynes, Mays, & Glanz, 2008) and their value in physiotherapy (Dean, 2009). Based on combinations of search terms relevant to the topic areas and the identified theories and models, literature searches in several databases were conducted. Further details are provided in paper I.

Phases 2a and 2b

To refine and validate the first version of the conceptual model, developed in phase 1, the aims of phases 2a and 2b (conducted in parallel) were to investigate the views of physiotherapy students and physiotherapists about the model. The model, a brief definition of the concept of clinical reasoning, information about the aim and procedure of the data collection were provided to the participants one week before the groups convened. The participants were prompted to review the model beforehand.

Data from the students were derived from two semi-structured focus groups, moderated by the first author of the studies in this thesis (ME). The interview guide is presented in paper I (Table 1). Informed consent was obtained prior to the focus groups. The focus groups began with the moderator giving a brief introduction of the study and guidelines for discussion. The participants were informed that their thoughts about the model were important and valuable and that there were no right or wrong answers. The interview method allowed the participants to interact, comment on each other’s answers and ask clarifying questions. The focus group sessions were audio recorded, conducted at the university and lasted two hours each.

Data from the physiotherapists were derived from a group discussion, moderated by ME. It was an open discussion that revolved around one question:
‘Based on the aim of the first version of the conceptual model, what are your views regarding the content and concepts of the model in relation to clinical reasoning in physiotherapy with a focus on clients’ activity-related behaviour and behaviour change?’ The moderator encouraged the discussion, ensured the discussion remained focused on its aim and recorded field notes to capture data for analysis (Krueger & Casey, 2000). The discussion was convened at the university and lasted one hour and 45 minutes.

Instrument development and evaluation (Studies II and III)
The instrument development, evaluation of feasibility, validity, reliability and generation of criterion scores were conducted in four phases and were informed by the guidelines outlined by DeVellis (2012).

Phase 1 (Study II)
The aim of the first phase was to determine the structure of the instrument and to generate items that captured the dimensions of the construct along with current recommendations for assessing clinical reasoning. ME, in collaboration with the research team, constructed the instrument structure and items (including cases and response scales) for the first draft of the instrument. All revisions in the instrument were informed by discussion and consensus of the research team. A description of the methods, sources and references informing the instrument construction and item generation is presented in table 5.

Table 5. Methods, sources and references informing the instrument development in phase 1

<table>
<thead>
<tr>
<th>Methods and sources</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instrument structure</strong></td>
<td>Study 1</td>
</tr>
<tr>
<td>The conceptual model including the dimensions of 1) Physiotherapist, 2) Input from client, 3) Functional behavioural analysis, and 4) Strategies for behaviour change</td>
<td></td>
</tr>
<tr>
<td>Guidelines in construction of clinical reasoning instruments: Focus on the clinical reasoning process rather than its endpoint of problem solving and diagnosis; include collection of important information from the client; include problem identification and decisions about interventions; continuously add new information about the client; accept a range of eligible decisions; and include several cases with several items per case</td>
<td></td>
</tr>
<tr>
<td><strong>Item generation overall</strong></td>
<td>Study 1</td>
</tr>
<tr>
<td>The conceptual model and conceptual descriptions; instruments assessing clinical reasoning; self-assessment scales measuring perceptions of factors affecting behaviours and health; clinical measures; the research team; and physiotherapists with knowledge and experience in in a behavioural medicine approach in physiotherapy (Study II, phase 3)</td>
<td></td>
</tr>
<tr>
<td>See references in the descriptions of domain items below</td>
<td></td>
</tr>
</tbody>
</table>
Items of Physiotherapist domain
Conceptual descriptions in the conceptual model; adaptation of existing self-assessment scales of knowledge, cognition, metacognition and contextual factors; guidelines for measuring self-efficacy and attitudes

Items of Input from client domain
Conceptual descriptions of the theory and evidence-based elements in input from client (assessment); the key feature approach; and influences from clinical measures

Items of Functional behavioural analysis domain
Conceptual description in the conceptual model; the script concordance test; and influences from clinical measures

Items of Strategies for behaviour change domain
Conceptual descriptions of the theory and evidence-based strategies for behaviour change (intervention); the key feature approach; the script concordance test; and the International Classification of Functioning, Disability and Health

Response scales
Recommendations in scale construction, e.g., Likert scales of six steps produce sufficient variability and acceptable reliability and forces the respondent to take a stand; 0–10 scales are recommended for self-efficacy scales; and five response options, numbered from -2 to +2, are recommended for script concordance tests

Cases
Authentic clients; inclusion of biological, psychological and social attributes; selection based on the most prevalent diseases, ill-health conditions, non-communicable diseases and associated life-style risk behaviours and common areas of physiotherapy practice; and validation of cases by four experienced physiotherapists

Scoring key
Several response options should generate scores based on the aggregate scoring method

Study I
(Amemori, Murtomaa, Michie, Korhonen, & Kinnunen, 2011; Bandura, 2006; Huig et al., 2014; Montano & Kasprzyk, 2008; Schraw & Dennison, 1994)

Study I
(Bergström et al., 1998; Bordage & Page, 2018; Jensen & Linton, 1993; Lundberg, Styf, & Carlsson, 2004; Marcus, Selby, Niaura, & Rossi, 1992; Page et al., 1995; Sechrist, Walker, & Pender, 1987; Wójcicki, White, & McAuley, 2009)

Study I and references included in 'Items of Input from client domain’ above.
(Charlin et al., 1998; Dory et al., 2012)

Study I
(Bordage & Page, 2018; Charlin et al., 1998; Dory et al., 2012; WHO, 2001)

(Bandura, 2006; Farmer & Page, 2005; Lubarsky, Dory, Duggan, Gagnon, & Charlin, 2013; Montano & Kasprzyk, 2008; Streiner & Norman, 2008)

(American Physical Therapy Association, 2014; Broberg & Tyni-Lenné, 2009; Gatchel et al., 2007; Statistic Sweden, 2015; WHO, 2013)

(Charlin, Desaulniers, Gagnon, Blouin, & van der Vleuten, 2002; Durning et al., 2013)

Phase 2 (Study II)
The aim of the second phase was to evaluate how physiotherapy students comprehended the items and response scales and perceived the feasibility of the instrument to identify the main problems in the instrument. Data were collected with individual cognitive interviews (Willis, 2005). The interviews were conducted by letting the participant respond to the items in the instrument, one domain at a time, followed by the interview questions. The interview included probing questions based on the cognitive process that occurs when respondents answer survey questions (Tourangeau, Rips, & Rasinski, 2000) and questions regarding the feasibility of the instrument (Bowen et al.,
2009; Yeung et al., 2015). The interview guide is presented in paper II (Table 1). Four of the interviews were conducted at the student’s university, and one was conducted via a video call on the web. The interviews were audio-recorded and conducted by ME. Each interview lasted between two and two and one-half hours.

**Phase 3 (Study II)**

The aim of the third phase was to evaluate the instrument’s content validity and agreement on the items in the instrument. Data were collected with a modified Delphi technique with a group of experts (Keeney, Hasson, & McKenna, 2006, 2011), i.e., physiotherapists with expertise in a behavioural medicine approach in physiotherapy. The number of rounds was determined based on a predefined consensus level (Polit & Beck, 2006). The instrument was accompanied by instructions and a definition of the construct to be measured with the instrument (Grant & Davis, 1997). The experts were asked to judge the relevance of the items as a set for each subscale in domain one and for domains two, three and four. They were also asked to judge the relevance of the entire instrument and provide qualitative comments about the items. A four-point ordinal scale was used for the relevance ratings: 1=highly relevant, 2=quite relevant, 3=somewhat relevant, and 4=not relevant. A data analysis based on the first round showed that consensus was achieved. The experts were informed about the results, the accomplished revisions of the instrument and that the Delphi process was completed.

**Phase 4 (Study III)**

The aim of the fourth phase was to generate criterion scores and evaluate the reliability and construct validity of the instrument developed in phase 3, called the Reasoning 4 Change (R4C) instrument. A web-based application and a scoring key were developed to facilitate use of the R4C instrument. The web-based R4C instrument and a questionnaire were used for data collection.

**Measures**

Initially, the R4C instrument was developed from a paper-based version to a web-based application through collaboration among the research team, a software developer, and a senior researcher with expertise in computer science and specialisation in interactive design. The design and system requirements of the application are presented in paper III (Supplement B). The scoring key of the R4C instrument was constructed and built into the web application. The item scores in the first domain corresponded to the respondent’s chosen response option on the Likert scales. The scoring key for domains two, three and four was based on the response distribution provided by the experts (Charlin et al., 2002). The aggregate scoring method was used, which implies that the response options of each item were assigned a credit corresponding to the proportion of experts who selected that option. In other
words, all responses of the expert group were considered and weighted to determine the scores of each response option on the items (Fournier et al., 2008). Write-in answers were initially categorised based on a qualitative analysis, independently conducted by ME and one of the researchers in the research team. The generation of scores was based on the frequencies of the experts’ responses within the categories and the aggregate scoring method. When responses should be assigned in percentages in the R4C instrument, the scores were derived from the experts’ means and standard deviations. Item scores were totalled for each subscale in the first domain and for the second, third and fourth domains separately.

The Pain Attitudes and Beliefs Scale for Physiotherapists (PABS-PT) is a self-report questionnaire assessing the biomedical and biopsychosocial orientation of physiotherapists with regard to low back pain management (Houben et al., 2005; Ostelo, Stomp-van den Berg, Vlaeyen, Wolters, & de Vet, 2003). PABS-PT was used to evaluate convergent validity, or similarity of constructs (Streiner & Norman, 2008). As no instrument exists measuring clinical reasoning focused on behaviour change, PABS-PT was found appropriate, as it measures similar aspects included in a clinical reasoning process incorporating a biopsychosocial perspective and behavioural considerations. The Swedish 19-item questionnaire was used in this study (Overmeer, Boersma, Main, & Linton, 2009). The PABS-PT has demonstrated satisfactory construct validity, test-retest reliability, responsiveness (Mutsaers, Peters, Pool-Goudzwaard, Koes, & Verhagen, 2012) and internal consistency (Eland, Kvale, Ostelo, & Strand, 2017; Houben et al., 2005; Mutsaers et al., 2012; Ostelo et al., 2003) in various contexts.

Procedure
A web link to the R4C instrument and the PABS-PT questionnaire along with a letter explaining the aim and the procedure of the study, individual login details, a demographic questionnaire and a consent form were sent to the participating experts. The participants were asked to complete the R4C instrument twice, two weeks apart. Up to three reminders were sent to non-responding participants.

The physiotherapy students’ participation in the study was approved by the study directors of the participating physiotherapy programmes. Verbal and written information about the aim and procedure of the study, a consent form, the PABS-PT questionnaire, a demographic questionnaire and individual login details were provided to the participating students. The data collection took place in a computer room at the participants’ university with ME present. The session lasted for two hours. Three weeks after the first test, the students from university A completed the R4C instrument a second time. Due to unforeseen schedule changes, 12 of the 17 participants could not participate at the predetermined second time for data collection; instead, they completed the R4C instrument on private computers.

38
Physiotherapy students’ clinical reasoning (Study IV)

Data were collected with the web-based R4C instrument. The independent variables were assessed with the subscales of the first domain (D) of the instrument (the Physiotherapist domain) as follows: D1.1 Knowledge, D1.2 Cognition, D1.3 Metacognition, D1.4 Psychological factors (self-efficacy and attitudes), and D1.5 Contextual factors. In addition, the independent variable curriculum orientation was a dichotomous variable consisting of programmes with content related to behavioural medicine competencies throughout the curriculum or programmes without such content. In this project, a curriculum with behavioural medicine competencies was defined as one in which a behavioural medicine approach was emphasised in the purpose of the programme, and behavioural medicine and associated competencies were identified as discrete core content. Additionally, movement and function should be conceptualised as behaviours, and the interaction between individuals’ daily behaviours and biopsychosocial factors should be emphasised. A curriculum without behavioural medicine competencies was defined as such based on the absence of the aforementioned features, and movement and function were described from a biopsychosocial perspective, but not conceptualised as behaviours. Two programmes were identified as having curricula with behavioural medicine competencies.

The dependent variables were assessed with the second, third and fourth domains of the R4C instrument as follows: D2 Input from client (IC), D3 Functional behavioural analysis (FBA), and D4 Strategies for behaviour change (SBC).

The physiotherapy programme directors gave their written informed consent for the study, and a plan for the data collection was made in collaborations between each programme director and ME. The physiotherapy students were provided with information about the aim and procedure of the study and an invitation to participate. Data were collected in a computer room at the students’ universities with ME present. Individual login details, a consent form and a demographic questionnaire were provided to the participants. The students were asked to respond as honestly as possible and reminded their answers were confidential, with only ME having access to them.
Data analysis

Model development (Study I)

Phase 1
The results of the identified studies in the literature search were continuously discussed and evaluated within the research team to identify the theories and concepts underpinning clinical reasoning and strategies needed to support clients’ behaviour change.

Phases 2a and 2b
In phase 2a, the transcribed focus group discussions were analysed with deductive content analysis (Elo & Kyngäs, 2008). A categorisation scheme with two predefined categories relevant for the study aim was developed, namely, agreement with the content and concepts of the model and disagreement, content or concepts that should be changed or added. If necessary, other categories could be added during the analysis. The excerpts were read several times to obtain a sense of the whole, whereupon meaning units (Graneheim & Lundman, 2004) were identified by ME and a senior researcher independently. Agreement of meaning units was achieved in consensus. Subsequently, the meaning units were condensed and coded. The codes were compared according to similarities and differences, sorted into the predefined categories and divided into subcategories. Both ME and the senior researcher were involved in the later stages of the analysis.

Data collected in phase 2b were initially analysed in a discussion between ME and a senior researcher who also attended the group discussion. The aim was to increase the possibility of capturing key reflections for the analysis. Based on this discussion and the field notes, a written summary of the group discussion was produced. Together, ME and the senior researcher examined statements in the summary according to frequency, specificity and extensive-ness (Krueger & Casey, 2000). The analysis resulted in the most prominent views of the participants presented in condensed descriptions.

Instrument development and evaluation (Studies II and III)

Phase 1 (Study II)
Departing from the sources identified as key for the instrument development, discussions in the research team led to the identification of instrument structure and item generation. The discussions were recurrently conducted to enable an iterative process whereby tentative decisions were allowed to be questioned based on new data and insights, and new directions in the instrument
development process could be conducted. All decisions about the final instrument structure and content were made by the research team in consensus.

**Phase 2 (Study II)**
The cognitive interviews were transcribed verbatim and analysed based on a coding system for classifying questionnaire problems (Willis & Lesser, 1999). The results were compiled across interviews and categorised in an analysis spreadsheet including items and codes. Finally, the similarity, severity and prevalence of the identified problems were discussed in the research team, which resulted in the condensed main problems and revisions of the instrument.

**Phase 3 (Study II)**
A content validity index (CVI) (Polit & Beck, 2006) was calculated for each domain (D-CVI) and for the instrument as a whole. The D-CVI was calculated based on the number of experts who rated a domain 1 or a 2 (i.e., agreed to the relevance of the domain items) on the four-point relevance scale, divided by the total number of experts. The level of consensus was defined *a priori* as D-CVI ≥0.78 and S-CVI/Ave ≥0.90 (Polit & Beck, 2006). Qualitative comments provided by the experts regarding item relevance and suggestions for improvements and refinements were qualitatively and quantitatively analysed. Comments were considered if at least 25% of the participants shared a similar opinion. Additionally, comments were considered if they were well motivated and concerned previously faced challenges in the instrument development process. Discussions and consensus by the research team informed decisions about item revisions, leading to the final version of the instrument.

**Phase 4 (Study III)**
Demographic data were analysed with descriptive statistics. Pearson’s chi-square test and Fisher’s exact test were used for categorical variables, and the independent t-test was used for continuous variables, to determine differences in demographic variables between the students from university A and B. Distributional properties in the forms of means, standard deviations, medians, quartiles and ranges were calculated for the R4C instrument and the PABSP. Z-scores of skewness and kurtosis were calculated to determine whether data were normally distributed (Field, 2013). Criterion scores for the R4C instrument were determined based on the experts’ means and standard deviations.

For reliability testing, the Cronbach’s alpha (Cronbach, 1951) was calculated to evaluate the internal consistency of each subscale in D1. Cronbach’s alpha coefficients ≥ .70 (Nunnally & Bernstein, 1994) were considered satisfactory, and coefficients ≥ .90 (Streiner, 2003) were considered an indicator of redundancy. Test-retest and inter-rater reliability were calculated using the Intraclass Correlation Coefficient (ICC) with two-way mixed model, absolute
agreement, and average measures (Schuck, 2004). An ICC value of less than .40 was interpreted as poor, between .40 and .59 as fair, between .60 and .74 as good, and above .75 as excellent (Cicchetti, 2001). Test-retest reliability (Streiner & Norman, 2008) was analysed for the total scores of the five subscales of D1 and for D2, D3, and D4. Inter-rater reliability (Hallgren, 2012) was analysed between the responses of the 14 experts and the responses of all pairwise combinations of experts for D2, D3, and D4.

For validity testing, the Pearson product-moment correlation coefficient was calculated to evaluate convergent validity (DeVon et al., 2007; Streiner & Norman, 2008). The a priori hypotheses were as follows: there are strong associations between the scores of D1.4, D2 and D4 and the biopsychosocial subscale of the PABS-PT for experts and students separately, and there are weak associations between the scores of D1.4, D2 and D4 and the biomedical subscale of the PABS-PT for experts and students separately. Convergent validity was interpreted as satisfactory if at least 75% of the results were in accordance with the multiple hypotheses stated in advance (Terwee et al., 2007).

Statistical analyses were carried out using the IBM Statistical Package for the Social Sciences (SPSS), version 22.0. Significance level was set to $p < 0.05$.

Physiotherapy students’ clinical reasoning (Study IV)

Demographic data and the scores of independent and dependent variables were analysed with descriptive statistics. A Pearson product-moment correlation coefficient was calculated for the bivariate relationships among the variables.

Three hierarchical multiple regression analyses were conducted, one for each dependent variable. Only independent variables correlating with respective dependent variables were included in the analyses (i.e., knowledge, cognition, metacognition, psychological factors (self-efficacy and attitudes) and curriculum orientation vis-à-vis behavioural medicine competencies). Contextual factors did not correlate with any of the dependent variables and thus were excluded in the analysis. The independent variables were modelled in three blocks, which were entered stepwise into the regression model. Theory and previous research guided the hierarchical order of the independent variables (Field, 2013; Tabachnick & Fidell, 2013). According to the conceptual model developed in study I, knowledge, cognitive and metacognitive capabilities and skills are essential factors in clinical reasoning. As students’ knowledge, capabilities and skills are based mainly on their education, curriculum orientation was regarded as a primary independent variable and was thus entered first in the model. The second step was a block of knowledge, cognition and metacognition. The third step comprised psychological factors.

A liberal p-value ($p < 0.10$) was regarded as significant due to the exploratory approach and the relatively small sample.
Ethical considerations

The ethical application for the four studies (Dnr 2013/020) was reviewed by the Regional Ethical Review Board, Uppsala, Sweden. According to the board, the requirement for ethical review stated in the Act on the Ethical Review of Research Involving Humans (SFS 2003:460, 3-4 §§) did not apply to the project. The board provided an advisory statement that stated that no obstacles were identified to conduct the research project. The studies were conducted in accordance with the Helsinki Declaration related to human research (World Medical Association, 2013). All participants in the studies received written information about the studies, and written informed consent was collected. The participants were informed about confidentiality, that participation was voluntary and that they had the right to withdraw consent to participate at any time without giving any reason. The physiotherapy students were informed that their participation did not affect their study grades. A personal ID code and a private, password-secured login for the R4C instrument were provided only to participating students. Only the researchers had access to the responses of the R4C instrument and the data collected from interviews and questionnaires. Only ME knew which ID code was connected to which study participant.
Results

The clinical reasoning model focused on clients’ behaviour change with reference to physiotherapists

The identified main theories and models informing a conceptual model of clinical reasoning focused on clients’ behaviour change with reference to physiotherapists are shown in table 6. The key concepts of the first version of the model, based on theory, evidence and the research team’s knowledge and experience are presented in paper I (Figure 1).

**Table 6.** Main theories and models informing a conceptual model of clinical reasoning focused on clients’ behaviour change with reference to physiotherapists

<table>
<thead>
<tr>
<th>Topic area</th>
<th>Theory and model</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical reasoning</td>
<td>A biopsychosocial model of clinical reasoning</td>
<td>(Jones et al., 2008)</td>
</tr>
<tr>
<td></td>
<td>A model of interactive reasoning and the problem space</td>
<td>(Higgs &amp; Jones, 2008)</td>
</tr>
<tr>
<td></td>
<td>A dialectical model of clinical reasoning</td>
<td>(Edwards, Jones, Carr, et al., 2004)</td>
</tr>
<tr>
<td></td>
<td>Dual process theory</td>
<td>(Marcum, 2012; Pelaccia et al., 2011)</td>
</tr>
<tr>
<td></td>
<td>Situativity theory</td>
<td>(Durning &amp; Artino, 2011)</td>
</tr>
<tr>
<td>Health behaviour</td>
<td>Biomedical and motor learning theories</td>
<td>(Melzack, 1999; Powers &amp; Howley, 2012; Shumway-Cook &amp; Woollacott, 2011)</td>
</tr>
<tr>
<td>and behaviour</td>
<td>Respondent and operant theories</td>
<td>(Sarafino, 2001)</td>
</tr>
<tr>
<td>change</td>
<td>Social cognitive theory</td>
<td>(Bandura, 1986, 2004)</td>
</tr>
<tr>
<td></td>
<td>Health belief model</td>
<td>(Rosenstock, Strecher, &amp; Becker, 1988)</td>
</tr>
<tr>
<td></td>
<td>Transtheoretical model/Stages of change</td>
<td>(Prochaska &amp; DiClemente, 1982; Prochaska &amp; DiClemente, 1983)</td>
</tr>
</tbody>
</table>

The students and physiotherapists perceived that the first version of the model reflected their views of clinical reasoning focused on behaviour change to a great extent, which validated the model construction. They also suggested content and concepts that could be added or refined. The findings related to agreement and disagreement with the model and the following consequences in the model development process are presented in table 7.
Table 7. Students’ and physiotherapists’ views about the first version of a model of clinical reasoning focused on clients’ behaviour change with reference to physiotherapists and following consequences in the model development process

<table>
<thead>
<tr>
<th>Category</th>
<th>Physiotherapy studentsa</th>
<th>Physiotherapistsb</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agreement with the content and concepts</td>
<td>Complete model with interacting components</td>
<td>A valuable model</td>
<td>Validation</td>
</tr>
<tr>
<td></td>
<td>Collaboration</td>
<td>Activity-related behaviour</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Holistic view of the client</td>
<td>is a preferable concept</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reflect theoretical knowledge and practical experience</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reflection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disagreement; content or concepts that should be changed or added</td>
<td>Add conceptual definitions</td>
<td>Highlight the uniqueness with the model</td>
<td>Refinement</td>
</tr>
<tr>
<td></td>
<td>Possibly add additional assessments and interventions</td>
<td>Consider whether additional factors should be added to the physiotherapist dimension</td>
<td>(i.e., change, replacement or addition) of concepts</td>
</tr>
<tr>
<td></td>
<td>Clarify clients’ priority of activity-related behaviour</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clarify biomedical and physical factors</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Edit the layout</td>
<td>Edit the layout</td>
<td>Clarification of relationships among concepts</td>
</tr>
<tr>
<td></td>
<td>Add a feedback loop</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a Subcategories that emerged from the focus groups
b Condensed descriptions that emerged from the group discussion

The final selection and refinements of concepts in the model resulted in the transformation of abstract concepts to more-concrete concepts; for example, the concept ‘analysis and problem formulation’ was replaced with ‘functional behavioural analysis’, and ‘problem solving’ was replaced by ‘strategies for behaviour change’. Conceptual descriptions were developed and are presented in paper I (Table 3).

In summary, the final version of the clinical reasoning model focused on client’s behaviour change with reference to physiotherapists (CRBC-PT) comprises five dimensions, namely, the client, the physiotherapist, input from client, functional behavioural analysis, and strategies for behaviour change. The concepts of the dimensions and their relationships describe clinical reasoning focused on clients’ behaviour change as a cognitive, reflective, contextual, collaborative and iterative process with multiple interrelated reasoning levels incorporating input from the client, a functional behavioural analysis of a prioritised activity-related target behaviour, and the selection of behaviour change strategies based on the analysis. Meeting individual needs and considering biopsychosocial factors throughout the reasoning process are essential. Central elements in behavioural assessments related to determinants of health and health behaviour and theory- and evidence-based interventions are included in the reasoning process to support a specific behaviour change in clients. The physiotherapist uses knowledge, cognition and metacognition in clinical reasoning and is influenced by psychological and contextual factors. The CRBC-PT model is presented in figure 1.
**Figure 1.** The clinical reasoning model focused on clients’ behaviour change with reference to physiotherapists. *Input includes central elements in behavioural assessment. **Strategies for behaviour change includes central elements in behavioural interventions.

Reasoning 4 Change instrument

The development process of the R4C instrument resulted in the following five versions of the instrument: three versions in hard copy (Phases 1–3, study II), one web-based beta-version (preliminary), and one final web-based application (Phase 4, study III). The first version of the instrument included eight written case scenarios and 79 items distributed among four domains, namely, Physiotherapist domain (D1), which includes the five subscales of Knowledge (D1.1), Cognition (D1.2), Metacognition (D1.3), Psychological factors (D1.4), and Contextual factors (D1.5), Input from client domain (D2 IC), Functional behavioural analysis domain (D3 FBA), and Strategies for behaviour change domain (D4 SBC).

Contributions of physiotherapy students and experts in a behavioural medicine approach in physiotherapy

The cognitive interviews with students (Phase 2, study II) about the first version of the R4C instrument resulted in the identification of 171 distinct problems in the item-response process, which were condensed to 15 main problems. The problems were equally distributed across the four domains and were mostly related to the codes ‘clarity – vague’ (in relation to items) and ‘response categories’. Examples of problems were the risk of multiple interpretations of items, lack of important client information, insufficient relation between items and the client in focus and lack of eligible response options. Sixty-three percent of the problems were revised. The reasons for not addressing the remaining problems were respondents’ inattention when reading items or their ability to respond despite perceived uncertainty, minor ambiguities regarding words, and the items’ equivalence with guidelines in clinical reasoning instrument construction. Based on the refinements, the second version of the instrument including 82 items was developed.

The first round in the Delphi process (Phase 3, study II) demonstrated consensus among the experts regarding content-relevance of the instrument as a whole, and the four domains and the five subscales separately. The experts’ agreement resulted in the inclusion of the instrument’s items. Based on the analysis of the experts’ comments, a few minor revisions were made in the instrument. In terms of developing the third and final version of the R4C instrument in hard copy, 81 items (76 of the original and five added items) distributed across four domains were identified and included.

Instrument structure, items, response scales and scoring

The construct to be measured in the R4C instrument was defined as ‘physiotherapists’ clinical reasoning focused on clients’ activity-related behaviour and behaviour change’. The instrument development process resulted in
operationalisation of the construct by generation of items related to the four domains. The instrument structure and relationships among items, subscales, domains and the construct to be measured are presented in figure 2. For the subscales D1.1–D1.5, the item scores reflect the effect of the concept that is measured in each subscale, illustrated as arrows from the subscale towards the items. For D2, D3, and D4, the items share a common consequence, i.e., the concept measured in each domain, illustrated as arrows from the items towards the domain. Together, the domains and subscales formed an index including eight outcomes, expressed as eight total scores, that determined the level of the construct to be measured. The total scores included five total scores for the subscales D1.1–D1.5 and three total scores for D2, D3, and D4. Higher scores indicate higher levels of clinical reasoning skills focused on clients’ activity-related behaviour and behaviour change. Theoretical min and max scores are presented in table 8.

Figure 2. Structure and relationships between items, subscales and domains of the R4C instrument
The subscales D1.1–D1.5 comprised self-assessment scales. The items were composed of statements concerning capabilities and skills to focus on clients’ activity-related behaviour and behaviour change in clinical reasoning related to Knowledge, Cognition, Metacognition, Psychological factors (self-efficacy and attitudes), and Contextual factors. The respondents rated their agreement with the statements on either 6- or 11-point Likert scales.

D2, D3, and D4 were based on written clinical case scenarios comprising various medical specialties (e.g., neurology and geriatric), health problems (e.g., shoulder pain, respiratory problem, stress and overweight), activity-related behaviours (e.g., help a three-year-old daughter to dress, moving around outdoors when playing with friends at preschool and physical activity by daily walks) and contexts (e.g., work-related context and acute care). D2 and D4 each comprised two cases, and D3 comprised four cases. The case scenarios included key features, i.e., described stimuli of, for example activity and participation limitations, unhealthy behaviours, associations among biopsychosocial factors, hypotheses, data from the assessment and data from the analysis to inform clinical reasoning decisions. In the series of following items, the key features should be identified, prioritised, analysed, or interpreted. To reflect real-life clinical encounters, the case scenarios included some degree of uncertainty, and new information was gradually added as the clinical reasoning progressed. The items of D2 covered the client’s narratives and assessment and measurement of biopsychosocial factors associated with the activity-related target behaviour. The items of D3 consisted of six hypotheses to explain what possible factors cause, control or maintain the activity-related target behaviour. In the first item, the respondent was asked to select the three most likely hypotheses, and in the following three-pronged item, the respondent should judge to what extent new client information, e.g., new physical examination findings, contextual changes, consequences of client’s behaviours, or intervention outcomes, strengthens or weakens the first given hypothesis. The items of D4 commenced with a hypothesis generated from a functional behavioural analysis of the client’s activity-related target behaviour. The hypothesis was continuously reformulated in accordance with client progress or accumulation of new client information. The items covered judgements regarding the importance of physical, psychological and contextual factors for performing the target behaviour and selection and prioritisation among intervention strategies for behaviour change. The response scales of D2–D4 included Likert-scales, write-in formats, and short and long lists of options.

The web-based application of the R4C instrument included instructions for responding, the items of the four domains, an administration tool and an auto-generating scoring tool.

An overview of the R4C instrument is provided in paper II (Figure 1), and example items and example response scales are provided in paper II (Table 5) and paper III (Supplement A). Examples of screenshots from the web application and accessibility of the instrument are presented in the Appendix.
Criterion scores

Criterion scores for the domains and subscales of the R4C instrument were generated based on the experts’ responses (Phase 4, study III) and are shown in table 8. The criterion scores correspond to high quality mastery of clinical reasoning focused on clients’ behaviour change.

Table 8. Criterion scores expressed as means (M) and standard deviations (SD) and theoretical min-max scores of the R4C instrument

<table>
<thead>
<tr>
<th>R4C instrument: domain and subscale</th>
<th>M Criterion score</th>
<th>SD</th>
<th>Theoretical min-max score</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1.1 PT: Knowledge</td>
<td>39.0</td>
<td>5.3</td>
<td>8 - 48</td>
</tr>
<tr>
<td>D1.2 PT: Cognition</td>
<td>36.9</td>
<td>5.5</td>
<td>7 - 46</td>
</tr>
<tr>
<td>D1.3 PT: Metacognition</td>
<td>43.0</td>
<td>3.8</td>
<td>8 - 48</td>
</tr>
<tr>
<td>D1.4 PT: Psychological factors total</td>
<td>181.3</td>
<td>12.3</td>
<td>0 - 200</td>
</tr>
<tr>
<td>Attitudes</td>
<td>93.9</td>
<td>6.0</td>
<td>0 - 100</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>87.4</td>
<td>8.4</td>
<td>0 - 100</td>
</tr>
<tr>
<td>D1.5 PT: Contextual factors</td>
<td>17.9</td>
<td>6.4</td>
<td>5 - 30</td>
</tr>
<tr>
<td>D2 Input from client</td>
<td>52.2</td>
<td>5.1</td>
<td>0.6 - 66.1</td>
</tr>
<tr>
<td>D3 Functional behavioural analysis</td>
<td>28.2</td>
<td>1.8</td>
<td>3.8 - 34.3</td>
</tr>
<tr>
<td>D4 Strategies for behaviour change</td>
<td>23.7</td>
<td>2.4</td>
<td>0 - 36.4</td>
</tr>
</tbody>
</table>

a Scores based on the responses of physiotherapists with expertise in a behavioural medicine approach (n=14)
PT = physiotherapist

Psychometric properties

Reliability

Internal consistency
The reliability analyses in phase 4, study III demonstrated satisfactory internal consistency for all subscales of D1. Cronbach’s α coefficients ranged from .67 to .88 for the experts and from .74 to .91 for the physiotherapy students; see table 9.

Test-retest reliability
The results demonstrated excellent test-retest reliability for the subscales of D1. The ICC values ranged from .75 to .89 for the experts and from .81 to .92 for the students. For D2, D3, and D4, test-retest reliability was overall fair or good except for D3 for the experts and D4 for the students. After exclusion of the most prominent outlier, the analyses of D2, D3, and D4 showed ICC values ranging from .46 to .61 for the experts and from .55 to .72 for the students; see table 9.
Table 9. Internal consistency (Cronbach’s α) for the experts (n=14) and students (n=39) and test-retest reliability (ICC) for the experts (n=12) and students (n=17)

<table>
<thead>
<tr>
<th>R4C instrument: domain and subscale</th>
<th>Experts in a behavioural medicine approach in PT</th>
<th>PT students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cronbach’s α</td>
<td>ICC^a</td>
</tr>
<tr>
<td>D1.1 PT: Knowledge</td>
<td>.86</td>
<td>.89***</td>
</tr>
<tr>
<td>D1.2 PT: Cognition</td>
<td>.88</td>
<td>.94***</td>
</tr>
<tr>
<td>D1.3 PT: Metacognition</td>
<td>.67</td>
<td>.75*</td>
</tr>
<tr>
<td>D1.4 PT: Psychological factors</td>
<td>.88</td>
<td>.89***</td>
</tr>
<tr>
<td>D1.5 PT: Contextual factors</td>
<td>.84</td>
<td>.77**</td>
</tr>
<tr>
<td>D2 Input from client</td>
<td>.31</td>
<td>.46*</td>
</tr>
<tr>
<td>D3 Functional behavioural analysis</td>
<td>.31</td>
<td>.56</td>
</tr>
<tr>
<td>D4 Strategies for behaviour change</td>
<td>.45</td>
<td>.61*</td>
</tr>
</tbody>
</table>

^a Intraclass Correlation Coefficient. Two-way mixed model, absolute agreement and average measure  
^b One outlier (the expert or student with the largest score difference between test one and two was excluded in the analysis)  
* p < .05 ** p < .01 *** p < .001  
PT = physiotherapy

Inter-rater reliability

Inter-rater reliability for D2, D3, and D4 showed excellent agreement within the expert group: D2 (12 items) ICC = 1.0 (p<0.001), D3 (8 items) ICC = .99 (p<0.001), and D4 (12 items) ICC = .94 (p<0.001). Inter-rater reliability analyses of all possible paired combinations of experts showed ICC values ranging from .15 to 1.0.

Validity

Content validation

The Delphi study with experts conducted in phase III, study II, demonstrated that the D-CVIs (range: 0.78–1.0) and the Scale-CVI/Ave (mean of all CVIs = 0.90) met the predefined criteria. Accordingly, the R4C instrument was judged to have excellent content validity

Construct validation

The analysis of correlation between the scores of D1.4, D2, and D4 in the R4C instrument and the two subscales of PABS-PT (Phase 4, study III) confirmed nine out of the 12 (75%) a priori stated hypotheses for the expert group and the students together. The confirmed hypotheses were strong associations between the scores of D1.4, D2, and D4 and the biopsychosocial subscale of the PABS-PT for the experts and weak associations between the scores of D1.4,
Physiotherapy students’ clinical reasoning focused on clients’ behaviour change

The physiotherapy students’ clinical reasoning focused on clients’ behaviour change was demonstrated in their scores on the R4C instrument; see paper IV, table 2 for details. The results of study IV showed significant bivariate correlations between the dependent variable IC and all independent variables except contextual factors, between FBA and curriculum orientation, knowledge, cognition and self-efficacy and between SBC and curriculum orientation, cognition and self-efficacy.

The multiple regression analyses demonstrated that curriculum orientation was the only independent variable associated with all three dependent variables. Curriculum orientation, entered in the first step of the model, explained 3% of the variance in IC, 4% of the variance in FBA, and 5% of the variance in SBC. Higher scores in IC, FBA and SBC were reported by students attending a programme with a curriculum including behavioural medicine competencies. For IC, all independent variables explained 37% of its variance. Knowledge, cognition and metacognition were entered in the second step of the model and explained 22% of the variance in IC. However, knowledge did not significantly contribute to the model. Psychological factors – self-efficacy and attitudes – were entered in the third step and explained 15% of the variance in IC. However, self-efficacy did not significantly contribute to the model. Knowledge, cognition, metacognition and psychological factors – self-efficacy and attitudes did not contribute to any explained variance of FBA and SBC. Further details about the results of the regression analyses are presented in paper IV, tables 4 and 5.

According to the overall aim of this project, additional analyses of collected data, except those analyses included in studies I-IV, were judged appropriate. Comparisons between the R4C instrument scores of physiotherapy students (n=151) and experts in a behavioural medicine approach in physiotherapy (n=14) revealed significant differences. The experts’ scores in all domains and subscales of the R4C instrument, except contextual factors, were significantly higher than were the students’ scores. For further detailed results, see table 10.
Table 10. Comparisons of the scores of the R4C instrument for physiotherapy students (n=151) and experts (n=14). Medians (Mdn), first and third quartiles (Q1-Q3)

<table>
<thead>
<tr>
<th>R4C instrument: domain and subscale</th>
<th>PT students</th>
<th>Experts in a behavioural medicine approach in PT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mdn\textsuperscript{b}</td>
<td>Q\textsubscript{1-3}</td>
</tr>
<tr>
<td>D1.1 PT: Knowledge</td>
<td>34.0</td>
<td>30.0-38.0</td>
</tr>
<tr>
<td>D1.2 PT: Cognition</td>
<td>33.0</td>
<td>28.0-36.0</td>
</tr>
<tr>
<td>D1.3 PT: Metacognition</td>
<td>38.0</td>
<td>34.0-42.0</td>
</tr>
<tr>
<td>D1.4 PT: Psychological factors, attitudes</td>
<td>81.0</td>
<td>75.0-88.0</td>
</tr>
<tr>
<td>D1.4 PT: Psychological factors, self-efficacy</td>
<td>68.0</td>
<td>60.0-74.0</td>
</tr>
<tr>
<td>D1.5 PT: Contextual factors</td>
<td>18.0</td>
<td>14.0-22.0</td>
</tr>
<tr>
<td>D2 Input from client</td>
<td>36.7</td>
<td>31.9-41.3</td>
</tr>
<tr>
<td>D3 Functional behavioural analysis</td>
<td>23.2</td>
<td>21.3-24.9</td>
</tr>
<tr>
<td>D4 Strategies for behaviour change</td>
<td>18.7</td>
<td>16.1-21.1</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Theoretical min-max scores of the R4C instrument: D1.1 = 8-48, D1.2 = 7-46, D1.3 = 8-48, D1.4 attitudes = 0-100, D1.4 self-efficacy = 0-100, D1.5 = 5-30, D2 = 0.6-66.1, D3 = 3.8-34.3, D4 = 0-36.4

\textsuperscript{b} Comparisons of medians with Mann-Whitney test, two-tailed

\*p < .05 **p < .01 ***p < .001

PT = physiotherapy or physiotherapist

Comparisons between the R4C instrument scores of physiotherapy students attending a programme with a curriculum including (n=61) or not including (n=90) behavioural medicine competencies revealed significant differences in seven variables. Students attending an education curriculum with behavioural medicine competencies scored significantly higher in D1.1 Knowledge, D1.2 Cognition, D1.4 Psychological factors – self-efficacy, D2 IC, D3 FBA, and D4 SBC than did students from an education curriculum without behavioural medicine competencies. For D1.5 Contextual factors, students from an education curriculum without behavioural medicine competencies scored significantly higher than did students from an education curriculum with behavioural medicine competencies. For further detailed results, see table 11.
Table 11. Comparisons of the scores of the R4C instrument for physiotherapy students attending a programme with a curriculum with (n=61) or without behavioural medicine competencies (n=90). Means (M) and standard deviations (SD)

<table>
<thead>
<tr>
<th>R4C instrument: domain and subscale</th>
<th>PT students - Curricula with behavioural medicine competencies</th>
<th>PT students - Curricula without behavioural medicine competencies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M&lt;sup&gt;b&lt;/sup&gt;</td>
<td>SD</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------</td>
<td>-----</td>
</tr>
<tr>
<td>D1.1 PT: Knowledge</td>
<td>35.7***</td>
<td>4.8</td>
</tr>
<tr>
<td>D1.2 PT: Cognition</td>
<td>34.9***</td>
<td>5.8</td>
</tr>
<tr>
<td>D1.3 PT: Metacognition</td>
<td>37.4</td>
<td>5.8</td>
</tr>
<tr>
<td>D1.4 PT: Psychological factors, attitudes</td>
<td>80.5</td>
<td>10.4</td>
</tr>
<tr>
<td></td>
<td>70.4**</td>
<td>12.6</td>
</tr>
<tr>
<td>D1.5 PT: Contextual factors</td>
<td>14.9</td>
<td>4.7</td>
</tr>
<tr>
<td>D2 Input from client</td>
<td>38.5*</td>
<td>7.2</td>
</tr>
<tr>
<td>D3 Functional behavioural analysis</td>
<td>23.8*</td>
<td>2.9</td>
</tr>
<tr>
<td>D4 Strategies for behaviour change</td>
<td>19.6**</td>
<td>3.7</td>
</tr>
</tbody>
</table>

<sup>a</sup>Theoretical min-max scores of the R4C instrument: D1.1 = 8-48, D1.2 = 7-46, D1.3 = 8-48, D1.4 attitudes = 0-100, D1.4 self-efficacy = 0-100, D1.5 = 5-30, D2 = 0.6-66.1, D3 = 3.8-34.3, D4 = 0-36.4

<sup>b</sup>Comparisons of means with independent t-test, two-tailed

*p < .05  **p < .01  ***p < .001

PT = physiotherapy or physiotherapist
Discussion

Summary of results

This thesis aimed to develop and evaluate an instrument to study physiotherapy students’ clinical reasoning focused on clients’ activity-related behaviour and behaviour change. Studies I-III have addressed the step-by-step process to develop a clinical reasoning instrument, including the building of a conceptual model and evaluation of its psychometric properties. Finally, the instrument was used to investigate physiotherapy students’ clinical reasoning and explore predictors of their clinical reasoning outcomes (Study IV).

The model building process contributed to a theory- and evidence-informed model with validated and useful content according to students and physiotherapists. The CRBC-PT model describes clinical reasoning focused on clients’ behaviour change as a cognitive, reflective, collaborative, contextual and iterative process with multiple interrelated reasoning levels in which central elements in behavioural assessment, analysis and intervention strategies are integrated. The instrument development process resulted in the web-based R4C instrument, consisting of four domains, namely, Physiotherapist, Input from client, Functional behavioural analysis, and Strategies for behaviour change. Feasibility and comprehensibility of the R4C instrument were supported, and its content validity was excellent. The psychometric evaluation demonstrated satisfactory reliability and acceptable construct validity. Physiotherapy students’ skills in clinical reasoning focused on clients’ behaviour change were inferior compared to physiotherapists with expertise in a behavioural medicine approach. Students from curricula including behavioural medicine competencies performed superior clinical reasoning compared to students from curricula without behavioural medicine competencies. Physiotherapy students’ cognitive and metacognitive capabilities and skills and positive attitudes explained their clinical reasoning skills at the IC level. Curriculum orientation vis à vis behavioural medicine competencies was the only predictor of the students’ clinical reasoning at all three levels: IC, FBA, and SBC.
The clinical reasoning model focused on clients’
behaviour change with reference to physiotherapists

The development of the CRBC-PT model revealed a complex picture of physiotherapists’ clinical reasoning process including multiple dimensions, multifaceted reasoning levels and various interrelated concepts. This picture is largely consistent with other models describing clinical reasoning in health professionals (Jones et al., 2008; Levett-Jones et al., 2010). However, the complexity of clinical reasoning models varies depending on their focus. Focusing on the cognitive activities of clinical reasoning depicts a series of advanced and non-linear reasoning pathways that depend on the mobilisation of specific knowledge and associations with similar tasks and situations (Charlin et al., 2012). The addition of the interpersonal relationship between the client and the clinician, contextual factors (e.g., colleagues and time) and psychological factors (e.g., beliefs and ethical aspects) to the cognitive activities makes the clinical reasoning process even more intricate (Daykin & Richardson, 2004; Edwards, Jones, Carr, et al., 2004; Langridge et al., 2016; Masley et al., 2011; McGlinchey & Davenport, 2014). None of contextual factors, psychological factors or non-linearity of the reasoning process were emphasised in the first version of the CRBC-PT model but were added in the final model (Phases 2a and 2b, study I). These model revisions clarified important clinical reasoning concepts and relationships among concepts and improved the completeness of the model. Even though existing models of physiotherapists’ clinical reasoning demonstrate advanced cognitive activities and multiple influencing factors (Edwards, Jones, Carr, et al., 2004; Higgs & Jones, 2008; Jones et al., 2008), they lack the inclusion of behavioural elements. Thus, the incorporation of behavioural change strategies into clinical reasoning further increased the complexity of the reasoning process. It is likely that many of the previously demonstrated difficulties in integrating the client’s needs and preferences, a biopsychosocial approach and behavioural elements in physiotherapists’ and students’ clinical reasoning (Alexanders et al., 2015; Gilliland, 2017; Gilliland & Wainwright, 2017; Synnott et al., 2015; Wainwright et al., 2011) are due to the complexity of the reasoning process. The CRBC-PT model may help physiotherapists to identify separate elements of clinical reasoning and improve their understanding of how these elements together shape the compound reasoning process. In turn, such clarification may facilitate physiotherapists’ improving client participation and increasing psychosocial and behavioural considerations in client management, consistent with prioritised competencies in the profession (Dean, 2009; Driver et al., 2017; World Confederation for Physical Therapy, 2015b) and emphasised global health goals (United Nations, 2015; WHO, 2013).
The CRBC-PT model is founded on empirical data, theoretical frameworks (Bandura, 1986; Durning & Artino, 2011; Marcum, 2012; Prochaska & Di Clemente, 1982; Rosenstock et al., 1988; Sarafino, 2001; Shumway-Cook & Woollacott, 2011) and expertise, which distinguishes it from other clinical reasoning models. A majority of clinical reasoning models in physiotherapy are developed based on empirical data (Edwards, Jones, Carr, et al., 2004; Holdar et al., 2013; Josephson et al., 2011; Masley et al., 2011; McGlinchey & Davenport, 2014; Smart & Doody, 2007; Smith et al., 2008) and a few on theoretical knowledge (Jensen & Givens, 1999; Jones et al., 2008; Jones, Edwards, & Gifford, 2002). Lynham (2002) presented two broad components in applied model building research: theorising to practice and practice to theorising. Regardless of whether the attention in the beginning is on the theoretical or practical component, the model-building process should be applied as a cyclical process including continuous refinement related to both components. Thus, as the CRBC-PT model was based on theory and practice and subsequently refined (Study I, phase 1, 2a and 2b), the model meets demands in applied model building research, which strengthens its utility in research and practice.

The CRBC-PT model demonstrates consistency with other physiotherapy clinical reasoning models (Edwards, Jones, Carr, et al., 2004; Jones et al., 2008), provides concreteness by its concepts and conceptual descriptions, and contributes to novelty in the field of clinical reasoning, which are important features of a useful model (Jaccard & Jacoby, 2010; Shaw & Costanzo, 1982). The uniqueness of the CRBC-PT model is its elucidation of how key factors in the areas of clinical reasoning and health behaviour and behaviour change are interrelated. Furthermore, essential clinical reasoning elements related to assessments and intervention strategies that could help physiotherapists in their clinical reasoning to support behaviour change in clients are specified.

The main purpose of a model or theory is to help us better understand phenomena in our world. From this perspective, the utility of a model and its consensual validation, i.e., the acceptance of a model by scholars in the field, are essential (Jaccard & Jacoby, 2010). In the current project, the utility of the CRBC-PT model was twofold – to serve as the basis for a new clinical reasoning instrument and to guide physiotherapists’ clinical reasoning. Value and validity of the model were based on the views of physiotherapists and students. Accordingly, the CRBC-PT model fulfils many quality criteria of a ‘good’ model, which increases the likelihood of its acceptance and use. Further evaluation of the model is needed to establish its validity in other contexts.

Recently, Huhn, Gilliland, Black, Wainwright, and Christensen (2018) presented a concept analysis of physiotherapists’ clinical reasoning. The conceptualisation of clinical reasoning and the CRBC-PT model shared most characteristics, such as the involvement of the physiotherapist and client perspectives in the reasoning process and iterative and contextual features, which confirmed the concepts of the CRBC-PT model. Integration of a biopsychosocial
approach and involvement of clients’ behaviours throughout the clinical reasoning process were mentioned in the findings of the concept analysis but not described in the key features of the concept. This description indicates that the CRBC-PT model may contribute to a new direction for clinical reasoning in physiotherapy in accordance with emphasised needs of the physiotherapy profession and healthcare (Dean, de Andrade, et al., 2014; Driver et al., 2017; Foster & Delitto, 2011; Jones, Edwards, & Jensen, 2019).

In summary, the CRBC-PT model has the potential to serve as a useful tool for physiotherapists and students in their efforts to better understand and apply clinical reasoning skills consistent with a biopsychosocial perspective and support for clients’ behaviour change and to guide research within the field of clinical reasoning. As a development of previous definitions of clinical reasoning in physiotherapy the following definition is suggested for use in the physiotherapy context:

Clinical reasoning in physiotherapy integrates a cognitive, reflective and iterative process with the process of behaviour change in clients and guides physiotherapists’ practice actions. It is pervaded by a biopsychosocial perspective and individualised to the client’s needs. It is dependent on the context and influenced by psychological factors pertaining to the physiotherapist. The reasoning process comprises multiple interrelated reasoning levels in which central elements in behavioural assessments and interventions are incorporated to support behavioural change. The physiotherapist and client in partnership identify and collect information regarding biopsychosocial factors of relevance for the client’s activity-related target behaviour, conduct a functional behavioural analysis, select intervention strategies to support behaviour change or maintenance, and evaluate the outcomes.

Reasoning 4 Change instrument

The development process of the R4C instrument was characterised by balancing the need to capture the multiple aspects of clinical reasoning in a way that reflects reality along with considerations of psychometric theory to focus on the need for precision in measuring clinical reasoning. Durning et al. (2013) described such a combination of various epistemological views of clinical reasoning as challenging but essential to enhance our understanding of clinical reasoning and optimise its assessments.

To capture cognitive activities in the R4C instrument, the three essential and measurable cognitive aspects provided by Kreiter and Bergus (2009) were carefully incorporated. First, identification and collection of important information were included in the IC domain, for example identification of key features, prioritisation of biopsychosocial factors in the cases and decisions about gathering of client information. Second, assessment and decision of client
management, which results from the process of integrating new information with pre-existing knowledge, were included in the identification of the client’s main complaint (IC domain), the interpretation of data to generate hypotheses (FBA domain), and the selection of interventions (SBC domain). Third, the development of the new knowledge organisation was assessed based on the respondent’s efficiency in integrating new client data within existing knowledge. This aspect was captured in items where the respondent judged the effects of new client information on hypotheses (FBA domain) or interventions (SBC domain).

To grasp clinical reasoning as a context-dependent process, several item-constructions were included. First, domain one (the Physiotherapist) included the contextual factor subscale focusing on the influences from the clinical setting. Second, information describing physical and social contextual factors were incorporated in the case scenarios. Third, the prevalence of case/context specificity in clinical reasoning (Eva, 2003) had implications for the number and characteristics of cases. Studies have provided strong evidence that assessments including a single or few cases have poor psychometric qualities due to the contribution of case/context specificity (Nendaz & Tekian, 1999). Consequently, to increase context variability and correspondingly increase generalisability of test results, several cases across various field of practice, for example neurology, musculoskeletal and elderly care, were included. Additionally, the activity-related target behaviours in focus in each case varied from behaviours in daily life activities, such as independently standing up at the bedside using a walker, to life-style-related behaviours, such as performing regular physical activity by walking 30 minutes per day. Fourth, multiple possible reasoning paths and several response options generating scores were used to reflect the diversity of acceptable clinical reasoning decisions (Dory et al., 2012; Fournier et al., 2008).

The aspect of clinical reasoning as a collaborative process was captured by the respondents’ ability to identify and consider the client’s perspective in the reasoning process. Valuing the client perspective implies, among other things, considering the clients’ life-situation, individual needs and health concerns, values, experiences and preferences in the decision-making (Cheng et al., 2016; Feldthuse, Dean, Forsblad-d'Elia, & Mannerkorpi, 2016; Morgan & Yoder, 2012). Given the client’s perspective is key in a clinical reasoning process focused on clients’ behaviour change, the client-physiotherapist collaboration was assumed to be considered by the expert panel’s responses and thus rewarded in the scoring key of the R4C instrument.

The aspect of non-linearity in the reasoning process (Durning et al., 2013) was obtained by the addition of new client information throughout the reasoning process. A change of the case scenario forces the respondent to go back and forth in their reasoning process to rethink and adjust their decisions to the needs of the client and the new situation. For example, in the SBC domain, interventions are selected and subsequently challenged by new client
narratives or by new examination findings that need to be interpreted and analysed to make new, informed decisions.

Clarity about what is assessed with the R4C instrument is essential for accuracy in the inferences of test results (Streiner & Norman, 2008). Miller (1990) has proposed a framework of assessing clinical competence based on the levels of individuals’ cognitive and behavioural progress from acquiring knowledge to performing a task in practice. The four levels comprise “knows”, “knows how”, “shows how”, and “does”. The R4C instrument reflects the first three levels, thus demonstrating physiotherapists’ or students’ knowledge in clinical reasoning, their understanding of how to reason, and their ability to perform clinical reasoning within situations reflecting reality. The last step, to act in the clinical setting, is not captured with the R4C instrument. Because covert behaviours such as cognitive activities in clinical reasoning are not observable (Baldwin & Baldwin, 2001), they are difficult to assess in the clinical setting. However, written instruments have demonstrated their value in capturing thinking and reasoning activities (Bordage & Page, 2018; Yeung et al., 2016). It is clearly stated that no single strategy is sufficient to completely capture all facets of clinical reasoning. Thus, trade-offs in the selection of assessments need to be made (Eva, 2004; Ilgen et al., 2012; Young, Dory, Lubarsky, & Thomas, 2018). In conclusion, the R4C instrument captures essential cognitive, collaborative, contextual and non-linear facets of clinical reasoning, and by responding to its items, physiotherapists and students show how they perform clinical reasoning. However, the interactive facet is weakly captured, and inferences regarding respondents’ clinical reasoning actions in practice are limited.

A particular strength of the current project is the thorough and stepwise process of collecting reliability and validity evidence for the R4C instrument, evidence that is scarce for competence-based assessments (Cook, Zendejas, Hamstra, Hatala, & Brydges, 2014). Reliability represents the consistency of measures and the extent to which test scores are free from error (Portney & Watkins, 2009) and is a necessary but insufficient condition for validity (Streiner & Norman, 2008). Classical validation frameworks describe validity as a rather narrow concept including three “types” of validity: content, construct and criterion validity (Streiner & Norman, 2008). Contemporary frameworks view validation as a more complex, broad and on-going process (Cook & Hatala, 2016) and refer to the collection of validity evidence to evaluate the correctness of the interpretations, uses, and decisions based on assessment results (Kane, 2006). The current standard for assessment validation is based on the framework proposed by Messick (American Educational Research Association, 2014), and requires evidence from five sources, namely, content, response process, internal structure, relationships with other variables, and consequences (Cook & Beckman, 2006). In the present project, data were collected to match all sources. Content evidence was collected with the assurance that the R4C instrument items reflected the construct to be measured. The
well-grounded theoretical foundation of the construct, based on the CRBC-PT model, provided strong support for the validity (Study I). Furthermore, guidelines in assessing clinical reasoning, influences from established instruments, the research team’s knowledge and experience, and the Delphi study contributed to content evidence (Study II). Response process evidence was provided by the cognitive interviews with physiotherapy students (Study II) and by securing individual responses with the use of personal login details for the web application (Study III). A basis for the internal structure evidence was the theoretical cause and effect relationships among the domains, subscales and items described in figure 2. Only the subscales Knowledge, Cognition, Metacognition, Psychological factors and Contextual factors were identified as relevant for internal consistency testing because the scores of their items were believed to be caused by the concept measured in each subscale, meaning correlations among the items (DeVellis, 2012; Streiner & Norman, 2008). In contrast, for domains two, three and four, internal consistency testing was not relevant because the items of these domains were believed to share a common consequence (the concept measured in the domain) rather than being caused by the measured concept (Diamantopoulos & Winklhofer, 2001; Streiner & Norman, 2008). Thus, these relationships guided the internal consistency testing in study III. Further internal structure evidence was provided by the excellent inter-rater reliability test results and by the satisfactory test-retest reliability results (Study III). Evidence of relationships with other variables was provided by the associations between the test scores of the R4C instrument and the PABS-PT (Study III). In addition, the differences between students’ and physiotherapists’ test scores contributed to validity evidence. Finally, consequences evidence, i.e., the impact of the assessment itself and the actions or decisions that result, was provided by the determination of criterion scores of the R4C instrument (Study III), by the associations between individual- and curriculum-focused factors and students’ clinical reasoning outcomes (Study IV), and by the identified score differences between students attending a programme with a curriculum with or without behavioural medicine competencies. These findings set a standard for scoring interpretation and may have an impact on curriculum development and clinical reasoning learning. Ultimately, the R4C instrument may contribute to well-founded decisions and investments in physiotherapy higher education, which in turn is a profitable welfare investment.

Thus, the extensiveness of data in this project, informing each source of validity, constitutes an essential platform for the use of the R4C instrument in research, education and practice. However, increased accumulated validity evidence is needed to further improve its usefulness.
Physiotherapy students’ clinical reasoning focused on clients’ behaviour change

The students perceived their knowledge, cognition and metacognition as inferior, attitudes as less positive, and self-efficacy beliefs as lower compared to the experts’ perceptions of their capabilities, attitudes and beliefs. Moreover, at all three clinical reasoning levels, the physiotherapy experts demonstrated superior quality in their clinical reasoning to support clients in behavioural change compared to the students. These findings are consistent with several studies presenting differences between novice and experienced physiotherapists’ clinical reasoning skills (Doody & McAteer, 2002; James, 2007; May, Withers, Reeve, & Greasley, 2010; Wainwright et al., 2010). Experienced physiotherapists engage more frequently in reflection during clinical reasoning than do novice physiotherapists (Wainwright et al., 2010), which is strengthened by the current findings of the students’ inferior metacognitive capabilities. Doody and McAteer (2002) showed that physiotherapy students in the final part of their education recognise fewer cues and clinical patterns in clients than experts do, which is consistent with the current findings of students’ limited ability to identify key features in the case and identify the client’s main complaint at the IC level, compared to the experts. Additionally, the accuracy in diagnoses (James, 2007) and the linkage between hypotheses and intervention decisions (Doody & McAteer, 2002; May et al., 2010) are less advanced in students. Similarly, the students performed less well compared to the experts in analysing biopsychosocial data, generating hypotheses at the FBA level and selecting appropriate interventions based on hypotheses at the SBC level. A notable difference between the students and experts was the low self-efficacy beliefs in applying behavioural considerations in clinical reasoning in the students compared to the experts. Hayward et al. (2013) showed that newly graduated physiotherapists have low confidence and trust in their decision-making capabilities, but a turning point occurs during the second year in the profession. Of note is that the experts in the current project had long physiotherapy experience, on average 25 years, which has contributed to the expansion of their confidence and skills. However, the findings point clearly to the importance of learning through experience for the growing of self-efficacy and clinical reasoning skills.

The comparisons of students from two different physiotherapy curriculum orientations revealed that students from programmes including behavioural medicine competencies had superior self-perceived knowledge, cognitive capabilities and skills related to biopsychosocial and behavioural aspects in clinical reasoning and superior clinical reasoning skills at all reasoning levels compared to students from programmes without explicit behavioural medicine competencies in the curricula. The findings suggest that these students may be developing some of the characteristics of experienced physiotherapists, even at this early stage of their professional career. In addition, students from
curricula with behavioural medicine competencies perceived their self-efficacy beliefs in clinical reasoning focused on behaviour change as superior compared to corresponding beliefs of students from curricula without such competencies. This perception is an important finding, as self-efficacy beliefs have been demonstrated to have an impact on performance in clinical practice (Godin et al., 2008). However, there was no difference between the student groups’ attitudes towards behavioural considerations in clinical reasoning. Together, these findings point on the importance of incorporating behavioural medicine content and goals in curricula to direct teaching and support students in acquiring clinical reasoning competence in favour of a biopsychosocial approach and clients’ behaviour change.

The findings in study IV demonstrated that students’ perceptions of their cognitive and metacognitive capabilities and skills are associated with their skills in addressing the client’s perspective, identifying an activity-related target behaviour, selecting and prioritising assessments of biopsychosocial factors and interpreting findings at the IC level. Knowledge only, did not explain the outcome of IC, indicating that the scope of what students know is insufficient for explaining their clinical reasoning skills. This finding confirms previous studies demonstrating that knowledge is a prerequisite for more advanced cognitive activities (Holdar et al., 2013; Norman, 2005; Smith et al., 2008). Thus, developing students’ abilities in applying, adapting and reflecting on their knowledge with respect to the needs of the clinical reasoning process appears essential.

Psychological factors also explained a fairly large proportion of the IC outcome. The importance of non-cognitive factors such as emotions (Langridge et al., 2016), personal traits (Holdar et al., 2013), motivational factors and beliefs (Daykin & Richardson, 2004; Smith et al., 2007) for physiotherapists’ clinical reasoning has been emphasised previously and was confirmed by the current findings. As students’ positive attitudes towards integrating behavioural considerations in clinical reasoning explained their outcome at the IC level, the learning environment including peers, educators and clinical instructors has the potential to influence the quality of clinical reasoning by promoting positive attitudes. For instance, enabling students to experience positive consequences of their reasoning might be a reasonable approach (Chaiklin, 2011). However, self-efficacy beliefs, included in psychological factors, did not alone contribute to the explained variance of IC. This finding differs from previous research findings. Self-efficacy beliefs are recognised as important predictors for academic performance (van Lankveld, Jones, Brunnekreef, Seeger, & Bart Staal, 2017), clinical practice (Darlow et al., 2012; Godin et al., 2008) and physiotherapy students’ performance in the clinical setting (Jones & Sheppard, 2012). Further research is needed to clarify the relationship between self-efficacy and clinical reasoning. According to van Lankveld et al. (2017), students’ self-efficacy beliefs in physiotherapy are not generic, but rather are specific to a clinical area or specific clients. This description
complies with the conceptual definition of self-efficacy, being beliefs about one’s capability to successfully perform a specific behaviour in a specific situation (Bandura, 1997). Thus, the lack of association indicates a need to further evaluate the self-efficacy subscale regarding specificity of items.

An important finding was that curriculum orientation, vis à vis behavioural medicine competencies, was the only variable explaining physiotherapy students’ clinical reasoning skills at all levels. Similarly, Gilliland and Wainwright (2017) found that curriculum variances contributed to differences in students’ abilities to consider behavioural responses and behaviour modification in their clinical reasoning. Accordingly, the undergraduate education plays an important role in shaping health-focused clinicians with high quality clinical reasoning skills in supporting behavioural change. Such physiotherapists have the prerequisites to target intermediary determinants of health, such as behaviours and contextual factors (WHO, 2010), thereby contributing to address health outcomes and health inequities in society. Although the social determinants of health account for the largest proportion of individuals’ and populations’ health outcomes, the importance of an individual’s own health-related behaviours should not be underestimated (Hubinette et al., 2017). However, curriculum orientation explained a significant but limited proportion of the clinical reasoning variance in students; thus, other predictors need to be explored.

Learning in clinical reasoning

By applying the Revised Bloom’s Taxonomy (Anderson & Krathwohl, 2001) to the clinical reasoning process assessed with the R4C instrument, a more refined understanding of the learning processes underpinning the outcomes at the IC, FBA and SBC levels evolves (Study IV). The taxonomy demonstrates learning as levels on a continuum of complexity, from simple to more complex and challenging types of learning, comprising six cognitive process levels. Both the taxonomy and the three clinical reasoning levels demonstrate the importance of developing and mastering lower-level cognitive skills to support and master higher-level skills. As outlined by table 12, collecting relevant biopsychosocial data at the IC level relies on cognitive skills to understand the meaning of client-provided information and assessment findings. At the level of FBA, the analysis of the activity-related target behaviour corresponds to cognitive skills of detecting how factors relate to one another and to the situation overall. At the level of SBC, hypotheses are appraised to determine interventions, which corresponds to cognitive levels of making informed judgements. In the FBA and SBC domains of the R4C instrument, the iterative and reflexive clinical reasoning process is assessed, which corresponds to the most complex cognitive process level – create. Even though this picture of two complex and related processes may be simplified, it is relevant for practice. The parallelism of clinical reasoning and cognitive process levels emphasises
that high, complex levels of learning are needed for performance of complete clinical reasoning. Moreover, the connection of levels of learning to the clinical reasoning levels demonstrates that low and high levels of cognitive skills are assessed within the domains of the R4C instrument, which is a strength of the instrument. Of note is that no conclusions about causality between cognitive skills and clinical reasoning skills could be drawn based on the findings of this project.

**Table 12.** General description of physiotherapists’ cognitive process levels and clinical reasoning levels assessed with the R4C instrument

<table>
<thead>
<tr>
<th>Level of learning</th>
<th>Cognitive process levela</th>
<th>Description</th>
<th>Clinical reasoning levelb</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>High/complex</td>
<td>Create</td>
<td>Putting elements together to form a novel, coherent whole or make an original product</td>
<td>Strategies for behaviour change</td>
<td>Iterative reasoning. Generating revised hypotheses based on new assessment findings or intervention outcomes. Developing a new intervention plan based on new information and client progress.</td>
</tr>
<tr>
<td>Evaluate</td>
<td>Making judgements based on criteria and standards</td>
<td>Strategies for behaviour change</td>
<td>Weighting the importance of biopsychosocial factors and appraising hypotheses to determine interventions</td>
<td></td>
</tr>
<tr>
<td>Analyse</td>
<td>Breaking material into its constituent parts, detecting how the parts relate to one another and to an overall structure</td>
<td>Functional behavioural analysis</td>
<td>Determining important, controllable, causal functional relationships among biopsychosocial factors believed to affect the client’s activity-related target behaviour</td>
<td></td>
</tr>
<tr>
<td>Apply</td>
<td>Carrying out or using a procedure in a given situation</td>
<td>Input from client</td>
<td>Prioritising and collecting biopsychosocial data through interview and assessments</td>
<td></td>
</tr>
<tr>
<td>Understand</td>
<td>Determining the meaning of instructional messages, including oral, written, and graphic</td>
<td>Input from client</td>
<td>Identifying biopsychosocial key features, interpreting client-provided information and assessment findings, and inferring the client’s main concern</td>
<td></td>
</tr>
<tr>
<td>Low/Simple</td>
<td>Remember</td>
<td>Retrieving relevant knowledge from long-term memory</td>
<td>Input from client</td>
<td>Recalling biopsychosocial key features related to the client’s disease/ disorder/health concern</td>
</tr>
</tbody>
</table>

a Cognitive process levels according to The Revised Bloom’s Taxonomy by Anderson and Krathwohl (2001)
bClinical reasoning levels assessed with the Input from client domain, Functional behavioural analysis domain, and Strategies for behaviour change domain of the R4C instrument
The multiple regression analysis revealed that knowledge, cognition and metacognition together explained a large proportion of the variance in IC. This finding indicates that physiotherapy students acquire well cognitive skills necessary at the IC level. However, as these variables did not contribute to any explained variance in FBA and SBC, it is likely that the physiotherapy students’ skills may be insufficient for more advanced and complex levels of clinical reasoning. This interpretation supports previous research findings. Studies investigating the causes of medical diagnostic errors and difficulties in clinical reasoning have revealed associations between frailty in cognitive processes and difficulties in the analytical part of the reasoning process (Graber, Franklin, & Gordon, 2005; Norman et al., 2017; Scott, 2009). Gilliland and Wainwright (2017) demonstrated that most reasoning errors conducted by physiotherapy students were related to cognitive bias, for example failure in generating key hypotheses and altering previous inferences in the face of new and conflicting findings. Furthermore, students and novice physiotherapists use reasoning strategies related to history taking, physical examination (May et al., 2010) and diagnosis (Gilliland & Wainwright, 2017) more frequently than they use reasoning strategies about interventions. Together, the findings highlight the need to advance students’ clinical reasoning, particularly on the levels of analysis and selection of intervention strategies, i.e., those levels requiring higher, complex cognitive skills.

The acquisition of such skills requires a deep approach to learning where the meaning of information, relationships among variables and the pursuit of complete mastery are emphasised (Marton & Booth, 2009). A deep approach to learning also increases the ability to transfer knowledge and skills to a greater variety of tasks and contexts (Marton & Booth, 1998), which is essential in clinical reasoning. However, a deep approach to learning is difficult for students to engage in without support from a learning environment that endorses a comprehensive view of learning (Illeris, 2015). The findings of a lack of significant associations between the individual-focused predictors and the outcomes at the FBA and SBC levels point to an educational limitation with respect to supporting students’ learning in clinical reasoning from a comprehensive perspective at these two levels.

How Illeris (2015) uses the three learning dimensions points to the fact that learning clinical reasoning and subsequently assessing clinical reasoning are complex processes. Based on Illeris’ comprehensive view (2015), effective learning of clinical reasoning implies, for instance, the need to understand and connect various factors, to experience the value of the clinical reasoning strategies and to interact with others, e.g., clients in the clinical reasoning learning process. These facets of a comprehensive and deep approach to learning appears to be captured in the R4C instrument, which is a strength. Additionally, just as the R4C instrument assesses complex clinical reasoning, it also contributes to clinical reasoning learning by providing the students with clinical
Developing physiotherapy students’ clinical reasoning focused on clients’ behaviour change

Based on the findings of this project, capabilities and skills in clinical reasoning can be viewed as a fundamental outcome of the physiotherapy entry-level education. Thus, prioritisation of educational strategies is important. No single best approach employed in the teaching of clinical reasoning exists (Christensen et al., 2017), but some directions have been provided. Studies have demonstrated that learning of generalisable skills only, such as problem-solving skills, is insufficient for effective clinical reasoning. Rather, the role of case/context specificity (Eva, 2003) needs to be considered (Schmidt & Mamede, 2015; Wimmers & Cha-Chi, 2008), implying that students need to engage with many clients (Jessee, 2018). Furthermore, a certain degree of uncertainty needs to be incorporated in cases to mimic real clients, reflection upon reasoning is important (Eva, 2004), and encouraging feedback is essential (Jessee, 2018). Learning activities that afford opportunities to apply knowledge and skills to practice, i.e., ‘learning by doing’, have been demonstrated to be a valuable source in the learning of clinical reasoning among physiotherapists (Wainwright et al., 2011) and have advanced students’ clinical reasoning skills (Knecht-Sabres, 2013). Even though the current project did not investigate learning activities in education per se and no conclusions could be drawn about their impact on the students’ clinical reasoning, the project’s findings together with the aforementioned evidence and scholarly argumentation may highlight possible educational strategies. First, knowledge of the multiple, interrelated clinical reasoning levels and their related cognitive process levels is critical to the teaching of clinical reasoning focused on behaviour change. Second, encountering various clients or cases is essential for adapting knowledge and reasoning to the needs of the client and situation, consistent with behavioural considerations in clinical reasoning. Third, students’ abilities to analyse behaviours, select and evaluate interventions, and create novel understanding of the client’s problem and situation need increased focus to enable effective clinical reasoning at all levels. Fourth, incentives for learning clinical reasoning integrated with clients’ behaviour change need to be targeted by promoting students’ attitudes towards such reasoning in educational contexts. Implementation of such strategies in education may develop clinical reasoning competence in physiotherapy students and in turn develop competencies in the profession to support individual and societal health needs.
Methodological considerations

This project utilised multiple research designs, methods and sources of data to develop and evaluate the R4C instrument, which is considered a strength (DeVellis, 2012; Streiner & Norman, 2008). Generalisability of the CRBC-PT model and the R4C instrument across physiotherapy practice contexts was strengthened by the model’s and instrument’s content elements founded on prioritised competencies in the profession overall, regardless of professional specialisation. In addition, the view of movement as behaviour, embracing behaviours in important daily life activities such as client’s personal care and work-related activities and life-style related behaviours, for instance physical activity, increases the flexibility of the clinical reasoning process, thus strengthening the applicability of the model and the instrument in various contexts. Quantifying the study of clinical reasoning with the use of the R4C instrument also allows a stronger analysis of clinical reasoning in the physiotherapy context than is currently present in the literature. Moreover, the inclusion of students from all physiotherapy programmes in Sweden was a strength even though the representation varied among the programmes. The consistency between the sample and the physiotherapy student population according to age and gender was satisfactory, which allows the results in study IV to be generalised to the population of final year physiotherapy students in Sweden.

The use of self-assessments to assess students’ knowledge, cognitive and metacognitive capabilities and skills, psychological and contextual factors can be a limitation. Despite the accepted theoretical value of self-assessments and their frequent use in education to summarise or predict students’ performances, individuals’ capacities in assessing one’s professional strengths and weaknesses are questioned (Eva & Regehr, 2005), and relationships between self- and external assessments vary significantly (Davis et al., 2006) and for different reasons. Thus, the low explained variance of the clinical reasoning outcomes in study IV might be a result of inaccuracy of the predictive variables. Further studies, using triangulation of methods to assess these variables, are necessary to determine their accuracy.

Additionally, the risk of response bias due to response patterns or that respondents choose what they think is the most correct response and not what they actually should do in practice (Streiner & Norman, 2008) was present in all domains of the R4C instrument. Thus, these possible limitations need to be taken into consideration when interpreting the results of this project.

Because the first author (ME) of studies I-IV was the one conducting the data collections in this project, the possible impact of researcher bias needed to be carefully handled. When data were gathered at the physiotherapy programme of ME’s university, there was a risk of bias. Therefore, the role of ME as a researcher and not a lecturer was emphasised in the contacts with students and physiotherapists. Self-reflections about possible influences of
own knowledge and experiences in clinical reasoning and behavioural medicine on the data collections and analyses were continuously performed to minimise the risk of bias. Moreover, discussions in the research team and the inclusion of students and experts from various universities ensured that multiple views of the process were considered. Thus, the role of ME should not have influenced the findings significantly.

To control the influence of prior knowledge of the participants in the interviews, the standardised introduction and the interview guide served to reduce the risk of varying the interviews dependent on the participant. Informing the participants that there were no wrong answers also increased the participants’ likelihood of answering according to their real thoughts and feelings. ME’s knowledge about the origin of the conceptual model and the assessment instrument was considered essential in the interviews for gathering data. Thus, how data were gathered enhanced the believability of the findings, thus increasing their credibility (Graneheim & Lundman, 2004). In addition, the use of several researchers in the coding and analytical decisions of the qualitative data reduced the possibility of biased interpretations and decisions, which enhanced confirmability of the findings (Polit & Beck, 2010).

There might have been a risk of sample bias because of the low response rate of students attending programmes without behavioural medicine competencies in the curricula, which may have influenced the results. However, the sample size of the responding students was large, which increased the probability that the findings reflected the responses of the group of students from education curricula without behavioural medicine competencies.

Scoring of the participants’ responses in the R4C instrument was mostly automatically computed in the web application, which significantly reduced the risk of affecting the scoring results compared to manual input of the data. In cases of qualitatively judged responses, the participants were anonymous for the researcher computing the data to avoid the risk of bias. Together, these actions resulted in a very low risk of assessor bias, which is important for the interpretation of the studies’ findings.

Investigations including students may imply a risk that they feel coerced to participate due to the power imbalance between students and lecturers or researchers. To reduce this risk, information about voluntariness to participate was emphasised, written informed consent was collected and the participants were informed that they could withdraw their participation at any time without explanation. Furthermore, information about the study and invitation to participate was always presented to the students as a group to avoid personal requests. The fact that a majority of the students in study IV declined participation indicates that the students made self-determined decisions.

The independent variable curriculum orientation in study IV can be a limitation due to difficulties in identifying detailed content and educational practices in the physiotherapy programmes, which may have influenced the findings. Of note, the dichotomisation of curricula into either with or without
behavioural medicine competencies was a means of clarifying differences among the programmes even though commonalities exist. It is possible that programmes categorised as curricula without behavioural medicine competencies also included content of relevance for behavioural medicine, even though such content was not explicitly formalised in their curricula. Because curricula describe content taught in programmes and define competencies that students are expected to learn (SFS 1993:100), reviewing these documents was found appropriate to distinguish among programme distinctions in behavioural medicine content and competencies. Other indicators such as number of teaching hours of behavioural medicine content and competencies could have been included in the assessment of curriculum orientation. However, dependent on variations in what teaching includes (e.g., lectures, self-studies and practice), teaching hours was not judged an appropriate measure. Thus, assessment based on curricula content together with contacts with programme directors in cases of uncertainty were judged the most standardised way to differentiate among the programmes.
Conclusions

This thesis contributes to improved knowledge of clinical reasoning of relevance for health professionals in general and for physiotherapists specifically. The CRBC-PT model depicts the complexity and multidimensionality in clinical reasoning focused on clients’ behaviour change and highlights essential concepts in clinical reasoning and behaviour change and their relationships. The model can provide a foundation for research and assist students and physiotherapists in understanding and incorporating factors related to human behaviours, analyses of what factors motivates or hinders behaviours and behavioural change strategies in their clinical reasoning.

R4C is the first systematically developed theory- and evidence-informed instrument to assess physiotherapists’ and physiotherapy students’ clinical reasoning focused on clients’ activity-related behaviour and behaviour change. The psychometric properties of the R4C instrument support its use in research and education. The instrument enables investigations and evaluations of physiotherapy students’ skills in integrating a biopsychosocial approach, behavioural considerations and behavioural change strategies in clinical reasoning of relevance for various clinical contexts and behaviours in focus.

Cognitive and metacognitive capabilities and skills and positive attitudes were key predictors of students’ clinical reasoning at the input from client level and should be targeted to improve clinical reasoning skills. At all levels of the reasoning process, curricula with behavioural medicine competencies were associated with positive clinical reasoning outcomes, which should be considered in physiotherapy education development. However, as the explained variance was limited, other predictors, yet unidentified, also contribute to clinical reasoning outcomes.

Overall, based on the results of this thesis, physiotherapy students’ skills in clinical reasoning focused on clients’ behaviour change vary, and there are opportunities for improvements. Physiotherapy educations are recommended to increase students’ practice of more complex reasoning including analysis of behaviour, selection and evaluation of behaviour change strategies, and use of reflection. Furthermore, students’ attitudes towards clinical reasoning focused on clients’ behaviour change should be reinforced by an encouraging learning environment.
Implications for education and profession

The R4C instrument, developed in this thesis, contributes to fill an important gap in physiotherapy research, practice and education. The instrument can serve as a tool to investigate students’ clinical reasoning and evaluate education. With further testing, the instrument may support competence development for practitioners, and with modifications, the instrument may also have relevance for other health professionals. Investigations using the R4C instrument could provide valuable feedback for professional representatives and educators and could help inform learning activities and curriculum development.

Furthermore, this thesis contributes by highlighting the role of entry-level education for students’ clinical reasoning competence. Based on the findings, physiotherapy education is uniquely positioned to advance physiotherapists’ clinical reasoning towards a biopsychosocial approach with a focus on behaviours in daily life activities, participation and behaviour change. To support such competence improvement, theoretical and skill-based elements in a holistic and behavioural medicine approach in entry-level education curricula appear essential. Additionally, the findings may guide educators to increase the focus on the levels of analysis and intervention in the teaching of clinical reasoning, support students’ analytical and metacognitive skills and encourage positive attitudes towards behavioural considerations in clinical reasoning. Physiotherapy students, soon entering the profession, with competence in clinical reasoning focused on clients’ behaviour change will ultimately contribute to improved health and well-being in clients.

The findings of this thesis may support the development of prioritised interprofessional competencies in health behaviour assessment and behaviour change interventions. As a key healthcare profession, physiotherapists with such competence may play an important role in addressing unhealthy lifestyle behaviours and improve health outcomes in individuals and populations by ensuring a biopsychosocial perspective, client participation and the incorporation of evidence-based behaviour change strategies in their clinical reasoning.
Future research

Based on the results of this thesis, further research is warranted. One main direction is the further validation of the R4C instrument, for instance correlation with tests measuring similar constructs in a real-life context and tests of inter-case reliability, i.e., correlations among the instrument cases to detect a sufficient number of cases. Furthermore, to extend its use, validity evidence is needed in various contexts and populations, specifically physiotherapy practitioners.

Another main direction is to further deepen our understanding of students’ clinical reasoning. Studies are needed to investigate how other specific educational factors, such as the extent of practical experiences in clinical reasoning focused on behaviour change, are associated with students’ clinical reasoning outcomes. Educational interventions aimed at improving the students’ clinical reasoning at the levels of functional behavioural analysis and strategies for behaviour change are warranted, as are investigations of students’ development of clinical reasoning competence after some years of clinical experience.

A final main direction is the exploration of the client’s perspective of the clinical reasoning process, which was not emphasised in this thesis. Key in clinical reasoning focused on clients’ behaviour change is the shared process between the physiotherapist and the client. Therefore, clients’ perceptions and understanding of the process and their role in the process are important and need to be further studied.
Tackord/Acknowledgements

Att bedriva forskarstudier och skriva en doktorsavhandling har varit en utmanande och fantastisk resa som krävt såväl hårt arbete som mod men också reflektion och återhämtnings. Denna avhandling hade inte varit möjlig utan stöd och hjälp från människor runt omkring mig. Jag vill rikta ett varmt tack till alla som på olika sätt bidragit i detta arbete. Ett speciellt tack vill jag rikta till:


Supervisor Elizabeth Dean, for your inspiring and unwavering support. Thank you for encouraging me to view my project in a broader global perspective and for sharing your expertise in research and in the art of scientific writing. Your firm yet encouraging questions have spurred me to think, re-think and work hard to achieve my goals. I am especially grateful for your generosity and for taking care about me during my stay in Vancouver.

Olle Hällman, för att du med din imponerande problemlösningsförmåga hjälpte mig med programmeringen av R4C och att du också blev medförfattare i en av artiklarna. Tack för support dygnet runt!

Rikard Lindell, för att du så engagerat och generöst bidragit med din kompetens i interaktionsdesign i utvecklandet av webbapplikationen.

Håkan Sandberg, för att du så varmhjärtat delat med dig av din kompetens inom lärande och pedagogik. Tack för många värdefulla diskussioner.

Eva Denison, för att du med din klokskap och genuina engagemang har bidragit till mitt stora intresse för utbildning och forskning. Jag är djupt tacksam för att du alltid stöttat mig och tagit dig tid till att diskutera utmaningar i mitt forskningsprojekt.

Alla kollegor och fysioterapeuter som på olika sätt bidragit med idéer och synpunkter i utvecklingen av R4C. Speciellt tack till Kristina Holmberg, Sofia
Ask, Karin Syk Zackrisson och Anna Karin Andersson för er hjälp med att konstruera patientfallen i instrumentet.

Alla studenter och fysioterapeuter som deltagit i studierna. Utan ert engagemang hade denna avhandling inte varit möjlig att genomföra!

Högskolegruppen, programansvariga vid fysioterapeutprogrammen samt alla lärare och studenter som hjälppt till i samband med datainsamlingen.

Mälardalens högskola, Akademin för hälsa, vård och välfärd, för möjligheten att genomföra min forskarutbildning. Tack även till Stiftelsen Sigurd och Elsa Goljes Minne för finansiellt stöd.


Alla härliga doktorandkollegor, för all vänskap, kreativa diskussioner och djupa reflektioner. Speciellt tack till Anna Karin Andersson, Caroline Eklund och Johanna Fritz, för alla ovärderliga stunder med skratt och samtal om forskning och livet i stort.

Christina Heling Opava, min mentor under senare delen av forskarutbildningen. Genom kloka frågor har du hjälppt mig att reflektera och utvecklas.

The Centre for Health Education Scholarship at the University of British Columbia, Vancouver, for hosting me as a visiting scholar. A special thanks to Glenn Regehr, for arranging my visit. I am so grateful for all stimulating meetings, which provided me with such inspiration and new insights about my research. I hope our paths cross again. Also, thanks to the Department of Physical Therapy for interesting discussions about physical therapy education.

Joliana Phillips, Pernilla Åsenlöf, Annika Bring and Petra von Heideken Wågert, för our collaboration in the translation of R4C to English.

Niklas Dahlberg, för att du fångade essensen i min avhandling och gjorde en så vacker illustration till omslaget. Tack även till Tommy Olsson, för din hjälp med att skapa bilden för CRBC-PT modellen i första artikeln.

Mina fantastiska föräldrar, svärföräldrar, bror och svåger med familjer och alla fina vänner, för att ni följt mig längs denna resa. Tack för att ni stöttat, hejat på och delat min glädje i stunder av framgång. Det har varit ovärderligt!

Min älskade man och bästa vän, Andreas, för att du gett mig möjligheten att grotta ner mig i mitt arbete när det behövts, för all uppmuntran och för att du alltid uppmärksamar de små stunderna i vardagen. Mest av allt är jag så tacksam för all den kärlek du ger mig och allt roligt vi gör tillsammans!

Mina fantastiska barn, Vilgot och Nellie, för att ni alltid påminner mig om vad som är viktigt i livet. Tack för allt ansvar ni tagit hemma och att ni nyfiket frågat vad jag håller på med. Men framförallt, tack för all den glädje och djupa-aste lycka jag får uppleva genom er. Älskar er så!
References


*Medicine, 14*(3), 150-156. doi:10.1207/S15328015TLM1403_3

79


90
Overmeer, T., Boersma, K., Main, C. J., & Linton, S. J. (2009). Do physical therapists change their beliefs, attitudes, knowledge,


Administrative Pharmacy, 10(2), 469-474.
doi:10.1016/j.sapharm.2013.06.007


Promotion International, 26(2), 148-162.
doi:10.1093/heapro/daq050


http://www.who.int/social_determinants/publications/9789241500852/en/


99


Appendix
The web application of the Reasoning 4 Change instrument: accessibility and examples of screenshots

Accessibility and use of the R4C instrument
The R4C instrument, developed and evaluated in this thesis, is the original Swedish version, which exists in a paper-based version and a web application. Both versions are possible to use upon request from the owner of the instrument, Maria Elvén. The paper-based version is free of charge and the web application is associated with a cost. Development of an English version of the R4C instrument is on-going. For more information, please contact Maria Elvén, maria.elven@mdh.se

Examples of screenshots from the R4C instrument in Swedish

**Screenshot 1. Information about important concepts**

**Screenshot 2. Domain 1, Psychological factors, self-efficacy**
Del 2: understödning av klientens besvär

Del 2 innehåller fallbeskrivningar. Varje fallbeskrivning börjar med en beskrivning av klienten och hans/hennes besvär och situation. Läs noggrant igenom beskrivningarna och besvara de efterföljande frågorna.

Del 2, fråga 1: Fallbeskrivning Joseph, 48 år


Välj tre av de understudena faktorerna i fallbeskrivningen.

Faktor 1

Faktor 2

Faktor 3

1. Smärtan började smärtande
2. Vitvåg i ländergyn
3. Rörelsebegränsning smärta på vänster sida av ryggen
4. Utblandande smärta med baksida av vänster lär
5. Värk ofta på natten p.g.a. värk
6. Att ändra sovstånd lindrar väkt
7. Tidigare diskord R LS höger
8. Styrsjukdom i månader
9. Värsta smärta försvann
10. Joseph handlar på om det är ett nytt diskord
11. Arbetar heltid i en kundtjänstbyrå
12. Att även är svälö
13. Han äter också mycket med promenaderna

Del 3, fråga 2 (Albin)


Märk den stift som stämmer bäst in på din uppfattning.

1. Hypotesen försvagats mycket
2. Hypotesen försvagats något
3. Hypotesen varken försvagats eller förstärkts
4. Hypotesen förstärkts något
5. Hypotesen förstärkts mycket

Förrättsbesömmning som förklarar orsaken till individens svårighet att utföra sitt målbeteende: Albin säger ofta att han inte har tid för att klippa hårna och han har inte tid för att klippa hårna och han har inte tid för att klippa hårna.

Markera hur du menar att hypotesenförstärkts eller försvagats:

Förrättsbesömmning

-2 -1 0 +1 +2

Hypotesenförstärkts mycket

Markera hur du menar att hypotesenförstärkts eller försvagats:

Förrättsbesömmning

-2 -1 0 +1 +2

Hypotesenförstärkts mycket

... och om du får ny information om att ...

... Albin säger ofta att han inte har tid för att klippa hårna och han har inte tid för att klippa hårna.

... men att den hypotesenförstärkts eller försvagats?

... och om du får ny information om att ...

... Albin har ätit tomac i höftbaddkvarna, knäbaddkvarna och planerättskvarna.

... men att den hypotesenförstärkts eller försvagats?

... men att den hypotesenförstärkts eller försvagats?

... men att den hypotesenförstärkts eller försvagats?
Del 4, fråga 1: Anders, 23 år

Fallbeskrivning Anders, 23 år

Anders målbeteende: Kunna hjälpa sin 3-åriga dotter med av- och påklädnings

Hypotes/bedömning:
Anders har svårt med att hjälpa sin dotter med av- och påklädnings på grund av en högersidig främre
axelflexibilisering för 13 dagar sedan. Anders är högerhänt. Axelflexibiliseringen och efterföljande immobilisering
av armen i en syrnga under 7 dagar har orsakat rörremsmärta, nedåtgående fäste och muskelstyrka i axelviken
medfin svårigheter att stabilisera axeluden. Dessa symptom har lett till att Anders uppvisar oblydig och råda
för att axel ska hoppa ur livet igen. Anders har i dagsläget tagit till sig förmoda att klara av att hjälpa dottern
med av- och påklädnings. Det är extra svårt att klara aktiviteten på morgonen då dottern ofta är trött och
motstår sig påklädningsen. Oblydgivet i axelviken ledde till att han underteckat att ta i med armen och att han ofta inte
slutför de övningar han påbörjat.

1. Analsera att Anders svårighet att utföra allt målbeteende just nu huvudsaklig beror på fysisk/biomedicaliska, psykologiska eller omgivningsfaktorer (fysiska och/eller sociala)? Ange i procent hur du värderar betydelsen av dessa faktorer genom att markerar på linjen (summan ska bli 100%)

Ex: Fysiska/biomedicaliska faktorer 30%, psykologiska faktorer 10% och omgivningsfaktorer 60%.

<table>
<thead>
<tr>
<th>Faktor</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fysiska/biomedicaliska faktorer</td>
<td>30%</td>
</tr>
<tr>
<td>Psykologiska faktorer</td>
<td>10%</td>
</tr>
<tr>
<td>Fysiska och/eller sociala omgivningsfaktorer</td>
<td>60%</td>
</tr>
</tbody>
</table>

---

Screenshot 6. Domain 4, Strategies for behaviour change, item 5. Extract from a long list of interventions