UNIVERSIDADE CATÓLICA PORTUGUESA

MOVING PHYSIOTHERAPY FROM EVIDENCE BASED PRACTICE TOWARDS EVIDENCE INFORMED PRACTICE

Tese apresentada à Universidade Católica Portuguesa para obtenção do

grau de Doutor em Ciências da Saúde

por

Paul Christiaan Beenen

Instituto de Ciências da Saúde

Maio, 2016

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Preface

In the last twenty years I have been searching for dialogue and traction for the ideas described in this thesis. And as my friend and colleague Martin told me; 'this is what you have been doing since ever'. During this study I realized how little we still understand of our own practice, despite the enormous amount of experiences and research. It gave me the validation, the tools and the energy to keep going in this project. I strongly believe in the necessity and possibility to change how we organize health and knowledge in this world.

This project was unthinkable without the generous support of the people who I have met over the years throughout Europe. To get teams working in 10 countries made be proud and shows that an international community of physiotherapy is alive and kicking. Networks like ENPHE and COHEHRE made this possible.

I would like to thank Prof. Dr. Alexandre Castro Caldas for the tutoring and believing in the project.

The Hanze gave me the conditions to really focus on the job the last year. The conversations and help of prof. dr. Hugo Veldhuijsen en prof. dr. Johan de Jong where inspiring and helpful.

This project wouldn't have been started with the support of my friends Martin, Bas and Harald.

My great gratitude goes to Patricia. She kept me in healthy proportions of insanity when I was totally lost in translation and lost in numbers in the last intensive period. Tough years we had together, both doing PhD's, building a house, the kids, moving between countries and culture. Keeping up with me, having your own great drive, always is a bumpy road.… love you more! Thanks Julia and Margarida for being so patient and being the best girls we could possibly have.

I owe you!

Abbreviations

CAEB: Connotative Aspect of Epistemological Beliefs

CEDEFOP: European Centre for the Development of Vocational Training

COHEHRE: Consortium of institute of Higher Education in Health and Rehabilitation in Europe.

DEBQ: Domain specific Epistemological Beliefs Questionnaire

EBP: Evidence Based Practice

EB: Epistemic or Epistemological Beliefs

ENPHE: European Network of Physiotherapy for Higher Education

WCPT: World Confederation of Physical Therapy

WHO: World Health Organisation

Abstract

The context in which health professionals' function is rapidly changing and demands proactive change. Health care is not adequately reforming towards a structure, which orientates to the health questions of an ageing population and the exploding prevalence of non-communicable diseases. The demand of the society to show more efficiency in the work done is failing, as innovations don't get incorporated into practice and expenses for both research and practice keep rising. All these developments are set in the context of the knowledge society with its ability to collect and share more knowledge, more globally. This dissertation focuses in this context on the failure of the community of physiotherapy to manage the knowledge innovation and knowledge circulation in its theory and practice. The aim is to rethink the framework in which we manage knowledge in the profession, the evidence based practice movement, and define factors that can positively influence the impasse.
An alternative framework, called Evidence Informed Practice, is formulated, to improve the knowledge management.

Based on this new framework three studies were performed. The first one is a critical analysis of review methodology, representing one of the main EBP-tools used at the moment. In this analysis alternative and complementary directions for both the theory and practice of review methodology are formulated. The second and third study explores epistemic beliefs as one of the factors relevant for developing the evidence informed practice of the physiotherapist. This is done in a European perspective. The second study is the development of a survey by cross-cultural adapting two questionnaires measuring the epistemic beliefs of physiotherapist and one questionnaire to measure the attitude towards EBP. This is done in 10 different countries in Europe. The third study performs this survey in these countries. The results show that physiotherapists in Europe are similar in a moderate positive attitude towards EBP and that they have moderate epistemic beliefs.

The conclusion of this dissertation is that the framework of evidence based practice and, consequently, its tools needs to be reformulated in order to solve the apparent knowledge management problem. The study offers an alternative framework and emphasize the

‘understanding of practice’ and, more specifically within this broad concept, epistemic beliefs as a determinant for innovation within physiotherapy.

Introduction

Thirty years ago physiotherapy could be characterized as profession functioning as an extended arm of the physician, getting their knowledge predominantly from biomedical sciences and from copying authorities in the field. This has been changed quickly in the last decennia. The profession is working more autonomous, is in the majority of the western countries direct accessible, formulates its own diagnosis based on a multidimensional (biopsychosocial) health perspective, strives for integral or tuned health care with other disciplines and strives for quality and accountability (WCPT, 2007).
One of the main drivers of this professionalization is the emphasize on science and evidence based practice. Research and a broad eclectic knowledge base, derived from a wide range of relevant research areas, accumulates in a body of knowledge of physiotherapy that grows exponentially (van der Wees et al., 2008; Moseley, Herbert, Sherrington & Maher, 2002). To illustrate this, in one of the main research areas physiotherapy draws on; "It is estimated that the doubling time of medical knowledge in 1950 was 50 years; in 1980, 7 years; and in 2010, 3.5 years. In 2020 it is projected to be 0.2 years—just 73 days" (Densen, 2011). This exponential knowledge grow is entwined and strongly facilitated by an increasing globalization. This technology driven process offers databases and communication networks enabling to create and share more and more knowledge. However this process has been so successful that the individual practitioner is overwhelmed and doesn't know how to get to this information and how to select and judge what is relevant. New knowledge doesn't reach practice and innovation is staggered.

The profession invest a lot to develop instruments in order to keep knowledge accessible in developing evidence based practice tools which aims to decrease the perceived 'knowledge-to-action-gap. It also aims to facilitate high-level evidence and implementation research. All this efforts seem to have little result. The research creates knowledge, which is expensive and time consuming but is perceived to be not relevant enough for practice (Parry, 1997; Petty, Thomson & Stew, 2012A, 2012B). The answer to the question; how long does it take before original research is implemented?, is answered with '17 years' (Morris, Wooding & Grant, 2011). This comes together with the notion that the turn-over time of knowledge get shorter and shorter (Arbesman, 2013). The

translation of knowledge into practice fails on all fronts and interventions turn out to be little effective (Grimshaw et al., 2012). In physiotherapy both processes are well illustrated in the investment of developing guidelines with 'high level' evidence, the little 'adherence' of practice and the increasing investment of research orientating on how to get the guidelines implemented (Van Der Wees et al., 2007; Wilfred et al., 2013).

In medicine it has been already suggested that the evidence based practice movement is in a crisis and that it is time for a renaissance (Greenhalgh, Howick and Maskrey, 2014).
This research is built on the assumption that this crisis is equivalent in physiotherapy. The profession is failing to manage the knowledge innovation and knowledge circulation in physiotherapy and the strategies employed to resolve this are largely insufficient, with the consequence of omitting patients the best possible care (Grol & Grimshaw, 2003). It also creates an ineffective and expensive EBP movement unable to notice and deliver innovative solutions for the contemporary 'wicked' health problems (Matheson et al., 2013; Dean et al., 2014). Besides that the problems are not recognized enough, the EBP movement also fails to exploit innovative possibilities, for example from big data and personal digital health. The central problem of this dissertation is therefor:

Physiotherapy is failing to manage the knowledge innovation and knowledge circulation in its theory and practice.

The goal of this research is to rethink the evidence based practice movement drastically. To start a renaissance we need to acknowledge that the premises on which evidence based practice is built throughout the last decennia are seriously flawed. This acknowledgment starts fundamentally with the perception of knowledge and how we can get to this knowledge. This view is in the EBP movement largely built on the belief that knowledge is objective and context free and should therefore be (statistically) generalizable (Marks, 2002). The evidence pyramid, the existence of a knowledge-to-action gap, the research methods, the knowledge synthesis and the accompanying research industry are all largely built on these premises. Financial, organizational and quality structures in health care have been developed in accordance.

These premises has been wildly contested from different perspectives; scholars, researchers, practitioners and management from all kinds of professions, but with little effect (Matheson et al., 2013). As far back as in 1999, Main already noted that; "the incorporation of evidence into practice would prove "disappointingly small" until its advocates have a better understanding of clinical realities" (Main, 1999). This research collects some of these different perspectives and formulates an alternative framework for Evidence Based Practice called Evidence Informed Practice. This is done in the theoretical framework in chapter 1.

In chapter 2 the research questions are formulated. The main purpose of this study is to start validating the framework of Evidence Informed Practice. In order to do so two central elements are researched with a different focus. The first focus is on the consequences of the framework for the current EBP movement, using the illustrative case of review methodology. The second focus is on the understanding and justification of knowledge of physiotherapists as part of the 'understanding of practice'; an assumed important determinant in the incorporation of Evidence informed Practice.

Under the assumptions of Evidence Informed Practice, many evidence based practice tools need to be reconsidered. One illustrative example is the way the evidence based practice movement select and judge what knowledge is relevant and of enough quality for practice (knowledge synthesis). The first study presented in chapter 3 offers a critical review of review methodology in physiotherapy practice and offers key steps and recommendations towards the implementation of evidence informed practice.

One of the main pillars of Evidence Informed Practice is the understanding of the nature and justification of human knowledge, also called epistemological beliefs (Hofer, 2001, 2008). This is an elementary part of the understanding of practice of the physiotherapist and is closely related to other elements of the understanding of practice. Our identity, the identity of the profession, our theory development and the concrete behavior in practice are other elements (Trede, Macklin & Bridges, 2012). Since we are an international community dealing equally with the presented complex problems we need to increase our understanding of practice together, not to strive for uniformity but more to recognize and learn from the diversity available in so many different cultural practices. In the second

study of chapter 3 a report is presented from a multi-country cross-cultural adaption study for three questionnaires. Two complementary instruments are adapted for measuring the epistemological beliefs. One instrument is adapted to confirm the assumption that, internationally, physiotherapists have a positive attitude towards EBP and to find out if physiotherapists have the accompanying knowledge and skills.

In the third study of chapter 3, the instruments will be used to explore how sophisticated the epistemological beliefs of physiotherapists are in the community of physiotherapists in Europe. In order to see how uniform and differentiated these beliefs are in the international community, the results will be compared between the different countries and in between the respondents from their clinical experience, their education, their gender and their professional role (student, educator, practitioner).

Inchapter 4; the final discussion and conclusions, considerations are given for further development of the framework of Evidence Informed Practice and the simultaneous incorporation in physiotherapy practice. Also the obvious significance for other professions is briefly discussed.

In the next paragraph the research approach is described.

Research approach

Research is done to generate knowledge in a specific context and with specific beliefs, values en technics from individuals and the community (Kuhn, 1970). Guba described, following Kuhn, a paradigm as “a basic set of beliefs that guides action” (Guba, 1990). A research paradigm consists of three congruent elements of what can be known (ontology), ways of knowing (epistemology), and techniques used to generate knowledge (methods). Following this, a researcher needs to state his research paradigm and his theoretical framework. This chapter discusses the research approach followed by the theoretical framework in the next chapter.

Typically there are three major research paradigms. Before positioning this research, a brief overview is given. The empirical analytical perspective searches for knowledge to be independent of time, place and people's values and culture. Empirical analytical research is based on the (ontological) view that everything is natural and therefore belongs to the world of nature (objective physical reality), which can be studied by objective methods. This is known as positivism or positive realism. The researcher's task is to make accurate observations about objective reality, ensuring to isolate variables in order to eliminate error and bias to be able to identify cause-effect relationships (Marks, 2002).
The second, the interpretive paradigm focuses on interpretations of phenomena, human interactions, their meanings and subjectivities that are brought to the interpretation (Holloway & Wheeler, 1996). Trede (2006) describes this as followed*:*

> "In the interpretive paradigm, knowledge is generated by studying phenomena in context and as they are perceived by the actors. Its ontology assumes that reality is socially constructed; the world is available to people only through their construction of it (McIntyre, 1998). Social constructionists believe that foundations and knowledge are value-laden, and, contra positive realism, that the distinction between objective and subjective knowledge is unclear. All knowledge is mediated by interpretations (Morrow & Brown, 1994) and knowledge is also created through interpretation" (Trede, 2007, p.7).

The extreme ontological viewpoint is that reality can be only subjective which gives a relativist perspective; there is no real world outside our thoughts we can know. A less extreme point is that of critical realism. This form of realism accepts an external world but asserts that meanings, interpretations, social and political relations must have an influence.
The third paradigm is the critical paradigm. This paradigm shares the critical realism view but is skeptical towards knowledge being generated by just interpreting meaning. Trede, (2007):

> "Such researchers seek also to reform the phenomenon under study by making the ideology of the status quo transparent (Altenbernd & Johnson, 2000; Silverman, 1991). At the core of this paradigm is transformation and change (Habermas,

1981/1984). The assumption in critical epistemology is that knowledge is generated through critique and critical self-reflection" (Trede, 2007, p.8).

The empirical analytical perspective remains the dominant paradigm in health care. This is visible in the high value given to empirical evidence as shown in the evidence hierarchy in research and the evidence based practice movement. The recommended method in the movement is the Randomized Controlled Trial. However the positive realism perspective is widely accepted not to be sufficient, as the outside world cannot be known to be objective and true in an absolute sense. (Van der Ven & Johnson, 2006). In order to understanding health care as a complex, dynamic and social phenomena Pettigrew states that; *"the only sensible way forward can be conscious pluralism*" (Pettigrew, 2001). This takes distance from the positive realism perspective, embracing a critical realist perspective with the possibility to use various research methods and in a mixed way. For health care this means a better balance between the three paradigms; interpretive and critical paradigms, largely associated with qualitative evidence, and the empirical analytical paradigm more associated with quantitative evidence. Van der Ven & Johnson (2006) state that; "*research knowledge advances through a comparison of the relative contributions and perspectives provided by different models. A pluralist approach of comparing multiple plausible models of reality is therefore essential for developing objective* (researcher: or robust) *scientific knowledge"* (Van der Ven & Johnson, 2008). A researcher must therefore be critically reflexive, stating clearly whose point of view and interests are served in a model proposed to represent reality (Van Maanen, 1995). A researcher puts in this perspective his research question central in a certain context, instead of a research paradigm, offering him the choice between what would be the best fitting (mixed) methods (Asberg, 2011). This study is based on this pluralistic critical realist perspective[1].

A host of strategies and methods acknowledge the need to triangulate between different perspectives in both practice and research. One of them is the concept of arbitrage. Van der Ven and Johnson (2006) define this as followed; " arbitrage represents a dialectical method of inquiry where understanding and synthesis of a common problem evolve from

[1] The vocabulary on this issue differs. In some literature these epistemological assumptions are differently named with similar meaning for example; realist, contextualist and relativist. In sources discussing epistemological beliefs; dualist, multiplist and relativist is used (Schraw, 2013). In this thesis we follow the wording used here, unless epistemological beliefs are specifically discussed.

the confrontation of divergent theses and antitheses". They continue; "By exploiting multiple perspectives, the robust features of reality become salient and can be distinguished from those features that are merely a function of one particular view or model". In the development of a new framework this method is followed.

The challenge for researchers is to consider explicitly how generated knowledge is embedded (applied) in practice and what the generalizability or transferability of the generated knowledge to other contexts is. This means roughly the challenge for empirical-analytical methods to work more within the real context that is studied, and a constantly reflecting of the researchers, preferably together with practitioners, on the inherent tradeoff between methodological rigidity (control) and clinical relevance. All methods need to consider how they their newly created knowledge could fit in other models and situations.

Chapter 1 - Theoretical background and theoretical research framework

This part of chapter 1 draws a theoretical background about knowledge and knowledge management in health care. Parallel and derived from the theory several assumptions will be formulated accumulating to the theoretical framework of this research.

The classical question how to understand the relation between knowledge and action is in this age of information and increasing complexity more actual then ever. This seems to be especially true for health care, worldwide under siege for being outdated and unable to deliver adequate services (Matheson et al., 2013). The last 20 years the health care sector, like other sectors, has seen an enormous grow in information and knowledge[2] and an increasing demand to value and use this knowledge critically. In reaction to these developments a host of different concepts and knowledge industries are developed which all resort under the term 'knowledge management': "The systematic process of identifying, capturing and transforming information and knowledge people can use to create, compete and improve" (Nicolini, Powell, Conville & Martinez-Solano, 2008). Initiatives, and thus literature of knowledge management, are highly segmented in different disciplinary lines like information science, business and management and medical and allied health sciences (Nicolini et al., 2008). The first part of this chapter draws a general overview of the description of knowledge and epistemology and the central challenges in knowledge management within the literature. This literature comes predominantly from the areas of management, health care, (cognitive) psychology and education. The second part describes the struggle with knowledge for the health care sector in particular.

[2] This thesis distinguish in accordance with Tsoukas and Vladimiros between data; "an ordered sequence of given items or events", information; "a context-based arrangement of items whereby relations between them are shown" and knowledge "the judgment of the significance of events and items, which comes from a particular context and/or theory" (Tsoukas and Vladimiros 2001).

1.1 Knowledge and epistemology.

Knowledge can be defined as 'the capacity to exercise judgement' (Greenhalgh, 2010). Individuals exercise this judgment autonomous but within their domain of action. This domain of action is dynamically formed though a continuous socialization of a mixture of social-cultural, professional and organizational aspects, conditioning but also offering the ability to the individual to recognize and value aspects of the local context (Tsoukas & Vladimiros, 2001). Tsoukas and Vladimiros take the work of Michael Polanyi (who argued that all knowledge is personal) and Ludwig Wittgenstein (who argued that all knowledge is collective) and argue that each of these positions complements and extends the other ((Tsoukas & Vladimiros, 2001). Knowledge can then be described as; 'the inseparable contribution of individually embodied and socially shared meaning-systems within a ' domain of action'. In this interpretation knowledge is rich in shared cultural assumptions, unwritten rules, and taken-for-granted cognitive maps. (Tsoukas & Vladimiros, 2001). In this dissertation it is called 'embodied knowledge' to distinguish it from the general idea within health care viewing knowledge as a context free object. As Greenhalgh summarizes, an extensive body of research describe similar domain of actions. Bourdieu calls it 'field', Stones and Giddens are calling it "external social structures" and Scott calls it the "normative and cultural-cognitive pillars" of institutional life (Greenhalgh, 2010).

Literature from studies more orientated to the practical dynamic process of how individuals get to know in these 'domain of actions' use different parallel terms like "structuration" (Stones, 2005), "collective sensemaking" (Weick, 1995), "communities of practice" (Lave & Wenger, 1988), Landscapes of practice (Wenger-Trayner, Fenton-O'Creevy, Hutchinson, Kubiak & Wenger-Trayner, 2015) and "mindlines" (Gabbay & le May, 2010).

Theoretical framework: Assumption 1

Knowledge is embodied knowledge; being the inseparable contribution of individually embodied and socially shared meaning-systems within a ' domain of action'.

The awareness of knowledge being socially and culturally embodied offers within an opening, globalizing world a rich opportunity of learning but at the same time a challenge as the diversity is endless (Mansour & Wegerif, 2013).

1.1.1 Epistemology, a cognitive psychology perspective

The understanding of knowledge is the territory of epistemology, which can be defined as the nature and justification of human knowledge (Hofer, 2001). This area has its roots in cognitive psychology. How individuals view knowledge and knowing is studied in the field of personal epistemology. This research area focuses on what individuals believe in what counts as knowledge, where it resides, how individuals come to know, and how knowledge is constructed and evaluated (Hofer & Pintrich, 1997). This influence how an individual resolves competing knowledge claims, evaluates new information and takes decisions (King & Kitchener, 1994; Roex, Clarebout, Dory & Degryse, 2009).

Many models used in epistemological research share the assumption of stages from a naive view of knowledge towards more sophisticated views. This naive view starts with the idea that knowledge is certain, unambiguous, and dichotomous. Knowledge is either true or not true and is learned from an authority. This objectivist view is challenged when someone is recognizing shades of grey and different authorities, meaning different perspectives of trues. Knowledge is then viewed as highly subjective; a multiplistic stance.

This subjectivity is in its turn challenged by the notion that some points of view are better than others and that evidence plays a role in supporting one's position. In the final stage people have a critical stand towards knowledge and knowing is coordinated with justification of knowledge (Hofer, 2001). This stand is equivalent to the critical realist perspective described in the research approach. A host of research show that more sophisticated epistemic beliefs are related with an acceptance of uncertainty and changeability of truth and the notion that knowledge is more construed in stead of 'given'. The earlier description of knowledge being the inseparable contribution of individually embodied and socially shared meaning-systems within a ' domain of action' is an epistemology that fits this constructed and dynamic interpretation of knowledge. (Bromme, Pieschl & Stahl, 2010; Mason & Boscolo, 2004; Qian & Alvermann, 1995;

Kardash & Howell, 2000; Hofer & Pintrich,1997; Bråten & Strømsø, 2005; Cano, 2005; Cano & Cardelle-Elawar, 2008; Dahl, Bals & Turi, 2005; Neber & Schommer-Aikins, 2002; Paulsen & Feldman 1999; Urhahne & Hopf, 2004).

Theoretical framework: Assumption 2

Sophisticated epistemological beliefs are a prerequisite to understand knowledge as embodied knowledge.

The conceptual background of epistemological beliefs will be discussed in more detail in the second and third study in chapter 3 of this dissertation, studying the epistemological beliefs in physiotherapists.

1.1.2 Epistemological challenges in professional practice

In contrast to the concept of embodied knowledge, there is a dominant tendency in professional practice and research to separate between knowledge and knower and, in the same process, to decontextualize and 'objectify' this knowledge (Tanenbaum, 1993).
This has given way to many concepts and theories establishing a language between two seemingly incompatible views of knowledge. One view holding knowledge as value-free quotas of information and the other as a strongly politicalized, subjective, vague and negotiated product.

In the literature the complexity of the concept of knowledge stimulated the development of a variety of axes to explain different, seemingly opposing aspects like individual-collective, explicit-tacit, generic-specific and the value free-value laden nature of knowledge. These perspectives are often providing space for nuances and bridging, but can equally be used to polarize and validate the created dualism. So is explicit knowledge often connected and 'owned' by prodigies of 'hard' objective knowledge, say the scientist, and tacit 'soft' knowledge more to the local health professional. Because we are all part of this language this seem at a first glance logical but doesn't make sense in its essence as both parties are equally subject to both explicit and more tacit knowledge. Another example is that sources and types of knowledge can be described as distal and proximal knowledge (Clarke & Wilcockson, 2002). Distal knowledge (knowledge *for* practice) is

more prescriptive, codified knowledge often derived from outside the clinical setting in the form of research based knowledge. Proximal knowledge (knowledge *from* the practice) is the knowledge from the local context and involves the more tacit understanding, insight, and judgment used for practical action (Leblond, 2013). Health care seem to have the tendency to favor more proximal knowledge while knowledge management often seem to favor more distal knowledge (Nicolli, 2008; Clarke & Wilcockson, 2002). The circulation of knowledge between health care professionals happens mainly in the local context of a team or practice (Gabbey & Le May, 2010) arguing for the importance of social and physical proximity in knowledge exchange (Tagliaventi & Mattarelli, 2006).

The artificial separation of knowledge and knower has the great benefit of the existence of an objective held body of knowledge. From a practical point of view this is convenient and functional, as we can collect, share and create (manage) vast amounts of knowledge on a platform. However this separation also creates different challenges. One of the challenges is the existence of this external knowledge platform as a life of its own with institutions and positions separate from practice. Consequently, this platform can position itself independently, often resulting in creating more distance from the often-perceived 'muddy', soft and intrinsically subjective reality. Another challenge is that an external knowledge platform creates packages of high valued 'objective' knowledge, pressuring the professional to incorporate this in his daily practice. This platform really exists in the form of databases and implementation researchers. But the often used clean image of the 'pipeline of knowledge' in which knowledge flows from this platform to practice is seriously obstructed. This created the knowledge-to-action-gap and along with it the necessity to decrease this gap, which turns out to be costly and ineffective (Grol & Grimshaw, 2003; Greenhalgh & Wieringa, 2011; Grimshaw et al., 2012).

In the intention to develop a practical model to find an answer on how individuals and organizations relate theory and practice for addressing complex problems in the world, Van de Ven and Johnson described three different ways to conceptualize this relationship (Van De Ven & Johnson, 2006). They assert two basic conceptualizations in how people relate theory to practice; by truth claim (ontology) and method (epistemology). '*The first begins with knowledge and considers how it is transferred into practice. The second, drawing on Aristotle's notions of episteme, techne, and praxis, views theory and practice*

as different kinds of knowledge and considers that the former (which is oriented to building context-free generalizations) cannot be translated into the latter (which is situated, contextualized, and oriented to addressing here- and-now problems)' (Greenhalgh & Wieringa, 2011). The assumption under both conceptualizations are presumed to be false and this is where the debate often stops (Ellett, 2012). Instead of the reflex to focus on the differences and oppose to one of these conceptions, Van der Ven and Johnson looked for complementarity between these views. In doing so they derive to a more sophisticated third conceptualization; 'engaged scholarship', in which researchers and practitioners coproduce knowledge that can advance theory and practice in a given domain. They define 'engaged scholarship' as: *'a collaborative form of inquiry in which academics and practitioners leverage their different perspectives and competencies to coproduce knowledge about a complex problem or phenomenon that exists under conditions of uncertainty found in the world'.* Engaged scholarship works is based in a (evolutionary) realist epistemology, which is a pluralistic methodology for advancing knowledge by leveraging the relative contributions and conceptual frameworks of researchers and practitioners (Van Der Ven & Johnson, 2006).

Central in this research is the assumption that defining knowledge separately from the knower is creating a knowledge-to-action gap which based on the given description of embodied knowledge does not hold water and shows major negative consequences for both the quality and efficacy of health care. However the 'gap' is illustrated, widened and often validated by several societal developments, (the building of) theories and the organization within health care, the remainder of this background will give a brief overview of these processes.

Theoretical framework: Assumption 3

Engaged scholarship is consistent with embodied knowledge and offers in this perspective a practical concept to relate theory with practice.

1.1.3 The (super)complexity and uncertainty of the world

We live in an increasingly complex world that can be described by the acronym of VUCA: Volatility; the nature and dynamics of change, and the nature and speed of change forces

and change catalysts. Uncertainty; the lack of predictability; the prospects for surprise, and the sense of awareness and understanding of issues and events. Complexity; the multiplex of forces, the confounding of issues and the chaos and confusion that surround organizations. Ambiguity; the haziness of reality, the potential for misreads, and the mixed meanings of conditions (Johansen, 2009). This (world) view is widely accepted and converges with the development of complexity science and complexity theories representing different types of ideas and theories to address the nonlinearity and dynamics of the real world systems, often known as Complex Adaptive Systems (Sturmberg & Martin, 2013). This development goes together with the observed decline of the industrial world favoring a universal 'true' knowledge creating the foundation that facilitated growth, jobs, and social cohesion. The industrial world is scrutinized for being unsustainable and a contextual view on knowing is gaining strength (Tuomi, 2015). This is especially visible in business firms, working increasingly with a large variety of open, 'user-centric', collaborative, and co-creating models of knowledge production and innovation like design thinking and appreciative inquiry.

Health care is slowly moving from their original simplistic, "reductionist" scientific worldview to a complex and dynamic "holistic" scientific worldview (Sturmberg & Martin, 2013; Begun & Kaissi, 2004). This slowness can be related to the highly successful results of reductionist thinking in health care in the last 100 years. Ferie and Wood (2003), among others, have observed another possible reason, more related to interest and power. They noticed that with the separation of knowledge production and consumption the opportunity is given for subtle defense strategies for the basic academic disciplines by retaining control over knowledge creation and what counts as valid knowledge (Beer, 2001; Ferlie & Wood, 2003; Greenhalgh & Wieringa, 2011).

Stehr describes the world where knowledge is produced in and across society as the knowledge society (Stehr, 1994). Barnett (2000) concluded that we live in a supercomplex world in which knowledge is increasingly developed throughout all levels of an (international) society and in which the demands for validity and the criteria for validating knowledge claims are widening (Barnett, 2000). In 1996, UNESCO defined the four pillars of learning as 'learning to know', 'learning to do', 'learning to be', and 'learning to live together'. Tuomi (2015) formulates this as followed:

"In a heterogeneous world of knowing, these four pillars of learning need to be integrated in a new way. Learning to know requires a capability to understand how knowledge organises individual and social lives. Beyond the skills to access existing knowledge, we need an active capacity to create knowledge and make sense of the world. We could call this skill epistemic literacy. Epistemic literacy helps us to cope with heterogeneous and dynamic knowledge landscapes. *"It means that we understand how knowledge is created and what constitutes the social basis for learning and education"* (Tuomi, 2015).

Interesting is the reference of Tuomi (2015) to Sen, who pointed out that our capabilities are rooted in social, cultural, and bodily contexts that are not universal. Development is about the expansion of these personal and highly contextual capabilities (Tuomi, 2015). This is consistent with the description of embodied knowledge as being a close knit between knowledge and knower.

The highly prized universal knowledge gets competition of newer forms of action and engagement with and in the world, which Gibbons coined 'performative knowledge' (Gibbons et al., 1994). He describes two different kinds of epistemologies. Mode 1 knowledge, which is the classic propositional 'universal' knowledge normally available in peer reviewed journals. Mode 2 knowledge is, in contrast, created in the problem solving of daily work, or knowledge-in-use. The work situation is put central; knowledge is always created in, mostly temporary, interdisciplinary teams. Disciplines and individuals are seen as resources to the problem solving. It is an epistemology that moved from knowing to doing (performing).

This performative knowing leaves individuals or institutions seeking embodied knowledge by bringing along our being, our social, cultural and bodily rooted capacities, in the work context and such a knowing is a process of 'becoming to know' (Barnett, 2009). This is sharp contrast with the interpretation of T1 and T2 knowledge in much literature. Rather than acknowledging that Mode 2 research represents a fundamental shift in the way knowledge is produced it is often conceptualized in a linear research/implementation process (Nowotny, Scott & Gibbons, 2003). This can be illustrated for health care with an example of Pierson (2009), suggesting four 'translational' steps first from T1; clinical efficacy studies to T2;

"moving from efficacy to clinical effectiveness, including outcomes research, comparative effectiveness research, and health services research. Included in this second "T" is the development of evidence-based clinical practice guidelines for application of the knowledge gained in the first step to the care of individual patients" (Pierson, 2009; Dougherty & Conway, 2008). Continuing in these translational steps; "*T3 and T4 research extend translation from effectiveness to implementation and then to policy and broad public health implementation concerned with larger-scale public health impact"* (Kessler & Glasgow, 2011).

In practice there is still a tendency of polarization and overemphasis on either knowledge or performance, in parallel with the first two conceptualization of Van der Ven and Johnson. (Van der Ven & Johnson, 2006; Hodges, 2006)

Theoretical framework: Assumption 4

The increasing complexity and uncertainty in the world created the knowledge society, in which the concept of embodied knowledge is a 'condition sine qua non'.

Theoretical framework: Assumption 5

In order to manage knowledge in the knowledge society professionals need epistemic literacy.

1.1.4 Professional education

Education is traditionally the place where knowledge is situated. The development towards an open knowledge society challenged (higher) education, especially professional education, to redefine itself in the last 25 years (Barnett, 2009). This challenge is focused on the nature of knowledge and the short turn-over time of this knowledge base (temporalisation), pressing the ability of professionals to constantly renew their knowledge base (Pfadenhauer, 2006 cited in Scanlon, 2011). Another challenge is the loss of exclusive owing this knowledge base, what used to be one of the key defining attributes of professional practice. This comes with the loss of the position of power, trust and discretion (Eraut, 1994; Scuilli, 2005).

Education is on the way to make the shift from once-and-for-all qualification to a lifelong learning process and in that process moving from the traditional authoritive knowledge

transfer (preaching the truth) to a more contextualised, flexible, self-directed and reflective learning. This resulted up till now, in most contexts, in a hybrid system in which classical forms of teaching and new forms of learning co-exist with a strong focus on socialization, lifelong learning or continuous professional development. In other words building expertise is based on practical knowledge, theoretical knowledge and self-regulative knowledge (Bereiter, 2002). The relationships between those three factors are the essential pedagogical challenge for professional education (Shulman, 1987 cited in Scanlon, 2011).

These developments in (professional) education are in line with the earlier discussed embodied knowledge and influence each other reciprocally. In learning theory, the learning process is in this fashion often described as a socially, culturally en bodily embodied continuum of becoming an expert by integrating ways of knowing, acting and being (Scanlon, 2011; Barnett, 2001, 2009; Giddens, 1991; Lave & Wenger, 1988; Wenger Trayner et.al, 2015; Dall'alba & Barnacle, 2007; Dall'alba, 2009; Sandberg & Pinnington, 2009; Kegan, 1994; Shulman, 2005).

Hager and Hodkinson explain that the language in education is often based on metaphors that dominate how education is viewed and discussed (Hager & Hodkinson, 2011). Acknowledging the quite abstract description of the learning processes by educationalists, they argue we should be consistent with the changes in the use of our language. In professional education the metaphor of learning as being an 'acquisition' or 'transfer' of knowledge is then not sufficient as it focuses mainly on knowledge as an object. Other metaphors put learning more in a social context, like the metaphors of 'participation' or 'construction'. Hager and Hodkinson propose the metaphor of 'becoming' as it captures the essential relation between the individual learner and as they call 'the learning culture' (similar as the earlier described 'domain of actions' or fields). They see three central insides in the use of 'becoming':

> "1. Professional learning takes place in the interactions between the individual and the learning cultures found in the situations where they live and learn.
> 2. Professional learning entails combinations of change and consolidation. These combinations vary over time, from place to place, and from person to person.
> 3. Because learning is relational and is influenced by so many interacting forces

and factors, the specifics of particular situations and individuals are fundamentally important in determining that learning". (Hager & Hodkinson, 2011).

Van Merrienboer and Kirschner (2007) are putting it simply: *"Its no longer enough for the health professional to master the tools of the trade during their studies and then apply and perfect them throughout their carreers"* (Van Merrienboer & Kirschner, 2007). The risk of the historically formulated static, fixed view of expertise needs to be avoided by acknowledging the embodiment of knowledge. The variability in ways of experiencing and enacting practice and the associated potential of this variation will warrant a constant 'becoming' of individual professionals and renewal of practice. This opens the question how professionals develop their expertise in their careers and how the get to this 'integrated ways of knowing, acting and being' (Dall'alba & Barnacle, 2007).

Partly based on the criticism of too much focus on a pedagogy based on delivery of content, the research area of 'professional development' have been researching alternatives under many different names and slightly different orientations but with similar epistemological grounds (Hager & Hodkinson, 2011; Webster-Wright, 2009). An overview of this literature is beyond the scope of this study. Scanlon (2011) and Higgs (2013) offer excellent overviews. (Scanlon, 2011; Higgs, Sheehan, Baldry Currens, Letts & Jensen, 2013)

Offering concrete solutions for the challenges with regard to knowledge and knowledge management two orientations are briefly mentioned here. The first is Practiced Based Education; a framework based on embodied knowledge and aiming to achieve effective professional (higher) education through a pedagogical perspective, a curriculum framework and a set of pedagogical practices or teaching and learning strategies (Higgs et al., 2013).

The other orientation worth mentioning is Authentic Professional Learning; focusing more on the support for professionals as they inquire into and adapt their practices in the contemporary workplace, emphasizing the importance of personal experience and intentionality as the key premises for professionals' ongoing learning. Authentic learning focusses strongly on the set of beliefs and interests which individuals exercise in their

learning (Webster-wright, 2010). The view is that embodied understanding of practice as a whole, rather than attributes, forms the basis for professional skill and its development. More specifically, the knowledge and skills that professionals use in performing their work depend on their embodied understanding of the practice in question. Such embodied understanding of professional practice constitutes an unfolding "professional way-of-being" (Dall'Alba, 2004; Dall'Alba & Sandberg, 2006).This closely related to the term 'becoming' as described earlier and focuses on being a professional.

The professionals' way of understanding their practice forms and organizes their knowledge and skills into a particular form of professional skill. "When practice is understood in a certain way, (further) knowledge and skills will be developed accordingly" (Dall'alba, 2009). This is researched in a variety of professions (Dall'Alba, 2004, Dall'Alba & Sandberg, 2006). Dall'alba (2006) shows in medicine for example that if an undergraduate student has the understanding of practice that he is the technician and heals the patient. He will keep this viewpoint unless thoroughly challenged in this 'disposition'. Just offering this student another perspective, like introducing, a biopsychosocial perspective or the possibility of a more coaching role of the physician won't change his view. Simply teaching another viewpoint is an often used but little effective strategy (Dall'allba, 2009).

All described sources till now, from embodied epistemology, to literature from health care, business, psychology and education, seem to have one thing in common, the need to develop better the '(embodied) understanding of practice' of professionals. "Professionals are required to develop a sense of who they are in terms of professional practice, how they inhabit the professional world and on what terms and how they interact with others in that world. Professionals must learn to 'become' in the context of the twenty-first century" (Scanlon, 2011). This key concept is operationalized for this study in the next paragraph. Collectively, this research demonstrates that 'understanding of practice' is a necessary foundation for the successful practitioners to have ways and methods for effectively and efficiently managing knowledge. In this perspective it is also the foundation of contemporary higher education learning outcomes such as critical thinking, understanding complexity, negotiating multiple perspectives, intercultural maturity, lifelong learning, and the capacity for interdependence with others.

Theoretical framework: Assumption 6

Embodied knowledge put demands on professional education to facilitate a learning process described as a socially, culturally en bodily embodied continuum or of becoming an expert by integrating ways of knowing, acting and being.

1.1.5 Understanding of practice

The term practice can refer broadly to social practice and, more precisely, it frequently denotes professional practice' (Higgs et al., 2013). Practice may be collective (e.g. a profession's practice) or individual (an individual practitioner's practice). Collectively, practice comprises; rituals, social interactions, language, discourse, thinking and decision making, technical skills, identity, knowledge, and practice wisdom, framed and contested by interests, practice philosophy, regulations, practice cultures, ethical standards, codes of conduct and societal expectations. Individually, a practitioner's practice model and enacted practice are framed by the views of the practice community as well as the practitioner's interests, preferences, experiences, perspectives, meaning making, presuppositions and practice philosophy.

Understanding of practice can be broadly defined as a continuum of knowing, acting and being (Dall'Alba & Sandberg, 2006). This definition is closely related to other concepts with similar dimensions. For example the earlier mentioned epistemic literacy (Tuomi, 2015). Another example is the three dimensions of Barnett's constructs of epistemology (knowing), ontology (self-identity), and praxis (action) (Barnett, 2000). According to Kegan there are three major intertwined dimensions of meaning making in adulthood: epistemological, intrapersonal (i.e., identity), and interpersonal (i.e., relationships). The ability to generate one's own internal belief system (epistemological complexity) also requires an internal sense of self and values (intrapersonal complexity) and the capacity to consider but not be overwhelmed by the views of others (interpersonal complexity) (Kegan, 1994). Wenger (1998) proposes learning to consist of four intertwined components: meaning (learning as experiencing), practice (learning as doing), community (learning as belonging) and identity (learning as becoming) (Wenger, 1998). Yielder (2004) puts professional practice in the middle and recognizes four dimensions; knowledge base, cognitive processes, internal integrative processes and interpersonal

relationships provision (Yielder, 2004). Kinchin and Cabot simplify Yielders model in putting the integration and synergy of the knowledge base and professional practice central. They see the cognitive processes, internal integrative processes and interpersonal relationships provision as part of the context in which this linking occurs (Kinchin & Cabot, 2010). They also propose another model; 'A dual-processing knowledge structures perspective on the nature of expertise' (figure 1). The model recognizes two, separated knowledge structures; one in chains and one in nets (networks). The chains resemble more the classical learning perspective of linear sequences of information. The chains resemble more the complexity within practice; understanding is here based on a network of non-linear related resources.

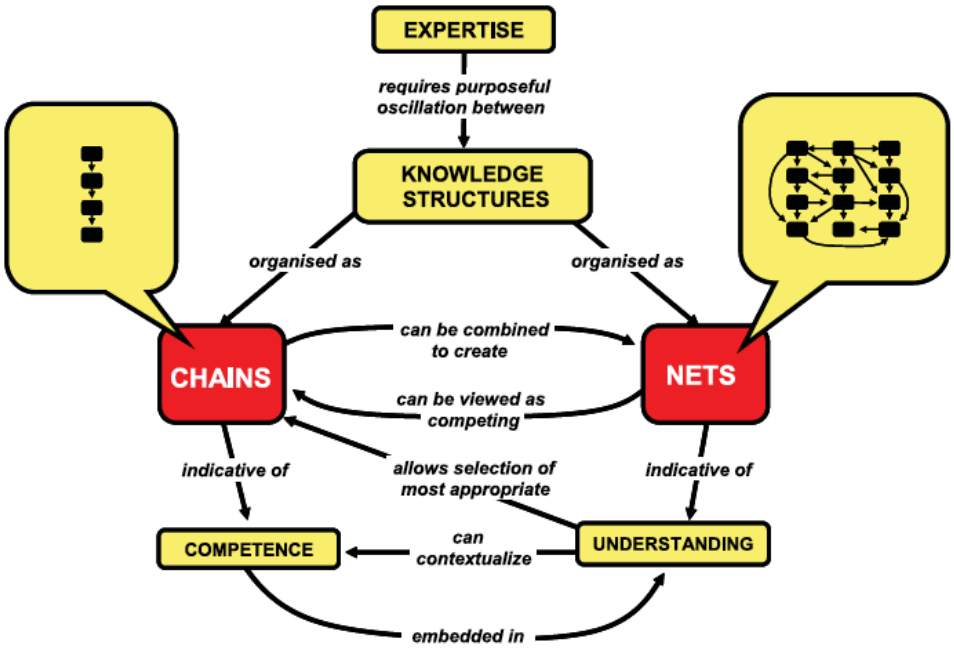

Figure 1 - A dual-processing knowledge structures perspective on the nature of expertise' Copied from (Kinchin & Cabot, 2010)

The relation between the two structures is parallel but depending on the experience of the professional;

"The implication that the development of net structures among students may be the goal of higher education is one that may be contested, particularly where chains of practice

seemingly have more immediate practical application than networks of understanding. In the clinical context, the chains and networks need to develop in parallel. As an individual develops expertise, the networks of understanding will develop sophistication whilst the choice of embedded chains of practice will also grow. The smoothness of transition between the two will increase with increasing expertise" (Kinchin & Cabot, 2010).

Wenger and colleagues offer a similar interpretation, making the distinction between competences and knowledgeability, the later term is used to describe the ability to translate the complex experiences (journey) within the landscape of practice (or similar; domain of actions) in something meaningful or action (Wenger-Trayner et al., 2015).

In their model Kinchin and Cabot emphasize the explicating of tacit knowledge available in practice as the key information/ connection for progress in learning. This is done by constantly connecting the chain(s) of knowledge with the nets of knowledge (Kinchin & Cabot, 2010). One of the critical features of this connecting professional is the constant search for meaning in order to develop and adapt (new) knowledge in practice. Wenger et al.(2015) are describing a similar process as the 'expressibility of an identity' (Wenger-Trayner et al., 2015).

Another driver of the knowledge process is identity. Although identity is often coined to be of essential importance in professional development, it turns out to be little researched and defined (Trede, Macklin & Bridges, 2012). Higgs (1993) assumes that professional identity occurs when a member of a profession develops the *"attitudes, beliefs and standards which support the practitioner role and the development of an identity as a member of the profession with a clear understanding of the responsibilities of being a health professional"* (Higgs et al., 1993). In higher education there is a strong focus on the ability of students to be critical independent lifelong learners as part of the professional identity. This is confirmed in the review of Trede, Macklin, Bridges (2012); *"the role of self, such as self-reflection, agency and self- authorship as being a key part of the process of professional identity development"* (Trede, Macklin & Bridges, 2012). They also notice an often implicit link between personal epistemology formation and professional identity development.

Wenger-Trayner et al. (2015) describe the role of identity as essential in the development of Knowledgeability;

> "It combines many relationships of identification and dis-identification through multiple modes. These relationships to the landscape are resources and fragments of experience to be assembled dynamically in moments of engagement in practice. Practitioners need to negotiate their role, optimize their contribution, know where relevant sources of knowledge are, and be practiced at bringing various sources of knowledge to bear on unforeseen and ambiguous situations"(Wenger-Trayner et al., 2015).

In an increasingly complex and uncertain world the identity of a person is no longer 'predestinated' as it was in a local community or as it was being socialized in a small professional world. Identity in a knowledge society means a close relation between identity and a constant identification with other individuals and resources continuously redefining and developing the identity, making it a task for life (Bauman, 2009; Wenger-Trayner et al., 2015). This assumes an awareness that knowledge is built in both individual and social systems (Kimmerle, Cress & Held, 2009). Knowledge structures are then a dynamic mixture of knowledge, and identities, held in individuals and collectives like teams, groups, professions but also in (social) technologies (Moskaliuk & KIimmerle, 2009).

In this interplay of identities it is a key question for individuals how to distinct between what is part of 'me' versus what is 'not (yet) part of me'. This demands a constant connecting and mobilizing across practices to avoid fragmentation and to keep learning (Akkerman & Bakker, 2011). These socio-cultural differences leading to discontinuity in action or interaction are in the literature described as boundaries (Akkerman & Bakker, 2011). Wenger et al. (2015) state: *'Crossing boundaries, boundary encounters, and boundary partnerships are necessary for the integration of a landscape of practice'.* (Wenger-Trayner et al., 2015) This demands the ability of social-cultural dialogue and the use of instruments to cross these boundaries (social media for example), which could well be one of the reasons that '21st century skills' are high on the agenda of both education and workplaces.

A term for an open and global knowledge society aware of a dual knowledge structure and the possibilities of boundary crossing could be called (originating by Tapscotte (2008) 'networked intelligence' (Tapscott, 2008). A dual processing and the intention to challenges borders demands a sophisticated epistemology or epistemic literacy in professional practice in order to step outside the chained knowledge concepts and to start the dialogue in a dualistic knowledge process (Tuomi, 2015; Otting, Zwaal, Tempelaar & Gijselaers, 2010).

Individual practitioners interpret and implement practice through their practice models and theories (Rycroft-Malone & Bucknall, 2010). Or as Ilott and colleagues (2012) are putting it; *"theories, models and conceptual frameworks are tools to structure thinking and action about a problem. They provide a rationale, to justify decisions and explain findings"* (Ilott, Gerrish, Laker & Bray, 2012). An important task is to formulate these models and theories explicit and constantly as they help to understand and organize the complexity of knowledge resources (Eccles, Grimshaw, Walker, Johnston & Pitts 2005; Thomas, Menon, Boruff, Rodriquez & Ahmed, 2014; Higgs et al., 2013). Within a dualistic knowledge process it is also important to acknowledge the diversity within practice and use and formulate theories out of and within the specificity of the practice (Lettinga & Mol, 1999).

Theoretical framework: Assumption 7

Understanding of practice is an important determinant in integrating embodied knowledge in the knowledge society

Theoretical framework: Assumption 8

Understanding of practice is an integration of knowin, acting and being, which is conceptualized as a dual processing of chains and nets of dynamically interacting knowledge structures.

Theoretical framework: Assumption 9

Understanding of practice assumes the continuous process of:

1. Sophistication of epistemic beliefs
2. Explication of tacit knowledge
3. Social (community) and individual identity building
4. Proliferation of practice models and theories

1.2 The struggle of knowledge in health care

Health care is increasingly confronted with challenges to manage knowledge created by the complexity of the knowledge society, the interpretation of knowledge, new demands towards health care and the failure to manage knowledge with the instruments developed in health care to create and implement knowledge. In the following these challenges are briefly discussed.

1.2.1 Health care system reform

The care for health is increasingly an inter-sectorial collaborative endeavor (Jamison, Summers & Alleyne, 2013). This collaboration is demanding the sharing of knowledge between informed and empowered clients, people and institutions in their daily environment and the professionals within health care, but also between sectors like education, sports and health care. Health care systems are little responsive to the knowledge available and collaboration is hampered. Ageing, new conceptions of health (Huber, 2012), global health issues (WHO, 2014) and the massive financial burden of current health care systems demand innovation (Matheson et al., 2013). The current problems of health care are perceiver as 'wicked problems'; multilevel, complex, and interrelated (Kessler & Glasgow, 2011; WHO, 2014; NICE, 2012), however little recognized like that in health care (Matheson, 2013). The strong social and cognitive or epistemological boundaries between and within professions and sectors are among the reasons of the difficulties to act adequately to the challenges (Ferlie, Fitzgerald, Wood & Hawkins, 2005). Also the neglect of a more complex worldview, as earlier discussed, prevents an innovative reformulation of health care reform (Sturmberg & Martin 2013).

1.2.2 Evidence Based Practice

Not so much knowledge management but evidence based practice has been the dominant model in health care to define the nature of its knowledge. Since the 1990 of the last century evidence based practice has been the norm for health care professionals and is instrumentalized by policymakers and financers. Evidence based practice originates from evidence based medicine. Sackett (1996) defined Evidence-based medicine (EBM) as:

"the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients. The practice of evidence based medicine means integrating individual clinical expertise with the best available research evidence and patient values" (Sackett 1996)**.** The major paradigm shift evidence based practice tries to establish is the move from predominantly authority based practice in which knowledge was uncritically accepted towards the critical use and judgment of scientific evidence. The Evidence Based Practice (EBP-)movement aims to cumulate 'high level' experimental evidence and integrate this in the daily practice. To reach this goal the movement has been fiercely advocating experimental knowledge and a broad range of strategies and 'EBP-resources' were developed for practitioners (Dijkers, Murphy & Krellman, 2012). Ranging from search strategies, evidence hierarchies, to the development of high level systematic reviews and the development of guidelines in order to support evidence based decision making.

The knowledge production has been highly successful. The current health sector produces an exponential growing amount of primary research, reviews, guidelines and other information that could inform the health professional (Davenport & Glaser, 2006; Kessler, 2011). This information is more and more accessible due to an increasingly attainable and efficient information technology, which offer databases and other platforms to share information. The result is that the individual health professional has to resolve an information paradox; in which they are overwhelmed with presumably relevant evidence but cannot find particular information when and where they need it.

Regardless of its massive success, there have been fundamental criticism and discussion since the start of the EBP, movement (Marks, 2002; Tonelli, 2006; Dijkers, Murphy & Krellman, 2012; Greenhalgh, Howick & Maskrey, 2014). Marks unmasked EBP thoroughly in 2002 as being seriously flawed in its epistemological premises and other assumptions, stating; that "It is supremely ironic that the principles of EBP are unsupported or contradicted by evidence, that they are themselves nothing more than opinion-based theory, a faith" (Marks, 2002).

At the core of most critics on Evidence Based Practice are the epistemological premises of the movement. Knowledge in EBP is considered to be of a positivistic nature (or a naïve version of positive realism). In this view EBP is producing objective knowledge that need

to be translated and then adopted in the practice of health professionals (Marks, 2002).

One of the more persistent critics is the general priority of empirical evidence to the expense of the other sources of evidence like patient values, experience and context factors (Tonelli, 2006). This is neglecting the complexity of daily practice (Greenhalgh & Wieringa, 2011; Marks, 2002). Alternatively, evidence is viewed as always a situative, negotiated product (Crotty, 1998; Gabbay & Le May, 2011; Tonelli, 2006; Contandriopoulos, Lemire, Denis & Tremblay, 2010). This put evidence based practice right back in the mess of daily practice where decision making is a very local and temporal process in which many sources of evidence, based on different types of knowledge are used. As seen in table 2 (Petty, Thomson & Stew, 2012A).

Practical knowledge (how to)
Moral and ethical knowledge
Intuitive knowledge
Professional judgement and wisdom
Anatomical, biomechanical, physiology, pathology etc
Tacit knowledge
Situational knowledge
Research knowledge
Knowledge from experience
Attitudes, values and beliefs

Table 2 - Different types of knowledge in evidence informed practice (Petty, Thomson and Stew, 2012A)

Another consequence of the overly favored empirical-analytical research perspective is the neglect of other research perspectives. Interpretative and critical research perspectives are offering methodology to study individual meaning and change processes in the complexity of practice. (Parry, 1997; Petty, Thomson & Stew, 2012B). The value of cumulating empirical evidence is repeatedly questioned for being of too little relevance for practice and therefore not delivering a proper return of the high investments. Kessler and Glasgow state in this light that: "relying on an efficacy-based RCT research paradigm established to answer questions under decontextualized, optimal conditions will not produce the solutions needed" (Kessler & Glasgow, 2011). They suggest that; *"the minimal impact of efficacy, shown from RCTs in health and health services research calls for a 10-year moratorium. This would provide the necessary time for researchers, practitioners,*

policymakers, and citizens to collaboratively identify and evaluate innovations that have real potential for translation" (Kessler & Glasgow, 2011).

The increasing demand for evidence based medicine, fundamental criticism of its basic assumptions and the inability to get generated knowledge into practice, does put evidence based medicine in a crisis and in need for a renaissance (Greenhalgh, Howick & Maskrey, 2014). Although written from the perspective of medicine this landmark paper is equally valid for all health professionals, including physiotherapy.

1.2.3 Towards a practice based evidence

Alternative approaches often start with the inside that the question facing every health professional every time they encounter a case, and regardless the existing empirical evidence, is: 'What is it best to do, for this individual, at this time, given these particular circumstances'? (Greenhalgh & Wieringa, 2011).

Gabbey and Le May (2010) introduced Practice based evidence, this concept is based on the systematic observation that professional knowledge is 'knowledge-in-practice-in-context', which they call 'mindlines', opposing it to the propositional knowledge of guidelines. They followed physicians along their work and found that their thinking is predominantly formed on pattern recognition explained by psychological theories of schemata, frame theory and illness scripts, working to heuristics and rules of thumb (Gabbey & Le May, 2010). This thinking is stored in habits and in the close network of colleagues in their practice. Learning occurs mainly through informal interaction and a 'bricolage' van stories, anecdotes and accounts of formal knowledge melted into a mixture of tacit and explicit practical knowledge what works best. Socialization plays an important role in this mixture of individual and collective sense making. The role of proportional knowledge in the form of scientific literature or guidelines, as described in EBP, only minimally add to their thinking (Gabbey & Le May, 2004). The concept of practice based evidence is closely linked with the earlier described developments in (practice based) education.

1.2.4 Implementation research; translating evidence into practice

One of the consequences of the premises under EBP is the gap between academic research and the daily practice in health care with the result that patients don't get the best practice available. Research in the United States and the Netherlands have estimated that 30% to 45% of patients are not receiving care according to scientific evidence and that 20% to 25% of the care provided is not needed or is potentially harmful (Grol & Grimshaw 2003). This gap has led to a whole new research area in the health care sector and accompanying multi-billion research industry which goes under many names like knowledge-to-action research, translational research or implementation research (Straus, Tetroe & Graham, 2009; Greenhalgh, Howick & Maskrey, 2014). Graham (2006) defines implementation research as: "The scientific study of methods to promote the systematic uptake of clinical research findings and other evidence-based practices into routine practice and, hence, to improve the quality and effectiveness of health care" (Graham et al. 2006). Despite the enormous investments and grow of this field of research, it has been questioned from different perspectives. One of the foremost scholars within implementation research, Grimshaw (2012) states that; *"the most consistent findings from clinical and health services research is the failure to translate research into practice"* (Grimshaw et al., 2012). This acknowledgment is an incentive for implementation research, developing a host of research and initiatives all aiming to describe and influence facilitators and barriers in the battle to get knowledge translated into practice. The amount work done in this area is impressive. For an overview of the area has The Cochrane Collaboration a specialized group called Effective Practice and Organization of Care (EPOC). Further overview is offered in this selection of articles; Grimshaw et al., 2001; Cabana et al., 1999; Grol & Grimshaw, 2003; Graham 2006; Wensing, Bosch & Grol, 2010; Humphries, Stafinski & Mumtaz, 2014; Straus et al., 2011; Grimshaw et al., 2012; Straus, Tetroe & Graham, 2009.

One interesting line of development in implementation research is the notion that in order to get knowledge translated, it needs to be made fit-for-purpose, for this purpose it useful to consider next to the empirical evidence also theoretical and experiential evidence (Harvey, Fitzgerald, Fielden, McBride, Waterman, Bamford, Kislove & Boaden, 2011). Harvey and colleagues realize within the Collaborations for Leadership in Applied Health Research and Care (CLAHRCs) that it is impractical to priories' one of the forms of evidence and tries to integrate all of them. Collecting experiential knowledge and

operationalizing it in a way of 'learning by doing' (Harvey et al., 2011). The use of theoretical knowledge has gained more interest in implementation sciences. Theories are in this perspective defined as impact theories and process theories (Rossi, Freeman & Lipsey 1999):

> "Impact theories describe hypotheses and assumptions about how a specific intervention will facilitate a desired change, as well as the causes, effects, and factors determining success (or the lack of it) in improving health care. Process theories refer to the preferred implementation activities: how they should be planned, organized, and scheduled in order to be effective (the organizational plan) and how the target group will utilize and be influenced by the activities (the utilization plan)"(Grol, Bosch, Hulscher, Eccles & Wensing, 2007).

The ideal model for change in health care would encompass both types of theories (Grol et al., 2007). Harvey writes:

> "Theories are seen to provide a useful way of contextualizing, planning, and evaluating implementation strategies that typically comprise multiple interventions targeted at different groups and different levels within an organization. Such informing theories may be drawn from a broad range of disciplines, including, e.g., psychology, organizational behaviour, social marketing, and organizational learning" (Harvey et al., 2011).

These theories should influence the implementation of knowledge and as such there is a need to develop an understanding of the theory-based factors that underlie clinical practice (Eccles et al., 2005).
Although within implementation research (especially in the CLAHRC studies) a more nuanced picture of the relation between knowledge and the implementation context is gaining ground, the basic knowledge-to-action metaphor is not challenged and therefor the aim is still to narrow the gap between knowledge and action.

In line with the earlier mentioned more fundamental critic on the EBP movement similar critics are formulated towards implementation research. The presumptions grounding the

EBP movement; producing objective knowledge which need to be translated and then adopted in the practice of health professionals, are in perfect line with the assumptions underpinning the knowledge translation metaphor; *"The first is that 'knowledge' equates with objective, impersonal research findings, the second that it is useful to conceptualize a 'know–do gap' between scientific facts and practice and the third that practice consists more or less of a series of rational decisions on which scientific research findings can be brought to bear"* (Greenhalgh & Wieringa, 2011).

Both research done within the knowledge-to-action metaphor like CLAHRC, and the more fundamental research from the vein of practice based evidence put the importance of knowledge in and on practice more central. The Evidence Based Renaissance Group formulates it as a:

> "need to gain a better understanding (perhaps beginning with a synthesis of the cognitive psychology literature) of how clinicians and patients find, interpret, and evaluate evidence from research studies, and how (and if) these processes feed into clinical communication, exploration of diagnostic options, and shared decision making. Deeper study is also needed into the less algorithmic components of clinical method such as intuition and heuristic reasoning, and how evidence may be incorporated into such reasoning" (Greenhalgh, Howick & Maskrey, 2014).

In short; a much better understanding of practice is key. The fundamental critic of evidence based practice and ways of implementing (new) knowledge necessitates a new framework of how to understand the nature of knowledge and knowing in health professions. In this study this is called Evidence Informed Practice, based on the assumptions in this background this seems to be a better phrasing than Evidence Based Practice. The diversity of types of knowledge used and the dynamic change, intrinsic to an embodied knowledge and dual learning process put the term *'evidence based*' in perspective. *'evidence informed'* illustrates a more humble position towards the truth claim of used knowledge. All health professions are by nature "an uncertain, paradox-laden, judgment-dependent, science-using, technology-supported practice" (Abassi, 2011).

The separate 'institutionalization' of implementation sciences does not seem to help

connecting theory with practice. This is reflected in the assumption that implementation should be an integral aspect of evidence informed practice.

Theoretical framework: Assumption 10

Evidence informed practice has dual but entwined orientations in order to deliver best practice; a client orientation and a knowledge orientation.

Client orientation of evidence informed practice is a client centred approach to find the best course of action in the given context with the conscientious, explicit and judicious use of the resources available. These resources are the client values and goals, scientific evidence, experiential evidence, system features and the practice models and guiding principles[3] of the profession(al).

Knowledge orientation in evidence informed practice is the continuous process of understanding of practice and embodied knowledge creation and management in a dual processing of knowledge structures for professionals and their communities of practice.

1.2.5 Conclusion

The challenge in the information management of physiotherapy necessitates a critical re-orientation. From the theoretical background a set of 10 assumptions are formulated, together offering a framework which will be referred to in this thesis as Evidence Informed Practice.

Assumption 1
Knowledge is embodied knowledge; being the inseparable contribution of individually embodied and socially shared meaning-systems within a ‘ domain of action’.

Assumption 2
Sophisticated epistemological beliefs are a prerequisite to understand knowledge as embodied knowledge.

Assumption 3
Engaged scholarship is consistent with embodied knowledge and offers in this perspective a practical concept to relate theory with practice.

Assumption 4
The increasing complexity and uncertainty in the world created the knowledge society, in which the concept of embodied knowledge is a ‘condition sine qua non’.

Assumption 5
In order to manage knowledge in the knowledge society professionals need epistemic literacy.

Assumption 6
Embodied knowledge put demands on professional education to facilitate a learning process described as a socially, culturally en bodily embodied continuum or of becoming an expert by integrating ways of knowing, acting and being.

[3] Guiding Principles establish the fundamental norms, rules, or ethics that represent what is desirable (values) and affirmative for our profession and help us determine the rightfulness or wrongfulness of our actions. Principles are more explicit than values, and are meant to govern action (Bithell, 2005).

Assumption 7
Understanding of practice is an important determinant in integrating embodied knowledge in the knowledge society

Assumption 8
Understanding of practice is an integration of knowin, acting and being, which is conceptualized as a dual processing of chains and nets of dynamically interacting knowledge structures.

Assumption 9
Understanding of practice assumes the continuous process of:

1. Sophistication of epistemic beliefs
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Knowledge orientation in evidence informed practice is the continuous process of understanding of practice and embodied knowledge creation and management in a dual processing of knowledge structures for professionals and their communities of practice.

[4] Guiding Principles establish the fundamental norms, rules, or ethics that represent what is desirable (values) and affirmative for our profession and help us determine the rightfulness or wrongfulness of our actions. Principles are more explicit than values, and are meant to govern action (Bithell, 2005).

Chapter 2 - Research outline

2.1 Relevance and Goals

The research topic is outlined in this chapter with goals, research questions and positioning within the theoretical framework.

The complexity of the described problem of failing to manage the knowledge innovation and circulation in physiotherapy is also visible in the diffuse and scattered nature of the literature explored in the background. In order to be rigorous and consistent, a theoretical framework is formulated representing a coherent set of assumptions on how knowledge could be perceived and managed in health care in general and, in this study, more specific for physiotherapy. The result is a framework in its infancy called 'Evidence Informed Practice'. It is important to state that this model doesn't claim to be finished or that other perspectives are not possible.

The ultimate goal of the researcher is to facilitate 'engaged scholarship' by proposing and validating the evidence informed practice framework and offering improvements for (knowledge) innovation in order to face the knowledge society. The intention is to establish a consistent framework in order to work towards solutions for some of the most highlighted practical problems in the evidence informed practice of physiotherapists.
The disadvantage of a new framework is that it delivers yet another framework in the already cluttered platform of theories, models and frameworks dealing with the problem at hand (Ilott et al., 2012). Drawing heavenly on the insights of practice based evidence, practice based education and landscapes of practice one could ask why not following this literature. However it was felt that, although agreeing with the embodied character of knowledge, the explicit orientation in and from practice, doesn't solve the dichotomy between theory and practice enough (Hodges, 2006). The aim of this study is to work towards 'engaged scholarship', which necessarily involves the (very) different perceptions of what the problem is (Van der Ven & Johnson, 2006). This is in the community of physiotherapy the notion of knowledge transfer and exchange *and* the notion of a practice

based orientation. Both exists and the aim of the evidence informed practice framework is to be inclusive in order to create the space for dialogue and debate.

Another disadvantage of a new framework is the generality of the framework and the many research questions that can be asked to validate or falsify the framework. The advantage is that many existing research fit the framework and can be assessed on the proposed assumptions. Another advantage of a new framework is the fresh position it delivers, always an advantage for innovation, especially in a field in which people tend to specialize more and more and do little boundary crossing (Akkerman & Bakker, 2012; Wenger-Trayner et al., 2015).

Considering the wide scope of the Evidence Informed Practice framework, this study priories with the focuses on two of the main perceived problems within the framework:

1. The failure to get existing research evidence into practice and relevant for practice. (Research question 1).
2. The need to operationalize the 'understanding of practice' of physiotherapists as a determinant for the implementation of evidence informed practice (Research questions 2 and 3)

2.1 Research questions

2.1.1 Research question 1

How can knowledge synthesis in the form of review methodology in physiotherapy be consistent with the assumptions of Evidence Informed Practice?

One of the more urgent problems in physiotherapy is the inability to inform practice with the research evidence available (Grimshaw et al., 2012; Dijkers, Murphy & Krellman, 2012). The dominant orientation on the empirical analytical paradigm and its practical counterpart in the evidence based practice movement, as earlier described in the research approach, resonates logically in the specific methods developed to synthesis existing knowledge in order to be useful in the daily practice. The dominant and highly valued

method of synthesizing knowledge in health studies is the standardized systematic review methodology as described by the Cochrane collaboration. The critical realist perspective and the assumption of embodied practice (assumption 1) demand a better balance between different kinds of knowledge from different research paradigms. Engaged scholarship (assumption 2) puts the practical problem as a base to produce knowledge. Rethinking the review methodology towards Evidence Informed Practice (assumption 8 and 9) is a logical step in this process.

The researcher performed a critical review of review methodologies in order to offer an overview and a model for review methodology within evidence informed practice (Saunders & Rojon, 2011). The literature search was done on base of a series of initial (landmark) articles about review methodology (Higgins & Green, 2008; Gough, Thomas & Oliver, 2012; JBI, 2011; Grant & Booth, 2009). Papers from the reference lists of these articles were researched and more recent articles where identified by citation-tracking them in Google Scholar. Complemented with several searches with search terms identified form the found literature on Worldcat-online. Findings were summarized and drew together from these diverse and conflicting sources using narrative synthesis.

2.1.2 Research question 2

How sophisticated are the epistemological beliefs and how positive are the attitudes towards Evidence Based Practice in the community of physiotherapists within Europe?

To get an idea of the epistemological beliefs of physiotherapists, as an essential part in the understanding of practice, we need to be able to measure this (assumption 5, 7, 9). However little research is done in this area for physiotherapists. (Bientzle, Cress & Kimmerle, 2014). Sophisticated epistemological beliefs are a prerequisite to understand knowledge as embodied knowledge (assumption 2) and facilitate the ability of identity building. There are different ways to measure epistemological beliefs. The concepts and the methodology of epistemological beliefs are described in more detail in chapter 3. The goal is to get an overview of the European physiotherapy community and to see if there are differences within this community, based on country, level of education, years of experience and gender. Two questionnaires, the DEBQ (appendix 1) and the CAEB (appendix 2), are chosen on base of their complementary perspective to measure the

sophistication of the epistemological beliefs. The choice for a questionnaire is made because it can quickly offer data from a large population given a relatively low investment in time and money from both respondent and researcher. It also allows for attainable comparison between the respondents.

The beliefs about attitude and beliefs regarding evidence based practice and education, knowledge and skills in evidence based practice is also measured with a part of an existing questionnaire. The theoretical framework is built on the premises that evidence based practice is the dominant paradigm in physiotherapy at the moment. This questionnaire confirms this. Given the assumption that evidence based practice is based on an epsitomology of positive realism. This is in the concept of epistemological beliefs a naïve epistemological belief. The expectation is that physiotherapists do have a positive attitude towards EBP, but their epistemological beliefs are not expected to be highly sophisticated. The three questionnaires have been joined together into one online survey with three parts and named the EBQP (Evidence Belief Questionnaire for Physiotherapists) (appendix 3).

The following sub-questions have been formulated

- How sophisticated are the epistemological beliefs of physiotherapists?
    - Do epistemological beliefs differ in physiotherapists with regard to their:
        - Level of education
        - Years of experience
        - Gender
        - Country

- How positive are the attitudes towards evidence based practice of physiotherapists in countries within Europe?
    - Do attitudes towards evidence based practice differ in physiotherapists with regard to their:
        - Level of education
        - Years of experience
        - Gender
        - Country

- What is the relation between the epistemological beliefs and the attitudes towards evidence base practice of physiotherapists in Europe?

2.1.3 Research question 3

Can the DEBQ, The CAEB and the EBP questionnaires be cross-culturally adapted for different countries within Europe while keeping the uniformity needed in order to be comparable?

In order to be able to use the questionnaires in different countries the three questionnaires, together with the part of characterizations of the respondents, need to be translated and culturally adapted to the countries involved. The origin of the DEBQ and the EBP is the United States. The origin of the CAEB is Germany. The questionnaire needs to be translated and culturally adapted for Finland, Sweden, Denmark, The Netherlands, Italy, Spain, Portugal and in German for Austria, Swiss and Germany. The process is organized with teams in all countries with an in-country researcher in close relation with the main researcher in order to find a balance between adaptation of the questionnaires and maintaining uniformity in order to compare between countries.

The research questions resulted in following 3 studies:

- Study 1 (Research question 1 – Article 1)

Synthesizing knowledge for physiotherapy practice. - Key steps towards review methodology– a critical review.

- Study 2 (Research question 3 – Article 2 and 3)

- Epistemological beliefs in European physiotherapists - A multi-country cross-cultural adaptation for the DEBQ and the CAEB questionnaires.
- Attitude and readiness for EBP in European physiotherapists - A multi-country cross-cultural adaptation for the EBP-questionnaire.

- Study 3 (Research question 2 – Article 4)

Epistemological beliefs and attitudes towards evidence based practice in physiotherapy - A multi-country (Europe) survey study .

Chapter 3 - Studies Developed

3.1 Study 1 - Synthesizing knowledge for physiotherapy practice. - Key steps towards review methodology– a critical review.

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Abstract

Background

One of the consequences of rethinking evidence-based practice in physiotherapy is acknowledging the complexity and the different kinds of knowledge used in the decision-making of physiotherapists. This has profound consequences for the kinds of knowledge that should be researched and synthesized in order to inform practice.

Method

A critical review of review methodology was carried out and results were interpreted using narrative synthesis.

Findings

This article focuses on how to generalize (synthesize) different kinds of knowledge with the available review methodology in order to adequately inform physiotherapy practice. It does so by suggesting a set of key steps and offering a brief overview of review methodology.

Conclusions

More awareness and use of the diversity in review methodology in physiotherapy can improve theory building and inform practice better. Reviewers could increase the impact of their studies by focussing more on the external validity of methods and results. The article finishes with recommendations for improving the critical use of different review methodologies for physiotherapy practice.

Keywords

Evidence-based practice; knowledge synthesis; review methodology; theory building; understanding of practice.

Introduction

Evidence-based Practice in physiotherapy has been developed by observing the evidence-based medicine movement. The Evidence-based Practice movement aims to accumulate high level experimental evidence in Meta-analysis or systematic reviews, obeying a rigorous methodology. Physiotherapy has followed this movement, and so the ability to perform a systematic review has become a standard part of the curriculum of physiotherapy education. The increasing demand for evidence-based medicine, the fundamental criticism of its basic assumptions and the inability to translate the generated knowledge into practice, has fuelled the call for a change in perspective regarding evidence-based medicine (Greenhalgh et al, 2014).

This criticism is equally important for physiotherapists and leads, despite a lot of investment in translational activities, to the failure to inform physiotherapy action by available evidence, this being one of the basic premises of evidence-based practice (Dijkers et al, 2012; Grimshaw et al, 2012). We discuss briefly the concept of evidence-based practice and within this concept we then focus on the role of knowledge synthesis as an instrument in the knowledge management of physiotherapists. One of the common and efficient instruments for collecting and synthesizing existing knowledge is the review. Review methodology is often judged on its internal validity. We explain why this article emphasizes the external validity. We then describe some key steps as guides when engaging in knowledge synthesis. We conclude with recommendations for improving knowledge synthesis for informing physiotherapy practice.

Methods

A critical review of review methodology was carried out (Saunders and Rojon, 2011). The search for literature was done on the basis of a series of initial (landmark) articles about review methodology (Higgins and Green, 2008; Gough et al, 2012; Johanna Briggs Institute, 2011; Grant and Booth, 2009). Papers from the reference lists of these articles were researched and more recent articles where identified by citation-tracking in Google Scholar. These were complemented with several searches using search terms identified from the literature found on Worldcat-online. Findings were

summarized and combined together from these diverse and conflicting sources using narrative synthesis.

Findings

Perception of knowledge

A general assumption is that Evidence-based Practice offers objective, context-free scientific facts, predominantly derived from empirical-analytical research (Greenhalgh et al, 2014). In this line of reasoning such scientific knowledge can then be 'translated' into the explicit and rational decision making of clinicians. This view has been widely contested for neglecting the complexity of daily practice (Greenhalgh and Wieringa, 2011; Marks, 2002) and the slow, costly and often ineffective efforts to translate this knowledge into practice (Greenhalgh et al, 2014; Kessler and Glasgow, 2011). In an alternative view, evidence is always a situation-based, negotiated product (Crotty, 1998; Gabbay and May, 2011; Tonelli, 2006; Contandriopoulos et al, 2010). This puts evidence-based practice right back into the mess of daily practice where decision making is a very local and temporal process. Many sources of evidence like client values and goals, scientific evidence, experiential evidence, system features and the practice models and guiding principles of the profession(al) are used. Formal knowledge is melted down into a mixture of the tacit and explicit practical knowledge that works best. This knowledge is individual, but also a collective sensemaking in, for example, teams, research areas or professions (Wieringa and Greenhalgh, 2015). In this perception of knowledge, evidence-based practice is a socialisation process moving towards constant dialogue and network forming (Tuomi, 2015).

Although different resources are widely recognized, the emphasis is still on empirical-analytical research (Wieringa and Greenhalgh, 2015). To go forward from recognizing resources means to explicitly value and to research the variety of resources available and the process of their sensemaking in and between professionals. The challenge is to support more interpretative and critical research perspectives. This offers a methodology for studying individual meaning and change processes in the complexity of practice. (Parry, 1997; Petty et al, 2012). Consequently, this demands a broad perspective on the synthesis of diverse research outputs in order to inform practice. The challenge to synthesise an increasing amount

of available evidence is augmented by the increasing availability of new datasets from individual and big data.

Synthesizing knowledge in review methodology

Accepting the complexity of daily practice will increase the challenge to deal with the amount and diversity of scientific knowledge. Review methodology offers methods for synthesizing research results. Based on different ontological and epistemological foundations, an increasing variety of review methodologies exist (Gough et al, 2012). All these methodologies have in common the aim of collecting and appraising the available evidence in a particular area. This is in principle always a process of generalization. The EBP community has been mostly concerned with internal validity in knowledge synthesis. However, research in health care is struggling with the inability to truly randomise and offer representative samples, and we also wish to generalize non-quantitative data and generalize towards other settings and conditions (Polit and Beck, 2010). Therefore we contend that more attention to generalisation (external validity) could help the EBP community. We argue that the way review methodology operationalizes this generalisation is critical for including the variety of knowledge for physiotherapy practice. We will also cover some practical issues concerning review methodology.

Three different models of generalization can be distinguished (Firestone, 1993). The first model is the statistical generalization: from sample to population. The second model is analytical generalization: offering researchers the opportunity to generalize from particulars to broader constructs or theory. A third model that Firestone has suggested is the case-to-case translation or transferability. In this model researchers provide detailed information about the research context, so that consumers can consider the degree to which their own context is similar before using the results. Campbell coined this strategy to extrapolate knowledge 'proximal similarity' (Campbell, 1986).

As stated earlier, the effectiveness of physiotherapy practice also depends decisively on interactional and interpersonal experiences – based in people´s thinking, feelings and reflections (Britten et al, 2002). In order to learn more general lessons from all these individual cases, analytical generalization and proximal similarity are strategies for crossing over from the focus on the specific to the more general and abstract. Many review strategies have been developed in different scientific areas offering

methods to help synthesizing. These review strategies are infrequently used in physiotherapy in spite of their potential for offering a more complete understanding of practice, both in the development of theory and in daily evidence informed practice (Higgs and Titchen, 1995; Eccles et al, 2005; Thomson, 2012).
A practical problem with reviews is that they typically cost a lot of time and money, which often doesn't follow the time schedule of practice. Given the short-turn overtime of knowledge, the validity of research results is also threatened by the lack of new input, which may impact the conclusions. (Shojania et al, 2007).

Given the wide range of available review methodology, we recommend starting with a critical selection from the available methodologies. In the following paragraph, three key steps are introduced to offer guidance in the process of knowledge synthesis.

Key steps in knowledge synthesis

The wish to perform a knowledge synthesis can follow these key steps:

- Define the type of knowledge needed, followed by a research question;
- Consider the available resources in time, money and expertise;
- Make an explicit choice for a type of review methodology.

The first step is to formulate a relevant research question. This starts by formulating what type, or often types, of knowledge the reviewer prioritises given the decision at stake. In physiotherapy, the PICO tool is often used as a framework for operationalizing the question into searchable keywords (describing; Patient or Problem, Intervention, Comparison and Outcome). However, depending on the situation, many other aspects could be relevant. Davies names, in a review of different frameworks, 'timeframe, duration, context, setting, environment, type of question, type of study design, professionals, exposure, results, stakeholders, and situation' (Davies, 2011). Based on these elements, a variety of alternative frameworks are available to suit the specific situation (Davies, 2011). Step two gathers together the limitations of the given situation. Which timeframe is given by the decision makers and how much expertise and money is available will influence the choice of method. Based on the information in step 1 and 2, the reviewer selects in step 3 a review

methodology. We offer here a selection of review methodologies to illustrate the range of possibilities.

Systematic review and meta-analysis

A systematic review attempts to combine all high level empirical evidence in order to find the most effective intervention for a specified individual/ group. High level evidence is determined by a minimum of bias, and the highest level of evidence is considered to come from a randomised clinical trial (Dijkers, 2013). These quantitative results are preferably statistically generalized into a meta-analysis in order to pool the statistical power of individual studies and estimate more precisely the effect of an intervention. Protocols are available, for example, in the Cochrane library. Within physiotherapy, this form of review is the norm and, for example, the standard in the development of clinical guidelines (Van der Wees et al, 2011).

Meta-synthesis of qualitative research

The synthesis of qualitative research in order to inform practice can be done in two distinct ways. From a truly interpretative perspective, aggregating results across studies is not a valid practice. However, (re-)interpreting qualitative data from different studies, using analytical generalization, can contribute to a more complete theory development in physiotherapy (Richardson and Lindquist, 2010). Regardless of the growing amount of qualitative research and the awareness of the relevance of this research, meta-synthesis of qualitative research is a scarcity in physiotherapy (Richardson and Lindquist, 2010).

Other reviewers strive to develop direct recommendations for action by using an integrative or meta-aggregative approach to the synthesis of qualitative data. This strategy does not (re-) interpret data but systematically collects the practicality and usability of the primary author's findings and attempts to generalize these (Johanna Briggs Institute, 2011). The Joanna Briggs Institute has transformed this approach into a detailed review methodology, working closely with the Cochrane group. These two groups also work on mixed method approaches, synthesizing a mixture of qualitative and quantitative research.

Realist review and meta-narrative synthesis

Realist inquiry takes an explanatory approach in examining how the relation between interventions and outcomes is influenced by contextual factors. A realist approach tries to answer why and how interventions work in different situations while trying to honour the complexity in real-world situations. A Meta-narrative analysis discloses how a similarly complex topic has been conceptualized, theorized and empirically studied in different ways by different groups of researchers. Meta-narrative analysis helps to understand and interpret conflicting research results. It also assists the decision maker in considering what a certain factor would mean in a certain course of action. For example, the assumption or general goal in many guidelines in physiotherapy is to 'put the client at the centre'. The interpretation of what this means, however, is often unclear and can lead to very different approaches. Shedding light on different interpretations could help clinicians to explicitly and critically work with this concept. In order to assure that the methodology used is systematic and consistent, the Realist And Meta-narrative Evidence Syntheses: Evolving Standards (RAMESES) was developed to guide researchers (Wong et al, 2013).

Scoping studies

This is a review approach aimed at a wide 'scope' of a certain topic in scientific literature, allowing for the inclusion of a diversity of angles and research methodologies. This is especially relevant for physiotherapy, of which the knowledge base is just emerging in the last decennia, and which electively uses many other (quickly developing) knowledge bases. According to Arksey and O'Malley (2005), a scoping study can be done to: examine the extent, range, and nature of research activity; determine the value of undertaking a full systematic review; summarize and disseminate research findings; or identify gaps in the existing literature (Arksey and Malley, 2005). Researchers have been busy for some time developing the initial 6-step framework for standardisation of this methodology (Levac et al, 2010; Daudt et al, 2013).

Rapid review

Patients, policymakers, health professionals and researchers increasingly require the synthesis of knowledge to be done in a short period of time and be highly accessible and user friendly. Reviews typically take up to one or two years to conduct, and

normally have a very narrow research question in order to avoid bias (Khankura et al, 2012). Rapid review methodology trades off completeness and rigour to accommodate to the decision makers practical situation. Depending on the methodology, the time in a rapid review is reduced to a period of three weeks up to six months. However, the methodology used is not very standardized and researchers have difficulty in stating clearly which steps are to be taken to accelerate the approach (Ganann et al, 2010). Most rapid reviews are in line with Cochrane style reviews; an example is the evidence summary (Khankura et al, 2012). At this moment, rapid review methodology is also being developed for evidence from interpretative and critical research. An example is the Rapid Realist Review methodology (Saul et al, 2013).

Living systematic reviews

The last few years the idea of living system reviews is being explored (Elliott et al, 2014). The concept of "living" refers to easily adjustable, dynamic online-only publications attempting to enhance the accuracy and utility of research evidence. Living reviews are exploring new technologies about how to update knowledge syntheses continuously and, preferably, (semi-)automatically and with the support of crowd sourcing. In this platform, different resources can be connected and reviews can be directly linked with translational instruments like (‘living’) guidelines, offering a knowledge eco-system. A living review has the potential for integrating the collective sensemaking within the physiotherapy society.

Conclusions

Knowing different types of review methodology and following the key steps mentioned above offers a tool for reflecting on what kind of knowledge synthesis fits the local situation in physiotherapy practice, and to initiate more theory building in the profession.

Much work is still to be done towards explicit and accountable forms of methodology (Johanna Briggs Institute, 2011; Ganann et al, 2010). More consensus and the detailed description of review methodology can be very helpful in assisting the selection, evaluation, and development of methods for reviewing (Gough et al, 2012). Review methodology tends to focus on internal validity; the challenge is to find a balance

with external validity. The following recommendations have been formulated to increase the use of a diversity of review methodologies in order to inform physiotherapy practice.

Recommendations

Organisations setting the standard for review methodology, like the Cochrane collaboration, could encourage a broader spectrum of research synthesis as described in this article and could support an explicit decision making regarding the most opportune type of review, given the situation. One of the preferred instruments for 'translating' knowledge and using knowledge synthesis systematically is the guideline. The emphasis on rigor and statistical generalizability and the predominant use of empirical-analytical research evidence in the development of guidelines seem to neglect other evidence resources, and it is suggested that therefore guidelines often fail to inform, inspire or influence (Lavis et al, 2006). This might be improved by integrating more explicitly different forms of knowledge synthesis into the development of guidelines, thus reflecting more the complexity practitioners are dealing with. This could take place in, for example, the standards of the World Confederation of Physiotherapy (www.wcpt.org) or the Guideline International Network (www.g-i-n.net). Also within the criteria developed to assess guidelines, such as those offered by the AGREE enterprise (www.agreetrust.org), more attention could be given to the use of a diversity of knowledge synthesis. Scientific journals have the opportunity to open up for other kinds of reviews and support the publication and development of other types of (review) methodology. Search engines could facilitate the accessibility of this kind of methodology through explicit indexation, for example in Mesh-terms.

Given the increasing amount of research and the ineffective incorporation of knowledge into daily practice, there is a need for a more fundamental reflection on how physiotherapists think and thus integrate new knowledge into their daily patterns (Gabbay and May, 2011). Implementation strategies should be developed in close relation to this reality. This starts with challenging the idea of knowledge based on assumptions like 'knowledge equates with objective, impersonal research findings' or 'practice consists more or less of a series of rational decisions on which scientific research findings can be brought to bear' (Greenhalgh and Wieringa, 2011).

Professionals interpret and develop knowledge according to their idea of what knowledge is and how they acquire this (Dall'Alba and Sandberg, 2006). These assumptions form part of the understanding of practice, serving as a guide for daily practice. Physiotherapy could do more research in this area and be more explicit, so that professionals can become more aware of their assumptions and thus strengthen their theories of practice (Lettinga and van Twillert, 2006).

Implementation research should move beyond the knowledge-to-action model and develop strategies that acknowledge the multifaceted and context contingent nature of evidence. The focus then moves from transferring knowledge to co-creating knowledge (Harvey et al, 2011) or knowledge valorisation (Van Drooge et al, 2013). These options have a longer track record in other disciplines, like policymaking and business, and offer new and creative insights for innovating physiotherapy practice.

A more critical and sophisticated understanding of knowledge, evidence and the possible role of science should be at the forefront of a lifelong education. Acknowledging and discussing different views of knowledge and the use of knowledge brings evidence-based practice to the centre of the social and complex practice of physiotherapy. This also means anticipating and integrating new data sets from, for example, personal data and big data as increasingly important evidence resources. (Aspirant) professionals need to be aware of the challenges of knowledge synthesis and the different methodologies, and they could be supported by the proposed key steps. The focus of the education community has been on knowledge of the individual. The social character of evidence-based practice offers challenges for using knowledge within networks and for the ability to quickly and creatively obtain and contextualize relevant knowledge at the right moment (Gilbert, 2005; Tuomi, 2015). Some new learning theories are developing along this line, inspiring examples of which are social learning systems (Wenger-Trayner et al, 2015), connectivism (Kropf, 2013) and design thinking (Noweski et al, 2012).

Key points

1. The success of evidence-based practice is hampered by a limited use of evidence resources.

2. A more explicit use of a variety of generalisation strategies could improve knowledge management in physiotherapy.

3. A three-step approach when planning a review could improve the use of more evidence resources in knowledge syntheses.

4. A diversity of review methodologies is available for different types of knowledge and different available timeframes and resources.

5. Education and (implementation) research should encourage a more critical and sophisticated understanding of knowledge and operationalize knowledge management accordingly.

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3.2 Study 2 - Multi-country (Europe) cross-cultural adaptation process for DEQB, CAEB and EBP Questionnaires

Forward

This study resultated in two articles from the pragmatic viewpoint of the limitations of the length of articles allowed by the peer reviewed journals and the wish of the authors to present the results in an uncluttered view. The adaptation process of the three questionnaires was done in one integrated process.

Article 1 - Epistemological beliefs in European physiotherapists - A multi-country cross-cultural adaptation for the DEBQ and the CAEB questionnaires.

Article 2 - Attitude and readiness for EBP in European physiotherapists - A multi-country cross-cultural adaptation for the EBP-questionnaire.

The appendices related with these 2 articles are available on the CD attached, under Study 2 – Appendices.

Article 1 is structured according to the publication rules of the European Journal of Physiotherapy, including the references. Article 2 follows the standard used in the thesis.

Study 2 - Article 1. Epistemological beliefs in European physiotherapists - A multi-country cross-cultural adaptation for the DEBQ and the CAEB

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Abstract

Aims

This article assumes that epistemological beliefs of physiotherapists are an important determinant in improving the concept of evidence-based practice. Little research is done in epistemological beliefs in physiotherapy. In order to measure the sophistication of epistemological beliefs, two complementary questionnaires (The DEBQ and CAEB) were cross-culturally adapted in nine different countries and seven languages in Europe.

Methodology

A standardized seven-step guideline was used to translate and culturally validate the questionnaires. The questionnaires were distributed in the respective countries and the psychometric values were analysed in order to verify consistency and validity.

Conclusion

Based on the validation process the instruments are considered to be validly adapted for the countries involved. The uniformity in the adaptation process allows for future

comparison of the countries.

Keywords: cross-cultural adaptation, evidence-based practice, epistemological beliefs

Introduction

This study is performing a multi country cross-cultural adaptation of two complementary questionnaires within the domain of physiotherapy. The Domain specific Epistemological Belief Questionnaire (DEBQ) and the Connotative-Aspects of Epistemological Beliefs (CAEB) can measure from different perspectives, the domain specific epistemological beliefs of physiotherapy. This research seeks to answer the following research question: Can the DEBQ and the CAEB questionnaires be cross-culturally adapted for different countries within Europe, while keeping the uniformity needed in order to be comparable?

This introduction draws first the context of this study and then the background of the cross-cultural adaptation.

Context

In physiotherapy one of the main demands is to work in the framework of evidence-based practice (1). This is a challenge, as the practitioner needs to constantly negotiate the individual context of the patient but also the fast and growing amount of external evidence. The evidence-based practice (EBP-) movement is facing various challenges (2,3,4,5,6). Challenges are; the suboptimal or even damaging care given to patients (3), the failure to get new knowledge to professionals (6), and the growing expenses (4). This makes a reorientation of the underlying concepts of the EBP movement necessary. The understanding of knowledge is one of the more fundamental but little researched underlying concepts (7).

The individual thinking of the physiotherapists, and how they develop their expertise, is based on how they define, individually or within the professional community, what relevant knowledge is and how they access this knowledge.

Knowledge could be considered to be certain and can be transferred from an authority to the professional. In this case the main challenge would be how to select the right information and how to transfer it (guidelines, education etc.) to the professional. An opposing view is to consider knowledge to be less certain, changeable and depending on the context and the persons involved. From this perspective, selecting and transferring knowledge becomes insufficient, because it is likely not taking the specificities of the context into consideration. The understanding of the local context and how other people think becomes then increasingly important. Because meaning can differ between persons and can be more or less explicit, communicating and sharing this specificity becomes a key factor (8). When evidence-based practice was adopted in physiotherapy little attention was given to the importance of the way knowledge was viewed (3).

This study aims to contribute to a better understanding of the way physiotherapists understand the nature of knowledge, which is a matter that concerns the field of personal epistemology (9). This research area focuses on what individuals believe about what counts as knowledge and where it resides, how individuals come to know, and how knowledge is constructed and evaluated (10). This is called epistemological beliefs. These beliefs can be divided in general beliefs and domain specific beliefs. In this study, the interest is in the specific beliefs of the domain physiotherapy (11). Epistemological beliefs influence how an individual physiotherapist in daily practice resolves competing knowledge claims, evaluates new information and takes decisions (12). When put on a continuum it shows on one side

naïve beliefs based on a certain and objective nature of knowledge coming from authoritive resources; on the opposite side a sophisticated perception in which the nature of knowledge is contextual, temporary and coming from a variety of resources.

There are several instruments to measure domain specific epistemological beliefs (9). The choice for the used questionnaires is made because they allow gathering data from a large population with a low financial and time investment. They also allow an attainable comparison between the respondents.

The choice of the questionnaires Domain specific Epistemological Belief Questionnaire (DEBQ) and Connotative-Aspects of Epistemological Beliefs (CAEB) is made based on their complementary perspective to measure the sophistication of the epistemological beliefs. Both questionnaires recognize different dimensions (or factors) in their construct. These factors specify the content and construct and thus the validity of the instruments.

The DEBQ is based on the assumption that people can make their beliefs explicit. Hofer and Pintrich (13) suggest that the individual beliefs about knowledge and knowing are organized in personal epistemological theories. It offers a way to conceptualize a disciplines specific understanding of epistemology (13,14,15). This is relevant, as it seems that epistemological assumptions of individuals are grounded in disciplinary contexts. This personal epistemology can also differ within a person when regarding different disciplines (9). This Epistemological theory recognizes five dimensions, which cluster in the two areas of epistemology; the nature of knowledge and the process of knowing (14) (Table 1).

Table 1 – Dimensions of knowledge sophistication

Nature of knowledge	
Certainty	At lower levels, absolute truth exists with certainty. At higher levels, knowledge is tentative and evolving.
Simplicity of knowledge	On the lower level, knowledge is seen as discrete, concrete, knowable facts; at higher levels individuals see knowledge as more relative, contingent, and contextual.
Process of knowing	
Source of knowledge	At lower levels knowledge resides in external authority. At higher levels knowledge is actively and socially constructed.
Justification of knowledge	At lower levels knowledge is judged through observation, gut feeling or authority at higher levels individuals use rules of inquiry and begin to personally evaluate and integrate the views of different resources.
Attainment of truth	The extent to which experts can attain deep knowledge (i.e., "truth") within their area of expertise. A high level of sophistication would put knowledge more in perspective.

(Copied with acknowledgement from the author; Hofer, 2000)

Most research shares the view that epistemological knowledge consists of declarative beliefs that can be articulated by the individual. This view is challenged by another viewpoint, defending that many beliefs are implicit and so less articulated.

Stahl and Bromme (16) introduce the distinction in interpretation of knowledge between explicit-denotive knowledge and associative-evaluative assumptions. Explicit-denotive knowledge refers to the more distal concept of knowledge *for* practice, which is relatively prescriptive, such as guidelines in physiotherapy or epistemological beliefs about science. The associative-evaluative assumption relates more to a proximal concept of knowledge *of* practice, being more personal, emotional and context dependent (17). Stahl et al. (16) developed a new instrument to measure these more connotative aspects. Connotative meanings evoke associative and evaluative judgments. The term comes from linguistics in which it refers to additional and individual meanings that a person associates with a concept/word. Two dimensions were developed (Table 2).

Table 2 – Dimension connotative meanings

Texture	beliefs about the structure and accuracy of knowledge. This dimension ranges from beliefs that knowledge is exact and structured to beliefs that it is unstructured and vague.
Variability	beliefs about the stability and dynamics of knowledge. This dimension ranges from beliefs that knowledge is dynamic and flexible to beliefs that it is stabile and inflexible.

(Copied with acknowledgement from the author; (Stahl & Bromme 2007)

In Europe, given the great diversity in cultures, it is of interest to see if epistemological beliefs are similar between areas. This confirmation would set the stage for a further international development of the framework of evidence-based practice.

Beaton, Bombardier, Guillemin and Ferraz (18) uses the term "cross-cultural adaptation" to emphasize that the adaptation is looking to both language (translation) and culture in the process of preparing a questionnaire to be used in another setting then it was developed and maintain validity (18). The origin of the DEBQ is the USA; the origin of the CAEB is Germany.

To keep the ambition attainable, we studied the international community of physiotherapy through the comparison of nine countries, representative of the Northern, Central and Southern Europe. The questionnaires were translated and culturally adapted for Finland, Denmark, The Netherlands, Italy, Spain, Portugal and for the German speaking countries Austria, Switzerland and Germany. The created surveys needed to be cross- culturally adapted but also (stay) comparable to each other for further research.

Methods

The methodology for the adaptation was based on the guidelines of Beaton et al. (18) and Isis Innovation (19). At some points the process was altered for practical reasons.

Description of the selected instruments

Both instruments are self-reported online questionnaires. The DEBQ uses a 5-points Likert scale; ranging from strongly disagree to strongly agree (14). The CAEB uses a sematic-differential scale with opposite adjectives with a 7-point Likert scale **(**16). The proposed factors were used (Table 3 and 4).

Table 3 - DEBQ - Discipline Epistemic Belief Questionnaire (Hofer, 2000).

	Items	**Factors Hofer R = reversed**
1.	Truth is unchanging in this subject.	Cert.
2.	In this subject, most work has only one right answer.	Cert.
3.	Sometimes you just have to accept answers from the experts in this field, even if you don't understand them.	Source
4.	What we accept as knowledge in this field is based on objective reality.	
5.	All professors in this field would probably come up with the same answers to questions in this field.	Cert.
6.	The most important part of working in this subject is coming up with original ideas.	
7.	If you read something in a textbook for this subject, you can be sure it is true.	Source
8.	A theory in this field is accepted as true and correct if experts reach consensus.	
9.	Most of what is true in this subject is already known.	Cert.
10.	Ideas in this subject are really complex.	
11.	In this subject, it is good to question the ideas presented.	Cert. **R**
12.	Correct answers in this field are more a matter of opinion than fact.	Just.
13.	If scholars try hard enough, they can find the answers to almost anything.	Att. of truth
14.	The most important part of being an expert in this field is accumulating a lot of facts.	
15.	I know the answers to questions in this field because I have figured them out for myself.	
16.	One expert's opinion in this field is as good as another's.	
17.	Experts in this field can ultimately get to the truth.	Att. of truth
18.	Principles in this field are unchanging.	Cert.
19.	Principles in this field can be applied in any situation.	
20.	If my personal experience conflicts with ideas in the textbook, the book is probably right.	Source
21.	There is really no way to determine whether someone has the right answer in this field.	Just.
22.	Expertise in this field consists of seeing the interrelationships among ideas.	

23.	Answers to questions in this field change as experts gather more information.	Cert. **R**
24.	All experts in this field understand the field in the same way.	Cert.
25.	I am more likely to accept the ideas of someone with first-hand experience than the ideas of researchers in this field.	Just.
26.	I am most confident that I know something when I know what the experts think.	Source
27.	First-hand experience is the best way of knowing something in this field.	Just.

(Copied with acknowledgement from the author; Hofer, 2000)

Table 4 - CAEB - Connotative Aspects of Epistemological Beliefs

Items	Factors Stahl R = reversed
1. Stable- Instable	Variability
2. Objective-Subjective	Texture
3. Confirmable- Unconfirmable	Texture
4. Dynamic- static	Texture
5. Superficial-profound	Texture
6. Temporary-everlasting	Variability
7. Exact- vague	Texture
8. Absolute-Relative	Texture
9. Sorted- Unsorted	Texture
10. Precise-Imprecise	Texture
11. Flexible-Inflexible	Variability
12. Definite-Ambiguous	Texture
13. Negotiated-Discovered	Texture
14. Structured-Unstructured	Texture
15. Completed-Uncompleted	Variability
16. Refutable-Irrefutable	Variability
17. Open-Closed	Variability

(Copied with acknowledgement from the author; Stahl & Bromme 2007)

Sample size and characteristics

Each of these countries had the following contributors, an in-country investigator, two translators, one or two back translators and a group of five physiotherapy students. The in-country investigators were all senior lecturers in teaching methodology. Most teams involved both psychologists and physiotherapists. Back translators were all bilingual. The choice for students to pilot the questionnaire was made, based on the literature that notices an increase in sophistication of epistemological beliefs when people gain education and experience (20). It was assumed that the understanding of the wording by the students would indicate that the language would be accessible to

the whole targeted population. For the German language countries (Germany, Austria and Switzerland) a single validation process was performed with a multi-country collaborators group of collaborators, in order to maximize the equivalence between the questionnaire and the original source, while still ensuring the countries specific culture.

Procedures

Permission to carry out the translation and validation of the instrument was requested from the authors of the original questionnaires.

The project leader instructed the in-country investigator in the adaptation process, which was structured in seven phases conform the guideline of Isis Innovation (19). Each phase supported with blue print forms to ensure attainability and uniformity.

- Forward translation
- Forward translation reconciliation
- Back translation
- Back translation review
- Pilot testing
- Pilot testing review
- Proofreading Forward

The project leader ensured harmonization between in-country investigators during the process (21). The project leader made the survey for both the pilot phase and the final version available in the online environment (Google Forms, www.google.com/drive).

The in-country investigators were selected from members of the European Network of Physiotherapy in Higher Education (22). The in-country investigators were also asked to distribute the survey in their country.

Distribution of the survey

The survey was distributed to the population of physiotherapists of each country in order to verify its psychometric qualities. The main distribution strategy was to use the academic network within the country.

The final version of the survey was distributed in seven languages and for nine countries between March-December 2015. For this study we considered a minimum of 100 responses from the countries where the survey was distributed to be included for the psychometric analysis (23). The statistical analyses to check the psychometric value of the survey were therefore done for Dutch (N=283), Portuguese (N= 277), Italian (N=218), Danish (N=151) Spanish (N=229), Finnish (N=105) and the German Speaking Countries (N=123), with in total 1386 respondents.

Data Analysis

The data recorded on the excel databases (per country) was exported for a single database created on the IBM® SPSS® version 22.

The internal consistency was assessed using Cronbach's alpha coefficient, a value between 0.70 and 0.95 is considered acceptable and indicates a high internal validity or reliability (24).

In order to confirm the construct validity for the DEBQ and CAEB a Confirmatory Factor Analysis was performed with the factors suggested in the original studies (14, 16). Based on the rule that the Initial Eigen values should be > 1,

in all countries a minimum of the proposed factors were recognized, allowing for a factor analysis (25). A principal component analysis (with varimax rotation) was performed for both questionnaires.

According to Hair, Anderson, Tatham and Black (26), the Measure of Sample Adequacy (MSA), reporting appropriateness for data for a factor analysis, is satisfactory with values > 80. If the MSA was lower we looked at Bartlett's Test of Sphericity, when this has an associated P value of <0.001 we could continue to perform a valid factor analysis.

Solutions were confirmed by successively omitting items with no substantial factor loadings (<.32) (24). Items were also omitted with high loadings (>.40) on more then one factor (28).

Results

The DEBQ was cross-culturally adapted for all nine countries. The CAEB was translated and validated for six countries, except Germany, Austria and Switzerland, as the original version was German (16). The investigator confirmed, with experts from the three German-speaking countries, the validity of the used linguistics for the cultures of Switzerland and Austria. For the other countries the English translation of the CAEB was used, which was translated and published by the same research group.

Results analysis of psychometric factors

The MSA was confirmed for the seven languages, as the values were acceptable together with the Bartlett's test (Table 5).

Table 5 – MSA and Bartlett per questionnaire per country

Countries	DEBQ	CAEB
	MSA plus Bartlett	MSA plus Bartlett
The Netherlands	.751 - .000	.798 - .000
Portugal	.753 - .000	.905 - .000
Denmark	.715 - .000	.805 - .000
Italy	.739 - .000	.822 - .000
Spain	.767 - .000	.840 - .000
Finland	.634 - .000	.802 - .000
German SC	.651 - .000	.786 - .000

Eigen values were sufficient for both questionnaires to perform a factor analysis (Table 6).

Table 6 - Total Variance explained

a) DEBQ – confirmatory factors

Country	**Factor 1**		**Factor 2**		**Factor 3**		**Factor 4**		**Total explained variance %**
	Eigen Value	% Variance	Eigen Value	% Variance	Eigen Value	% Variance	Eigen Value	% Variance	
NL	3.78	13.88	2.07	7.65	2.02	7.48	1.96	7.27	36.30
PT	3.82	14.13	2.26	8.39	2.14	7.93	1.99	7.39	37.85
DK	3.58	13.25	2.90	10.74	2.29	8.49	2.08	7.69	40.17
IT	2.99	11.06	2.95	10.93	2.53	9.37	2.34	8.66	40.02
ES	3.91	14.50	2.87	10.62	2.03	7.51	1.90	7.02	39.64
FI	3.82	14.16	2.93	10.84	2.38	8.81	2.01	7.44	41.24
GSC	2.88	10.68	2.61	9.68	2.28	8.46	2.27	8.41	37.23

b) CAEB – confirmatory factors

Country	**Factor 1**		**Factor 2**		**Total explained variance %**
	Eigen Value	% Variance	Eigen Value	% Variance	
NL	4.05	23.80	2.67	15.72	39.52
PT	4.63	27.23	4.43	26.04	53.27
DK	4.54	26.69	3.30	19.42	46.11
IT	4.10	24.09	3.22	18.94	43.03
ES	4.66	27.44	2.98	17.55	44.99
FI	4.42	26.00	2.81	16.53	42.54
GSC	4.50	26.46	2.66	15.66	42.19

DEBQ

The overall result from the DEBQ shows a consistent result with a Cronbach alpha with omitted items between .70 and .77 in the countries. For all countries the four factors from the original article were reproduced, however the loading of the items do not occur consistently compared to the original study and in between the countries. The Cronbach alphas from the factor Certainty/Simplicity show an equal or higher number (between 0.67 - 0.79) compared to 0.66 in the original study. For the other three factors the Cronbach alpha are low for all countries (Table 7).

Table 7 DEBQ – Cronbach Alpha factor analysis

Country	Total	Omitted items	Factor Certainty/ simplicity	Factor Attainment of truth	Factor Source	Factor Justification
NL	.750	.736 (25)	.769	.567	.541	.268
PT	.740	.746 (24)	.779	.601	.507	-
DK	.754	.738 (23)	.759	.684	.479	.615
IT	.793	.749 (21)	.671	.412	.649	.586
ES	.796	.777 (23)	.762	.663	.380	-
FI	.686	.709 (25)	.746	.645	.481	.454
GSC	.691	.729 (18)	.644	.473	.366	.355

CAEB

The Cronbach alpha from the CAEB shows satisfactory to good internal consistency (between .70 and .92). Items, when accepted, show a 100% consistency on which factor they load in between countries. Item 1 and 15 loaded consistently on the texture factor, while, according to the original study in content they belong to the variability

factor. Item 4 also loaded consistently opposite as suggested in the original study but on the variability factor. The factor variability in the Finnish questionnaire lacks consistency (Table 8).

Table 8 CAEB – Cronbach Alpha factor analysis

Country	Total	Omitted items (amount)	Factor Texture	Factor Variability
NL	.782	.793 (14)	.823	.727
PT	.904	.916 (14)	.908	.821
DK	.852	.820 (14)	.838	.769
IT	.822	.821 (15)	.819	.760
ES	.809	.816 (15)	.848	.776
FI	.732	.701 (11)	.804	.531
GSC	.832	.839 (16)	.837	.752

Correlation between the questionnaires

The instruments show some convergent validity in negative low correlations found between the DEBQ factor certainty/simplicity and the CAEB factor texture. Given the opposite direction in scoring of the items of the CAEB factor texture this negative correlation could be expected. Between the DEBQ factor certainty/simplicity and the CAEB factor variability only for the Netherlands (.134, p = .026) and for the total (.130, p = .000) a weak correlation was found (Table 9).

Table 9 DEBQ- CAEB correlations

Country	Pearson R – Correlation (Significance/ p-value)
	DEBQ Certainty and simplicity- CAEB Texture
NL	
PT	-.314 (.000)
DK	-.143 (.017)
IT	-.321 (.000)
ES	-
FI	-.168 (.011)
GSC	-.369 (.000)
	-.263 (.003)
Total	
	-.217 (.000)

Discussion

The discussion starts by addressing the general process and the limitations of the parallel adaptation of the two questionnaires, followed by the psychometric analysis.

Adaptation process

The adaptation process followed the guideline from Isis Innovation (19). For practical reasons the guidelines recommendation to conduct two back translations with bilingual professionals was not followed. Instead, one translation per country was performed, and the country collaborators assessed its similarity with the original translation. When considered necessary, a second translation was performed, which only happen with the Portuguese version. Beaton et al. (18), describe the expert team (being in this study the project leader and the country teams) to be composed out of a methodologist, a health professional and a language professional. The absence of a language professional in most of the teams was a shortcoming in the process.

Every adaptation process has its own dynamics and timeframe. Doing a multi-country cross cultural adaptation in order to compare outcomes between different

countries possesses a challenge between the cultural adaptation in one specific country and the aim to keep the products comparable for the studies to follow. The main points of discussion during the process are now presented.

The different phases in the adaptation process per country influenced if and how the different countries would influence each other. In the Dutch translation the decision was made to not use the phrase ‘in this field’ as being too abstract and ‘anchor’ with the term ‘ons vakgebied’ which literally translates to ‘our discipline’. This seemed to improve the understanding of the questionnaire significantly. This was, partly and in retrospective, confirmed by the study of Muis, Duffy, Trevors, Ranellucci and Foy (29), which advices to use the term of the specific profession, ic physiotherapist, instead of the term ‘expert’ to improve validity. This adjustment, considered to be a general improvement, has not been implemented in all countries because at the time of this deliberation some questionnaires were already distributed. The discussion around the meaning and the translation of the words ‘expert’, ‘professors’ and ‘scholars’ in the DEBQ was resolved in deliberation with the project leader to ensure the same meaning and then considered within the specific language.

For the translation of de CAEB the English translation was used. Although published in English in many peer-reviewed articles, to our knowledge, the questionnaire is never formally adapted for the English language. The translation has been discussed within the German team and proved to be satisfactory. The interpretation of the meaning of the terms of the CAEB has been in general of difficulty for both translators and the respondents in the pilot phase. The most common feedback was the feeling that the questionnaire was fairly ‘abstract’. Some terms seem to be repetitive but phrased differently and particularly the terms ‘Negotiated-Discovered’ was not always clearly understood. As the nature of a

semantical differential is to judge about the topic in an associative and evaluative way, the more abstract character was considered to be a part of the construct. It was also hypothesized that the difficulty to give meaning to some of the terms could be a result of a more naïve epistemological belief. In this study the choice was made to stay as close as possible to the wording used in the original article.

Psychometric analysis

In general, research in epistemological beliefs has shown a low consistency and the factor structure does not always appear to be stable (30, 11). Conceptually there is still debate about the number and the nature of the dimensions (factors) and the philosophical consideration in which the concept is based upon (29). Further investigation is required to establish this validity. This study revealed flaws in psychometric values, which are common in other comparable studies (7, 11, 27). The general low consistency is confirmed in the adaptation process for the DEBQ. The stability of the CAEB factors revealed more consistent than expected, based on the difficulties of other studies trying to reproduce the factors (27, 31).

The DEBQ and the CAEB show a low explained variance, which indicates that adding more factors and developing the content validity of the questions could increase this number. Below the questionnaires are individually discussed in more detail and alternative strategies are discussed.

DEBQ

The proposed 4-factor structure in de DEBQ showed for all seven languages. The low explained variance, the Keiser-criterion and the amount of omitted items in the questionnaire seem to indicate a possibility for the existence of other relevant factors

However in the analysis of the questions of the DEBQ many questions in especially the factors of ‘source’ and ‘justification’ seem to be multi-interpretable, jeopardizing the construct validity of the instrument. Focussing on cognitive validity could reinforce the interpretation from the researchers about the respondents’ opinions. Using self-report surveys and relying on the interpretation of intrinsically abstract constructs, like epistemology, a thorough research of the cognitive validity is recommended (32). Muis, et al. (29) have indicated a quite consistent cognitive validity of the DEBQ questions, however it is also stated that it can be improved significantly.

CAEB

The CAEB shows also an opportunity to add a factor based on the Eigen values of the proposed factors in SPSS® version 22 and based on the content analysis that shows for all countries low loadings on the same four items. It was hypothesized that the lower consistency on the Variability factor for Finland is due to the comparatively low response. This should be further researched.

The relation between the DEBQ and the CAEB

The CAEB and the DEBQ were both employed in order to measure the same construct; sophistication of epistemological beliefs, however they measure different layers in the concept. Some convergent validity could be expected, as the dimension certainty/simplicity is similar to the dimensions ‘texture’ and ‘variability’ in the CAEB (27). The hypothesized correlations between the two instruments on these variables show weak correlations. Although the relation is present, the weakness of the correlation could be explained because of the difference between the denotive and connotative nature of the questionnaires (Table 9).

The relation between the countries

The construct validity of the DEBQ and the CAEB is strengthened by the comparable internal consistency of the DEBQ and CAEB questionnaires in total, as well as for the factors showing consistency. The same reasoning is valid for the little variance in item loading for the CAEB.

Conclusion

All instruments maintained their initial structure and content allowing for comparison between countries in the future. The two questionnaires DEBQ and CAEB are, based on their psychometric properties, sufficiently cross-cultural adapted for their countries. The problems regarding the stability of the factor loading occur similarly as in the original instruments. Only factors with a sufficient consistency can be used in further research, which seems to be different per context and therefore should be treated likewise.

The existence of the adapted questionnaires could measure the development of sophistication of epistemological beliefs as a determinant of evidence-based physiotherapy practice in national contexts. Because of the comparability between countries, differences between countries can facilitate dialogue and evoke international development of the underlying concepts of the evidence-based practice movement.

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Study 2 - Article 2. Attitude and readiness for EBP in European physiotherapists - A multi-country cross-cultural adaptation for the EBP-questionnaire.

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Abstract

Aims

This article assumes that the underlying concepts of evidence-based practice need to be improved. This improvement is best done in an international endeavour, but this would be only viable if countries are comparable in the attitude and readiness towards Evidence-based practice. This study cross-culturally adapts an EBP questionnaire in nine different countries and seven languages in Europe in order to validate the instrument to measure and compare this attitude and readiness between countries.

Methodology

A standardized seven-step guideline was used to translate and culturally validate the questionnaires. The questionnaires were distributed in the respective countries and the psychometric values were analysed in order to verify consistency and validity.

Conclusion

Based on the validation process the instruments are considered to be validly adapted for the countries involved. The uniformity in the adaptation process allows for future comparison of the countries.

Keywords: physiotherapy, cross-cultural adaptation, evidence-based practice,

Context

In physiotherapy one of the main demands is to work in the framework of evidence-based practice (Dijkers, Murphy & Krellman, 2012). This is a challenge, as the practitioner needs to constantly negotiate the individual context of the patient but also the fast and growing amount of external evidence. The evidence-based practice (EBP) movement is facing various challenges (Graham, Logan, Harrison, Straus, Tetroe, Caswell & Robinson, 2012; Marks, 2002; Greenhalgh, Howick & Maskrey, 2014; Grol & Grimshaw, 2003). Challenges are; the suboptimal or even damaging care given to patients (Marks, 2002), the failure to get new knowledge to professionals (Grimshaw, Eccles, Lavis, Hill & Squires, 2006), and the growing expenses (Greenhalgh, Howick & Maskrey, 2014). This makes a reorientation of the underlying concepts of the EBP movement necessary. Evidence-based practice has been implemented in physiotherapy education and practice since the early nineties. Since then critics also focussed on he importance and the dependency of the local context and beliefs of the people in this locality. The evidence based practice movement has been developed in an era of globalization. In the last 20 years physiotherapy is slowly using the potential to share experience and knowledge, enormously helped by the technological developments, to develop an international knowledge society (Stehr, 1994; Barnett, 2009). Given this international perspective the assumption is that this international community has a positive attitude towards Evidence Based Practice. This study developed the Evidence Based Practice questionnaire (EBP-questionnaire) to confirm the positive attitude towards EBP of physiotherapists. Another dimension of interest is the readiness for EBP. In other words; are physiotherapists competent and equipped to perform evidence based? Items were extracted from an originally much bigger questionnaire developed by Jette et al. (Jette et al. 2003). Especially in Europe, given the great diversity in languages and cultures in a relatively small area, it is of interest to see how evidence-based practice is viewed between areas. The confirmation this is similar would set the stage for a further international development of the framework of evidence-based practice, while differences perhaps would set the stage for a more tailor made approach.

Beaton et al. (2002) uses the term “cross-cultural adaptation” to emphasize that the adaptation is looking to both language (translation) and culture in the process

of preparing a questionnaire to be used in another setting then it was developed and maintain validity (Beaton, Bombardier, Guillemin & Ferraz, 2002). The original questionnaire of Jette comes from the USA.

To keep the ambition attainable, we studied the international community of physiotherapy through the comparison of nine countries, representative of the Northern, Central and Southern Europe. The questionnaires were translated and culturally adapted for Finland, Denmark, The Netherlands, Italy, Spain, Portugal and for the German speaking countries Austria, Switzerland and Germany. The created surveys needed to be cross- culturally adapted but also (stay) comparable to each other for further research.

The adaptation of the EBP questionnaire was done together with two other questionnaires measuring the way physiotherapist understands knowledge in order to tap into these underlying concepts of evidence-based practice, for more detail see Beenen et al., 2016 (Beenen et al., 2016).

Methods

EBP questionnaire (Modified from Jette et al., 2003)

Type - Self-reported online questionnaire with Statements about attitude and beliefs regarding EBP and education, knowledge and skills in EBP.

Scale - 5 points Likert – From Strongly disagree to Strongly agree

Analysis - Originally done by first collapsing the items and then performing a logistic regression analysis, resulting in Odds-ratios.

Items - for the purpose of the general research, only specific items of this questionnaire were subjected to the validation process (table 1)

Table 1 - EBP questionnaire (modified from Jette, 2003).

Items
1. Application of EBP is necessary in the practice of physical therapy.
2. Literature and research findings are useful in my day-to-day practice.
3. The adoption of EBP places an unreasonable demand on physical therapists.
4. EBP improves the quality of patient care.
5. EBP does not take into account the limitations of my clinical practice setting.
6. My reimbursement rate will increase if I incorporate EBP into my practice.
7. Strong evidence is lacking to support most of the interventions I use with my patients.
8. EBP helps me make decisions about patient care.

9. EBP does not take into account patient preferences.
10. I learned the foundations for EBP as part of my academic preparation.
11. I have received formal training in search strategies for finding research relevant to my practice.
12. I am familiar with the search engines for literature.
13. I received formal training in critical appraisal of research literature as part of my academic preparation.
14. I am confident in my ability to critically review professional literature.
15. I am confident in my ability to find relevant research to answer my clinical questions.

Sample size and characteristics

Each of these countries had the following contributors, an in-country investigator, two translators, one or two back translators and a group of five physiotherapy students. The in-country investigators were all senior lecturers in teaching methodology. Most teams involved both psychologists and physiotherapists. Back translators were all bilingual. The choice for students to pilot the questionnaire was made, based on the literature that notices an increase in sophistication of epistemological beliefs when people gain education and experience (20). It was assumed that the understanding of the wording by the students would indicate that the language would be accessible to the whole targeted population. For the German language countries (Germany, Austria and Switzerland) a single validation process was performed with a multi-country collaborators group of collaborators, in order to maximize the equivalence between the questionnaire and the original source, while still ensuring the countries specific culture.

Procedures

Permission to carry out the translation and validation of the instrument was requested from the authors of the original questionnaire.

The project leader instructed the in-country investigator in the adaptation process, which was structured in seven phases conform the guideline of Isis Innovation (Isis Innovation, 2010). Each phase supported with blue print forms to ensure attainability and uniformity.

1. Forward translation
2. Forward translation reconciliation
3. Back translation
4. Back translation review

5. Pilot testing
6. Pilot testing review
7. Proofreading Forward

The project leader ensured harmonization between in-country investigators during the process (Wild, Grove, Martin, Eremenco, McElroy, Verjee-Lorenz & Erikson, 2005). The project leader made the survey for both the pilot phase and the final version available in the online environment (Google Forms, www.google.com/drive).

The in-country investigators were selected from members of the European Network of Physiotherapy in Higher Education (ENPHE, 2016). The in-country investigators were also asked to distribute the survey in their country.

Distribution of the survey

The survey was distributed to the population of physiotherapists of each country in order to verify its psychometric qualities. The main distribution strategy was to use the academic network within the country.

The final version of the survey was distributed in seven languages and for nine countries between March-December 2015. For this study we considered a minimum of 100 responses from the countries where the survey was distributed to be included for the psychometric analysis (Ferguson & Cox, 1993). The statistical analyses to check the psychometric value of the survey were therefore done for Dutch (N=283), Portuguese (N= 277), Italian (N=218), Danish (N=151) Spanish (N=229), Finnish (N=105) and the German Speaking Countries (N=123), with in total 1386 respondents.

Data Analysis

The data recorded on the excel databases (per country) was exported for a single database created on the IBM® SPSS® version 22.

The internal consistency was assessed using Cronbach's alpha coefficient, a value between 0.70 and 0.95 is considered acceptable and indicates a high internal validity or reliability (Maroco & Garcia-Marques, 2006).

In order to confirm the construct validity an Exploratory Factor Analysis was performed. Ideally a reference would exist from the questionnaire the items were extracted from, however this study did not report a factor analysis.

Based on the rule that the Initial Eigen values should be > 1, in all countries a minimum of 4 factors were recognized, allowing for a factor analysis (Comrey & Lee, 1992). A principal component analysis (with varimax rotation) was performed for both questionnaires.

According to Hair, Anderson, Tatham and Black (Hair, Anderson, Tatham &Black, 1998), the Measure of Sample Adequacy (MSA), reporting appropriateness for data for a factor analysis, is satisfactory with values > 80. If the MSA was lower we looked at Bartlett's Test of Sphericity, when this has an associated P value of <0.001 we could continue to perform a valid factor analysis.

Solutions were confirmed by successively omitting items with no substantial factor loadings (<.32) (Maroco & Garcia-Marques, 2006). Items were also omitted with high loadings (>.40) on more then one factor (Brown, 2009).

Results

The EBP questionnaire was translated for 6 languages (appendix 14) except for Portugal where it already existed. For Portugal the questionnaire was validated by: Filipe, E., Lopes, A. & Lopes, A. F. (2004). The questions were put in the same format as the other languages and then performed the same pilot procedure as described in step 5-7 in the used guideline.

Results analysis of psychometric factors

The MSA was confirmed for the seven languages, as the values were acceptable together with the Bartlett's test (Table 2).

Table 2 – MSA and Bartlett per country

Countries	MSA plus Bartlett
The Netherlands	.820 - .000
Portugal	.786 - .000
Denmark	.732 - .000
Italy	.770 - .000
Spain	.786 - .000
Finland	.825 - .000
German SC	.746 - .000

The Eigen value was sufficient to perform a factor analysis (Table 3). Allowing four factors for all countries, with the exception of the German Speaking Countries which showed 5 factors (Table 3).

Table 3 – Exploratory factors

Country	Factor 1		Factor 2		Factor 3		Factor 4		Factor 5		Total explained variance %
	Eigen Value	% Variance	Eigen Value	% Variance	Eigen Value	% Variance	Eigen Value	% Variance	Eigen Value	% Variance	
NL	3.82	27.30	2.39	17.05	1.80	12.86					57.22
PT	2.61	18.64	2.50	17.88	1.95	13.90	1.96	13.97			64.39
DK	3.22	23.02	2.49	17.75	1.57	11.22	1.64	11.70			63.69
IT	3.01	21.46	2.82	20.15	1.59	11.34	1.63	11.67			64.63
ES	3.63	25.93	2.52	17.97	1.37	9.77	1.62	11.58			65.24
FI	4.26	30.45	2.86	20.44	1.89	13.48					64.37
GSC	2.91	20.77	2.37	16.90	2.23	15.89	1.26	9.00	1.21	8.01	70.57

Exploratory Factor Analysis

The overall consistency of the questionnaire is mixed. After analyzing the loading and the items, four factors could be defined (table 4):

Table 4 - Factors EBP questionnaire

- Formal education in EBP: At a low agreement the respondent didn't get the formal education in the concept of EBP and the skills to execute EBP in practice. On higher agreement the respondent received this education.
- Utility of EBP: At low agreement the respondent has a negative interpretation of the value of EBP for his practice. On high agreement respondents have a positive attitude towards the value of EBP for practice.
- Skills: On low levels of agreement the respondent doesn't feel competent to find, judge interpret and incorporate evidence really into practice. On higher levels of agreement the respondent feels confident in doing so.
- Barriers: On low level of agreement the respondent does not agree with general perceived barriers in EBP, on high agreement they do agree with the barriers.

Item six; '*My reimbursement rate will increase if I incorporate EBP into my practice'*, was considered to be not relevant for the maiority countries, as their reimbursement rates were fixed. As the aim of the questionnaire is to compare countries on the positive atittude and readiness for EBP it was decided not to include this item in the analysis.

The exploratory factor analysis showed clear and uniform factor loadings for the factors of 'education' and 'utility' with satisfying consistency with the exception of the German Speaking Countries. The items also load consistent between countries on the same factors (table 5 a, b, c, d, e, f, g). The items referring to the factor 'Skills', loaded sometimes on the factor education. The factor 'barriers' showed overall a lower consistency with the exception of the Netherlands.

Table 5 - Results factor analysis EBP

a) Netherlands

	Factors			
Item	Formal Education	Utility	Skills	Barriers
1		.745		
2		.669		
3				.680
4		.769		
5				.765
6		.384		
7		.748		
8				.745
9	.679			
10	.824			
11	.867			
12	.836			
13	.707			
14	.776			
Cronbach	*.878*	*.700*		*.689*

Cronbach of the validated questionnaire: .650

b) Portugal

	Factors			
Item	Formal Education	Utility	Skills	Barriers
1		.835		
2		.763		
3				.703
4		.781		
5				.842
6				.419
7		.622		
8				.691
9	.802			
10	.850			

11*	(.663)		(.454)	
12	.803			
13			.860	
14			.907	
Cronbach α	*.791*	*.778*	*.845*	*.624*

Cronbach α of the validated questionnaire: .668
Cronbach α with omitted items (13): .611

* Double loading - omitted

c) Denmark

	Factors			
Item	Formal Education	Utility	Skills	Barriers
1		.793		
2		.657		
3				.748
4		.806		
5				.779
6				
7		.652		
8*		(.500)		(.508)
9	.568			
10	.868			
11	.864			
12	.848			
13*	(.480)		(.693)	
14*	(.563)		(.685)	
Cronbach	*.830*	*.738*		*.520*

Cronbach of the validated questionnaire: .739
Cronbach with omitted items (11): .625

* Double loading - omitted

d) Italy

	Factors			
Item	Formal Education	Utility	Skills	Barriers
1		.890		
2		.808		
3				.682
4		.823		
5				.773
6				.530
7		.740		
8				.489
9	.886			
10*	(.545)		(.482)	
11			.834	
12*	(.657)		(.565)	
13	.908			
14	.889			
Cronbach	.514	*.845*		*.479*

Cronbach of the validated questionnaire: .737
Cronbach with omitted items (12): .687

* Double loading - omitted

e) Spain

	Factors			
Item	Formal Education	Utility	Skills	Barriers
1		.841		
2		.652		
3*	(.454)*			(.586)*
4		.831		
5				.803
6	.744			
7		.678		
8				.758
9	.586			
10	.809			
11	.883			
12	.817			
13	.808			
14	.772			
Cronbach	*.845*	*.784*		*.541*

Cronbach of the validated questionnaire: .729
Cronbach with omitted items (13): .750

* Double loading - omitted

f)Finland

	Factors			
Item	Formal Education	Utility	Skills	Barriers
1		.776	Did not load	
2		.788		
3*		(.403)		(.561)
4		.852		
5				.756
6*	(.448)			(.566)
7		.672		
8				.703
9	.664			
10	.823			
11	.787			
12	.828			
13	.840			
14	.823			
Cronbach	*.908*	*.839*		*.391*

Cronbach of the validated questionnaire:.739
Cronbach with omitted items (13): .786

* Double loading - omitted

g) German Speaking Countries

	Factors			
Item	Formal Education	Utility	Skills	Barriers
1		.769		
2*		(.546)	(.550)	
3		.403		
4		.761		
5*				
6				.870
7		.633		
8				.559
9	.918			
10	.937			
11	(.455)		(.587)	
12*	.864			
13			.790	
14			.820.	
Cronbach	*.928*	*.534*	*.868*	*.380*

Cronbach of the validated questionnaire: .704
Cronbach with omitted items (11): .629

* Double loading or not loaded - omitted

Discussion

The EBP questionnaire aims to confirm the assumption that physiotherapists have a positive opinion towards the concept of evidence-based practice and shows the level of education, skills and context (readiness) in order to execute this. The original questionnaire from Jette (2003) had a broader intention including the behavior in EBP leading to an extensive questionnaire (Jette et al., 2003). For the specific goal in this study and for the practical reason to keep the survey attainable by limiting the items, only items were used from the same categories (respectively 'nature and beliefs about EBP' and 'education, knowledge, and skills related to obtaining and evaluating evidence') of the original questionnaire. This limits the comparability of the two questionnaires; moreover introducing dimensions for the questionnaire jeopardized this comparison. The analysis of the original questionnaire collapsed the used Likert scale in order to be able to perform linear regression analyses. The factors found represent the categories of the original questionnaire. Interesting is the separation in two factors 'formal education' and 'skills'. Because the factor 'skills' is described to really get evidence and implement this in practice, the two factors differentiated from what people got in the university and the, often perceived, difficulty to execute this in

practice. However in the loading of the items this did not differentiate well.

As this questionnaire derived it's items from a wider orientated questionnaire and was developed 15 years ago the validity could be improved in performing a content analysis of the items. The items seem to be, implicitly based on a classic interpretation of Evidence Based Practice of Sackett (1996), focusing more on the scientific source of evidence (see for a discussion; Dijkers, Murphy & Krellman, 2012). Other interpretations and critics have been formulated since. The respondent can have another, more nuanced, view on evidence-based practice. For example by favouring more the patient values in the definition of Sackett. This can influence the interpretation of the items. On the question 'I learned the foundations of EBP as part of my academic preparation', the respondent could, based on the lack of attention for patient values, respond with more disagreement, while the researchers might think he did not have enough fundament in the necessity of the scientific resource. A cognitive validity test could support this analysis (Karabenick et al., 2007). Especially the factor 'barriers' needs attention as the formulated barriers are defined in the USA in the beginning of the millennium with a certain perspective of EBP in the mind. This can be different in time and places. An example is the validation of the original questionnaire for the Swedish context, which changed the questionnaire substantially (Heiwe, 2011; Bernhardsson & Larsson, 2013). However for the purpose of this study, the wish to be able to compare between countries demanded certain uniformity. For answering the main question if a sample has a positive attitude towards EBP and a certain readiness it can be argued to leave the items relating to the perception of barriers out.

Adaptation process

The adaptation process followed the guideline from Isis Innovation (Isis Innovation, 2010). For practical reasons the guidelines recommendation to conduct two back translations with bilingual professionals was not followed. Instead, one translation per country was performed, and the country collaborators assessed its similarity with the original translation. When considered necessary, a second translation was performed, which only happen with the Portuguese version. Beaton et al. (Beaton et al., 2002), describe the expert team (being in this study the project leader and the country teams) to be composed out of a methodologist, a health professional and a language

professional. The absence of a language professional in most of the teams was a shortcoming in the process.

Every adaptation process has its own dynamics and timeframe. Doing a multi-country cross cultural adaptation in order to compare outcomes between different countries possesses a challenge between the cultural adaptation in one specific country and the aim to keep the products comparable for the studies to follow.

Psychometric analysis

The overall consistency of the questionnaire has a big spread ranging from .61 to .79 and need therefor further analysis.

The factor analysis was done for the first time for this questionnaire, showing promising results for at least the factors utility and the formal education and skills. Further studies need to confirm these factors and their stability.

Conclusion and recommendations

The questionnaire maintained its initial structure and content, allowing for comparison between countries in the future and is, according to the norms of the Isis Innovation, cross-culturally adapted. However based on the psychometric values, only the results of Finland turned out to be sufficient. For the other countries the weak internal consistency after omitting items in the loading process demands a re-evaluation, the way the items double load on the two factors 'formal education' and 'skills' promises to have other options in the construct.

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Appendices

Due to the norms for the article 1 according to the journal, the appendices are not reffered along the text.

The appendices related with these 2 articles are available on the CD attached, under Study 2 – Appendices, with the following content:

Appendix_1_DEBQ_original
Appendix_2_CAEB_orginal
Appendix_3_EBP_Original
Appendix_4_Authorization_ questionnaires
Appendix_5_Instruction_cross_ country_adapation
Appendix_6_doc P1 existing surveys
Appendix_7_doc P2 Forward Translation
Appendix_8_doc P3 Forward Translation Reconciliation
Appendix_9_doc P4 Report Forward Translation Reconciliation
Appendix_10_doc P5 Phase 4 Back translation
Appendix_11_doc P6 Report Back Translation
Appendix_12_Doc P7 Phase 6 Pilot testing and pilot testing report
Appendix_13_doc P8 student comments_PT
Appendix_14_adapted_questionnaires
Appendix_15_validation_NL
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Appendix_18_validation_IT

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Appendix_20_validation_D_Ch_A

Appendix_21_validation_FI

Appendix_22_validation_DK

Appendix_23_factor_analysis_cronbach

Appendix_24_correlations

3.3 Study 3 - Epistemic beliefs and attitudes towards evidence based practice in physiotherapy - A multi-country (Europe) cross sectional online survey study

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Abstract

This article explores the epistemic beliefs of physiotherapists in 10 different countries in Europe. The study confirms the assumption that Evidence Based Practice as a framework to understand practice is a general and positively regarded model in these countries. Epistemic beliefs, or how physiotherapist view knowledge and how they come to this knowledge, is an important factor. High sophistication of epistemic beliefs are linked with better handling of divers and complex frames of references, a better contextualization of knowledge, more self-regulation and more cognitive flexibility. All capabilities that could help physiotherapists to deal with the complexity they are faced with in practice. The study resulted in 1416 surveys from 9 different countries. The results confirm the positive attitude and readiness towards EBP. The epistemic beliefs proof to be little different between countries showing a moderate sophistication in EB. This results in the possibility to define epistemic beliefs as a determinant that can improve the functioning of physiotherapists.

Keywords: Epistemic beliefs, Physiotherapy, Evidence Based Practice.

Introduction

This article reports a research of the positive attitude and readiness towards evidence based practice and the epistemic beliefs of physiotherapists throughout the community of physiotherapist in Europe. Assumed is that sophisticated epistemic beliefs, as part of the understanding of practice of physiotherapists, can be a determinant in improving evidence based practice. However epistemic beliefs are little researched in physiotherapy. Therefor the article starts with a theoretical background to explain the concept of epistemological beliefs in relation to physiotherapy practice.

Background

Part of the understanding of practice is the understanding of knowledge. This is the territory of epistemology, which can be defined as the nature and justification of human knowledge (Hofer, 2001). How individuals view knowledge and knowing is studied in the field of personal epistemology, focusing on what individuals believe about what counts as knowledge and where it resides, how individuals come to know,

and how knowledge is constructed and evaluated (Hofer, 2008). This influence how an individual resolve competing knowledge claims, evaluate new information and take decisions (King & Kitchener, 1994) and thus is able to work evidence based.

In the literature epistemic beliefs and epistemological beliefs are used interchangeable. However as they are beliefs about knowledge and knowing (the epistemic) and not beliefs about epistemology in this study epistemic beliefs are used (King & Kitchener, 2002).

Research in Personal epistemology

Little research is specifically done in the area of epistemic beliefs in education and less so in medical and physiotherapy education or practice (Bientzle, Cress & Kimmerle, 2014). This is a shortcoming as epistemic beliefs '*determine how (new) knowledge is perceived and processed*' (Roex, Clarebout, Dory & Degryse, 2009). This is a major issue in evidence based practice in health care.

Personal epistemology has its roots in cognitive psychology with two main positions, one view personal epistemology from a developmental perspective; the other assumes a system of independent beliefs. Both positions are discussed briefly from a historic perspective, and the most commonly used frameworks are illustrated. For a more detailed explanation and the continuous controversy about the dimensions see the excellent overviews of Hofer & Pintrich and Buehl & Alexander (Hofer & Pintrich, 1997; Buehl & Alexander, 2008).

The position of 'epistemological development' emphasizes that individuals move through a patterned sequence of development of their ideas about knowledge and knowing throughout life (Hofer & Pintrich, 1997). Different sequences are identified on base of different focus that has led to several slightly different models (Hofer & Pintrich, 1997). However all the models share the assumption of a quite linear development in stages from a naive view of knowledge towards more sophisticated views. This developmental line starts with a view of knowledge as certain, unambiguous, and dichotomous. Knowledge is either true or not true and is learned

from an authority. This objectivist view is challenged when someone is recognizing shades of grey and different authorities, meaning different perspectives of trues. Knowledge is then viewed as highly subjective; a multiplistic stance. This subjectivity is challenged by the notion that some points of view are better than others and that evidence plays a role in supporting one's position. In the final stage people have a critical stand towards knowledge and knowing is coordinated with justification of knowledge (Hofer, 2001).

The position of ' independent beliefs' challenges the uniformity of dimensions that is assumed in the linear development in personal epistemology and orientates on more or less independent dimensions of knowing and learning. Schommer (1992) identified five hypothesized dimensions of which four (Table 1) has been validated in empirical research, each factor offering a continuum from a naive to a more sophisticated viewpoint (Schommer, 1992).

Table 1 – Dimensions of beliefs sophistication

Certain Knowledge	knowledge is certain versus knowledge is tentative and evolving
Simple knowledge	knowledge is isolated, unambiguous bits of information versus knowledge as highly interrelated concepts
Quick learning	learning occurs quickly or not at all vs. learning as gradual enterprise
Fixed ability	intelligence is fixed versus intelligence is incremental

Hofer and Pintrich suggest that the individual beliefs about knowledge and knowing are organized in personal epistemological theories, as structures of interrelated propositions that are interconnected and coherent (Hofer & Pintrich, 1997). It offers a way to conceptualize a discipline specific understanding of epistemology (Hofer, 2000). This is important, as it seems that epistemological assumptions of individuals are grounded in disciplinary contexts. However they can also differ within a person regarding different disciplines (Hofer, 2001). For example; a physiotherapist can view the epistemology of physicians more or less sophisticated then the epistemology of occupational therapy. This Epistemological theory recognizes five dimensions, which cluster in the two areas of epistemology; the nature of knowledge and the process of knowing (table 2).

Most research in epistemological beliefs share the view that epistemological knowledge, whether naive or sophisticated, consists of declarative beliefs that can be articulated by the individual. This view is challenged by another viewpoint, arguing that many beliefs are implicit and so less articulated.

Table 2 – Dimensions of knowledge sophistication

Nature of knowledge	
Certainty	At lower levels, absolute truth exists with certainty. At higher levels, knowledge is tentative and evolving.
Simplicity of knowledge	On the lower level, knowledge is seen as discrete, concrete, knowable facts; at higher levels individuals see knowledge as more relative, contingent, and contextual.
Process of knowing	
Source of knowledge	At lower levels knowledge resides in external authority. At higher levels knowledge is actively and socially constructed.
Justification of knowledge	At lower levels knowledge is judged through observation, gut feeling or authority at higher levels individuals use rules of inquiry and begin to personally evaluate and integrate the views of different resources.
Aattainment of truth	The extent to which experts can attain deep knowledge (i.e., "truth") within their area of expertise. A high level of sophistication would put knowledge more in perspective.

Stahl and Bromme introduce the distinction in interpretation of knowledge between explicit-denotive knowledge and associative-evaluative assumptions (Stahl & Bromme, 2007) Explicit-denotive knowledge refer to the more distal concept of knowledge *for* practice which are relatively prescriptive, such as the framework of evidence based practice, guidelines in physiotherapy or epistemological beliefs about science. The associative-evaluative assumption relate more to a proximal concept of knowledge *of* practice which are much more personal, emotional and context dependent (Clarke & Wilcockson, 2002). Stahl and Bromme developed a new instrument to measure these more connotative aspects. Connotative meanings refer to associative and evaluative judgments. The term comes from linguistics in which it refers to additional and individual meanings that a person associates with a concept/word (Stahl & Bromme, 2007). Based on research, slightly different dimensions were developed (table 3).

Another perspective that relates to the proximal concept of knowledge is the understanding of having cognitive resources triggered in specific situations rather then fixed beliefs or theories. Depending on a situation an individual can have different 'resources' to explain the nature of knowledge and the process of knowing.

Table 3 – Dimensions Connotative meanings

Texture	beliefs about the structure and accuracy of knowledge. This dimension ranges from beliefs that knowledge is exact and structured to beliefs that it is unstructured and vague.
Variability	beliefs about the stability and dynamics of knowledge. This dimension ranges from beliefs that knowledge is dynamic and flexible to beliefs that it is stable and inflexible.

In this line, a physiotherapist asked why he knows the medical diagnosis is Osteoarthritis, can give an answer 'because the doctor told me' (knowledge as transmitted stuff). But he can also reply to the question how he got to the conclusion that the main problem of the same patient is a general overload; ' because I figured it out together with the patient' (knowledge as fabricated stuff). In this perspective, epistemic stances are ' resources' that are more fluid, largely tacit and show context-sensitive variability (Louca, Elby, Hammer & Kagey, 2004).

Although the conceptual and methodological discussions around epistemic beliefs are far from established, a growing amount of empiric evidence shows that more sophisticated epistemic beliefs are related with an acceptance of uncertainty and changeability of truth and the notion that knowledge is rather construed than 'given'. More sophisticated epistemic beliefs are also shown to provoke different and more self regulated learning strategies. (Bromme, 2009; Mason & Boscolo, 2004; Qian & Alvermann, 1995; Kardash & Howell, 2000; Hofer & Pintrich, 1997; Bråten & Strømsø, 2005, 2006; Cano, 2005; Cano & Cardelle-Elawar, 2008; Dahl et al., 2005; Neber & Schommer-Aikins, 2002; Paulsen & Feldman, 1999; Urhahne & Hopf, 2004).

Epistemic beliefs in physiotherapists

Green and Hood (2013) performed a review of epistemic beliefs in teaching and learning in psychology (Green & Hood, 2013). They conclude; *'for graduates to*

*apply psychological knowledge ethically, technical skills need to be accompanied by skills for discovering, interpreting, and integrating relevant evidence, which involves well developed epistemological beliefs' (*Green & Hood, 2013). This statement is equally valid for other health professionals like physiotherapists.

Evidence based practice is considered to be a dominant model of practice in physiotherapy and the context of understanding of knowledge. Within this model the beliefs of what physiotherapists consider adequate knowledge and how they get this knowledge are important factors (Beenen & Castro-Caldas, 2016). Epistemic beliefs can be considered as a lens of how physiotherapists create meaning in their daily practice, what their strategy are to select knowledge, what is relevant for decision making and how this affects continuous learning in the accumulation of experiences within individual physiotherapists and within the professional community.

For example; a physiotherapist considers in a patient case what kind of resources he needs to diagnose the problem of a client. His epistemic beliefs can range from a naïve view, knowledge comes from an authority, which could in this case very well be himself, to the 'sophisticated' view that knowledge is only valid if it fits the environment of the client. In the naïve view the physiotherapist is likely to take a position as the authorative expert-professional, while in the sophisticated view the relation with the client and other resources will be much more important in order to construct together the diagnosis. The way he judges knowledge also has repercussions on what the meaning is from his experience for other physiotherapists. In case of a sophisticated belief, he would put, for example, an effort in explaining (or researching) how he came to a shared decision-making process together with his patient.

Epistemic beliefs influences directly the learning strategies, since the naïve understanding of knowledge assumes transmission from an authority to the learner (from teacher to the physiotherapist or from the physiotherapist to the client). In this view the authority regulates the learning process and the learner is waiting or, at best, actively asking the authority for the answer. A more sophisticated view puts the learner in a more self-regulating position of learning since he is the one who is looking for active construction of knowledge in a specific situation (Hofer, 2004).

The same kind of reasoning count for the dimension 'justification of knowing' in which individuals justify what they know and how they evaluate their knowledge; *'it ranges from 'naïve' beliefs that observation, authorities, or "'what feels right' are valid sources of knowledge to more 'sophisticated' beliefs that knowledge can be justified by evaluating evidence, expertise, and authorities"* (Bromme, 2009). Such beliefs lead to the use of more divers, more constructivist and more self-regulated learning in practice (Otting et al., 2010). This is also supported by the concept of self-authorship, which assert that when knowledge is viewed as complex and socially constructed the door is open for professionals to put themselves with their own existing knowledge and identity in the center of learning and decision making (Baxter Magolda, 2008).

To ground these statements more theoretically, in psychology the functional relation between epistemic beliefs and metacognition and self-regulated learning is studied with promising results. The basic assumption is that epistemic beliefs impact on students' internal standards that in turn influence metacognitive monitoring and control processes. The beliefs 'inform' the learner about the task at hand in an abstract way (Bromme, 2009). However this line of research is considered beyond the scope of this study.

Another concept relevant in relation with epistemic beliefs is Cognitive flexibility. This can be described as: *"the disposition to consider diverse context-specific information elements while deciding on how to solve a problem or to execute a (learning) task in a variety of domains and to adapt one's problem solving or task execution in case the context changes or new information becomes present"* (Elen, Stahl, Bromme & Clarenbout, 2011). Cognitive flexibility offers creativity and the capability 'to think out of the box'. The concept is closely related to sophisticated epistemic beliefs as both offer the ability to take a stance and to be aware of the constructed nature of that position. Both concepts can be interrelated in various ways that could be interesting for influencing each other. More research needs to be done to confirm these relations.

The research above suggests that a physiotherapist needs a so-called sophisticated epistemic belief in order to work in a knowledge-based society (Barnett 2009,

Bromme & Kienhues, 2008) or more specific to act in accordance with the framework of evidence informed practice (Beenen, Castro-Caldas, 2016). The complex nature of physiotherapy demands a view on scientific knowledge as a coherent, hierarchical system of ideas, rather than as a simple collection of facts. Learning science should be about making sense of new ideas for themselves rather than receiving and accepting information from authority. The complexity and uncertainty physiotherapists are facing in their daily practice demands the need to have the skills to approach these ill-structured problems more active and critical. This is associated with progression or sophistication in epistemic thinking (Louca et al., 2004) to a higher level.

Conceptual doubts in epistemic beliefs

However working with the framework of epistemic beliefs demands cautiousness. The concepts within the framework are far from settled and are continuously subject of heated debate. Some relevant discussions and consequences for the study are described in this paragraph.

The normative and decontextualized connotation of what sophisticated beliefs contains needs to be nuanced (Louca 2004, Elby and Hammer 2000). Besides the idea that sophistication generally means that knowledge is perceived to be contextual, constructed and therefor never absolute. Sophistication also means the ability *'to distinguish established and controversial ideas'* (Linn & Songer, 1993). This means reflecting how tentative knowledge is. It would be unsophisticated to consider it tentative that the heart circulates blood through the body (Elby & Hammer, 2000). Beliefs are sophisticated if it allows for a contextual shift between knowledge as given facts and knowledge as being preliminary and socially shared (Bromme, 2008). In the most developed epistemic beliefs uncertainty is acknowledged, asking to take the responsibility to evaluate critically the knowledge claims (Van Strien, Bijker, Brand-Gruwel & Boshuizen, 2012; Nussbaum, Sinatra, & Poliquin, 2008).

Research is still in its infancy with respect to how individual held epistemic beliefs are consistent and stable within a discipline and groups within a discipline (for example level of education, level of experience, different specializations etc.) and in between disciplines. Research done in education indicates that students have domain-

independent but also domain-dependent beliefs. Up to now it is unclear how such different levels might interact with each other (Stahl & Bromme, 2007). The focus of this study is on the domain specific epistemic beliefs. To understand the domain specific physiotherapy practice from the perspective of epistemic beliefs a certain consistency and stability would be insightful. With respect to predict epistemic beliefs and possible interventions to develop and change epistemic beliefs this is paramount.

Considering the globalization within domains (in this study; the international physiotherapy movement) an extra question rises about the consistency and stability in between cultures (Hofer 2008). This is a factor what needs to be taken in account in the increasing international character of the physiotherapy community and the related communities. In this so called 'knowledge society' cultural differences are becoming more and more relevant in order to understand and develop together the profession and for this study relevant models of practice like evidence based practice (Stehr, 1994).

Some researchers assume, and show till a certain level, that domain-specific epistemic beliefs become more influential during further education and experience in the domain (Kienhues et al., 2008). Research in epistemic beliefs in physiotherapy should also take personal characteristics in account. Research done in the difference between gender show, especially in the less sophisticated phases, that male favor more individualistic and impersonal ways of knowing while women favor more personal and social ways of knowing (Baxter Magolda, 2002).

This study focusses on the confirmation of a positive attitude towards evidence based practice and explores the level of sophistication of epistemological beliefs of the community of physiotherapists within Europe. Leading to the following research questions:

Research questions.

- How sophisticated are the epistemological beliefs of physiotherapists?
    - Do epistemological beliefs differ in physiotherapists with regard to their:
        - Level of education

        - Years of experience
        - Gender
        - Country

- How positive are the attitudes towards evidence based practice and what is the readiness of physiotherapists in countries within Europe?
    - Do attitudes towards evidence based practice differ in physiotherapists with regard to their:
        - Level of education
        - Years of experience
        - Gender
        - Country

Methods

A survey study was implemented to collect the data regarding epistemological beliefs and attitudes towards evidence based practice on Physiotherapy.

Subjects

With the aim to characterize the three general European regions, ten countries were selected to collect data from physiotherapy practitioners, teachers and students:

- Northern Europe
    - Denmark
    - Sweden
    - Finland
- Central Europe
    a. The Netherlands
    b. Germany
    c. Austria
    d. Swiss
- Southern Europe
    a. Portugal
    b. Spain
    c. Italy

Sample size and characteristics

In total, the sample has 1416 respondents, which 19,9% (n=283) are Dutch, 19,5% (n=277) are Portuguese, 10.6% (n=151) are Danish, 15,4% (n=218) are Italian, 16,1% (N=229) are Spanish, 7,4% (N=105) are Finnish, 8,6% (N=123) are from the German Speaking Countries (GSC) and 2,3% (N=33) are from Sweden.

Generally, the subjects are mainly female (67.2%; n= 954) and with young age; 41.4% (n=589) ranging from 20 to 29 years old; 75,4% (n=1070) are graduated professionals, 63%; (n=673) having exclusively a bachelor diploma. From the professionals, 32.3% (n=345) are specialists and of those 22.2% (n=237) combine it with teaching in physiotherapy. More detailed characteristics for the total sample and per country are presented on table 4 and appendix 1.

Instrument

To answer the research questions, an online survey with four sections was developed.

Two different questionnaires were used to gain a domain specific comprehensive overview of the sophistication of physiotherapists in Europe. The Discipline-focused epistemological beliefs questionnaire (DEBQ) and the Connotative Aspects of Epistemological Beliefs (CAEB) (Hofer 2000; Stahl and Bromme 2007). For the confirmation of the positive attiude and readiness in evidence-based practice the EBP-questionnaire was used Beenen et al., 2016C) . These questionnaires were, satisfactory, cross-culturally adapted for the countries in this study (Beenen et al., 2016B). The questions for the general characterization were developed in the English language and underwent the same cross-cultural adaptation process. More details about the questionnaires and the adaptation process can be found in the studies of Beenen and colleagues (Beenen et al., 2016B and 2016C).

The survey has the following structure:

- Section I - General characterization (appendix 2)
- Section II - Epistemological beliefs
    - DEBQ (Discipline Epistemic Belief Questionnaire) - full questionnaire

- Section III - Epistemological beliefs
    - CAEB (Connotative Aspects of Epistemological Beliefs) - full questionnaire
- Section IV – Attitudes and readiness
    - EBP questionnaire

The final questionnaire per country, was constructed on Google Drive forms (Google, 2012) (appendices 3) with automatic creation of excel database for data recording.

Procedures for the data collection

Through the contacts of the country coordinators the survey was distributed online to the following type of participants: physiotherapy practitioners, physiotherapy teachers and students. Accompanying the link for the survey an introductory text and invitation for participation was added (appendix 4). The consent was explicitly given by filling in the survey.

The sample acquisition was variable among countries through the use of mailing lists from educational institutes and professional associations.

Data Analysis

The data recorded on the excel databases (per country) was exported to a single database created on the SPSS® version 22 for the statistical analysis.

A factor analysis was performed for each both the DEBQ and the CAEB questionnaire for the full sample, using the same procedures as described in the report of the cross-cultural adaptation. (Beenen, et al., 2016B). Also for the EBP questionnaire a confirmatory factor analysis, based on the findings of the earlier validation study, using a principal component analysis (with varimax rotation) was performed, in order to find stable and sufficient internal consistency for two factors relating to the positive attiude and readiness towards EBP (Beenen et al., 2016C)

A descriptive analysis was performed with mean, standard deviation, minimum and maximum calculated per admitted factor and, when possible, questionnaire per country and for the general characteristics.

For the comparison between dependent variables (scores of the questionnaires) and independent variables (country and general characteristics), a one-way Manova was performed, considering p-values < 0.05 for statistical significance.

A Pearson correlation was used for the correlation between scores of the questionnaires and dimensions.

In order to compare and correlate the scores, an inversion of the Likert scale was performed with 'recode into same variables' within SPSS-22 for the following items to align them towards the proposed scale for the level of sophistication with regard to the DEBQ and the CAEB and for the attitude and readiness for EBP questionnaire.

- DEBQ: Items; 10,11,22 and 23.
- CAEB: Items; 4,6,11,13,16 and 17.
- EBP: Items; 3,5,7 and 9

Results

The normality of the sample was verified by the Shapiro-Wilk test for all three questionnaires (appendix 5).

The Measure of Sample Adequacy (MSA) that reports the appropriateness for data for a factor analysis was confirmed. According to Hair, Anderson, Tatham, and Black (1998) the MSA is satisfactory with values > 80. If the MSA is lower we looked at Bartlett's Test of Sphericity, when this has an associated P value of <0.001 we could continu to perform a valid factor analysis (Hair, Anderson, Tatham & Black, 1998). The MSA values were acceptable together with the Bartlett's test for the DEBQ (.811 – sig. of .000), the CAEB (.890 – sig. of .000) and the EBP (.815 – sig. of .000).

Table 4 - Sample Characteristics

		Netherlands	Portugal	Denmark	Italy	Spain	Finland	GSC	Sweden	Total
N		283	277	151	218	229	105	123	33	1419
Sex	Female	51.2	76.5	69.5	58.3	68.1	81.0	77.2	86.7	67.2
	Male	48.8	23.5	30.5	41.7	31.9	19.0	22.8	13.3	32.8
Age	20-29	32.9	41.9	37.7	33.0	54.6	41.9	56.9	30.0	41.5
	30-39	24.7	31.4	21.2	20.2	31.9	21.9	18.7	23.3	25.3
	40-49	14.5	13.0	16.6	16.1	9.6	11.4	11.4	23.3	13.5
	>50	27.9	13.7	24.5	30.7	3.9	24.8	13	23.3	19.7
Years of license	<5	27.6	30.7	39.1	36.2	50.2	53.3	52	36.7	38.6
	5-10	20.8	35.7	12.6	8.7	14.8	10.5	17.9	16.7	18.9
	11-15	8.5	11.9	12.6	10.6	17.9	5.7	6.5	10.0	11.1
	>15	43.1	21.7	35.8	44.5	17.0	30.5	23.6	36.7	31.4
Educational level	Prof. diploma	-	-	-	-	-	-	20.3	6.7	1.9
	Bachelor student	13.4	11.2	29.9	50.5	34.1	39.0	41.5	10.0	22.6
	Bachelor degree	50.4	62.1	59.6	22.5	35.4	33.3	18.7	40.0	47.4
	Master student	8.8	5.8	05.3	1.8	5.2	3.8	5.7	6.7	5.5
	Master degree	20.1	15.5	12.6	24.8	13.5	15.2	10.6	10.0	16.6
	PhD student	3.5	2.9	0.7	0	6.6	4.8	3.3	10.0	3.2
	PhD degree	3.5	2.5	0	0.5	5.2	3.8	0	16.7	2.7
Specialisation	Yes	54.4	23.1	7.3	17.9	37.6	34.3	53.7	6.7	32.3
	No	45.6	76.9	92.7	82.1	62.4	65.7	46.3	93.3	67.7
Amount patients	<5	23.3	21.3	47.7	40.8	45.4	75.2	36.6	60.0	37.6
	5-10	15.9	28.9	31.8	50.0	27.1	22.9	23.6	33.3	28.7
	11-15	29.7	26.7	17.2	6.0	13.1	1.0	23.6	6.7	18.3
	>15	31.1	23.1	3.3	3.2	14.4	1.0	16.3	0	15.4
Teaching	Yes	18.0	18.1	34.4	32.6	17.5	20.0	19.5	20	22.2
	No	82.0	81.9	65.6	67.4	82.5	80.0	80.5	80	77.8
Combination with practice	Yes	21.2	44.4	66.0	42.9	39.3	15.0	17.4	9.1	31.7
	No	78.8	55.6	34.0	57.1	60.7	85.0	82.6	90.9	68.3

Factor analysis

As identified in the cross-cultural adaptation of the questionnaires and in other studies, the factor analysis for epistemic belief questionnaires generally do not show stable results (Beenen et al. 2016B). The results from each questionnaire are illustrated below. Showing acceptable Cronbach values for the total DEBQ and the DEBQ factor 'certainty' and for the CAEB and the EBP questionnaire both total and for the factors. (Table 5, 6, 7, 8, 9, 10).

Table 5 - Results factor analysis DEBQ (appendix 6)

	Factors/Dimensions			
Item	Certainty/ Simplicity	Attainment of truth	Source	Justification
1	.535			
2	.614			
3	.524			
4	.488			
5	.599			
6		.341		
7	.538			
8*				
9	.594			
10				.417
11			.479	
12				.628
13		.442		
14			.324	
15*				
16*				
17		.471		
18	.520			
19		.441		
20				
21				.638
22			.426	
23			.687	
24	.502			
25*				
26			.548	
27		.606		
Cronbach Alpha	.744	.484	.498	.353

Cronbach of the validated questionnaire: .756
Cronbach with omitted items: .709
Total variance explained: 24.34%

Numbers with an * were omitted due to low loading <.320

Table 6 - Organization of the DEBQ items per factors / dimensions

Item	Description
	Factor / Dimension – **Certainty/Simplicity**
1	Truth is unchanging in this subject.
2	In this subject, most work has only one right answer.
3	Sometimes you just have to accept answers from the experts in this field, even if you don't understand them.
4	What we accept as knowledge in this field is based on objective reality.
5	All professors in this field would probably come up with the same answers to questions in this field.
7	If you read something in a textbook for this subject, you can be sure it is true.
9	Most of what is true in this subject is already known.
18	Principles in this field are unchanging.
24	All experts in this field understand the field in the same way.
	Factor / Dimension – **Attainability of truth**
6	The most important part of working in this subject is coming up with original ideas.
13	If scholars try hard enough, they can find the answers to almost anything.
17	Experts in this field can ultimately get to the truth.
19	Principles in this field can be applied in any situation.
27	First-hand experience is the best way of knowing something in this field.
	Factor / Dimension - **Justification**
10	Ideas in this subject are really complex.
12	Correct answers in this field are more a matter of opinion than fact.
21	There is really no way to determine whether someone has the right answer in this field.
	Factor / Dimension – **Source**
11	In this subject, it is good to question the ideas presented.
14	The most important part of being an expert in this field is accumulating a lot of facts.
22	Expertise in this field consists of seeing interelationships among ideas
23	Answers to questions in this field change as experts gather more information.
26	I am most confident that I know something when I know what the experts think.

Table 7 - Results factor analysis CAEB (appendix 6)

	Factors	
Item	Texture	Variability
1	.571	
2	.608	
3	.543	
4		.722
5*		
6		.579
7	.711	
8	.648	
9	.718	
10	.761	
11		.716
12	.715	
13*		
14	.664	
15	.687	
16		.680
17		.712
Cronbach	.862	.762

Cronbach of the validated questionnaire: .840

Cronbach with omitted items: .853
Total variance explained: 44,1%

Numbers with an * were omitted due to low loading <.320

Table 8 - Organization of the CAEB items per factors / dimensions

Item	Description
	Factor / Dimension - **Texture**
1	Stable- instable
2	Objective-Subjective
3	Confirmable- Unconfirmable
7	Exact- vague
8	Absolute-Relative
9	Sorted- Unsorted
10	Precise-Imprecise
12	Definite-Ambiguous
14	Structured-Unstructured
15	Completed-Uncompleted
	Factor / Dimension – **Variability**
4	Dynamic- static
6	Temporary-everlasting
11	Flexible-Inflexible
16	Refutable-Irrefutable
17	Open-Closed

Table 9 - Results factor analysis EBP (appendix 6)

	Factors	
Item	Utility	Readiness
1	.716	
2	.655	
3*		
4	.733	
5*		
6*		
7	.677	
8*		
9		.617
10		.806
11		.842
12		.856
13		.760
14		.752
Cronbach	.795	.869

Cronbach of the validated questionnaire: .725
Cronbach with omitted items: .842
Total variance explained: 46.2%

Numbers with an * were omitted due to low loading <.320

Table 10 - Organization of the EBP items per factors / dimensions

Item	Description
	Factor / Dimension –**Utility**
1	Application of EBP is necessary in the practice of physical therapy.
2	Literature and research findings are useful in my day-to-day practice.
4	EBP improves the quality of patient care.
7	EBP helps me make decisions about patient care.
1	Application of EBP is necessary in the practice of physical therapy.
	Factor / Dimension - **Readiness**
9	I learned the foundations for EBP as part of my academic preparation.
10	I have received formal training in search strategies for finding research relevant to my practice.
11	The adoptation of EBP places unreasonable demands on physical therpaists
12	I received formal training in critical appraisal of research literature as part of my academic preparation.
13	I am confident in my ability to critically review professional literature.
14	I am confident in my ability to find relevant research to answer my clinical questions.

Sophistication of epistemic beliefs for questionnaires.

DEBQ

DEBQ factor certainty has a mean score = 18.72±4.82, given the score range between 45 (naïve) to 9 (sophisticated) the nature of knowledge (certainty and simplicity) was considered as a moderately high sophistication for the total sample (table 11). The The scores per general characteristics are also presented on table 11.

Table 11 - Descriptive Statistics DEBQ certainty (appendix 7)

	N	Minimum	Maximum	Mean score	Std. Deviation
Total	1419	45.00	9.00	18.72	4.82
Per nationality					
The Netherlands	283	32.00	9.00	18.30	4.64
Portugal	277	35.00	11.00	20.07	4.72
Denmark	151	36.00	9.00	18.79	4.93
Italy	218	31.00	9.00	16.90	4.30
Spain	229	45.00	9.00	18.63	5.19
Finland	105	31.00	11.00	20.45	3.96
GSC	123	32.00	10.00	18.98	4.67
Sweden	33	32.00	9.00	16.85	5.23
Per gender					
Female	954	45.00	9.00	18.95	4.85
Male	456	34.00	9.00	18.23	4.72
Per age range					
20-29	589	38.00	9.00	18.85	4.46
30-39	359	45.00	9.00	18.70	5.01
40-49	192	35.00	10.00	17.96	4.86
>50	279	36.00	9.00	17.90	5.27
Per level of education					

Porfessional diploma	27	28.00	11.00	20.15	5.01
Bachelor student	321	34.00	9.00	19.30	4.44
Bachelor	672	45.00	9.00	19.15	4.94
Master student	78	29.00	9.00	18.21	4.80
Master	236	32.00	9.00	17.54	4.60
PhD student	46	29.00	9.00	15.41	3.89
PhD	39	30.00	9.00	17.69	5.13
Per licensed years					
<5	255	45.00	9.00	18.65	5.00
5-10	185	36.00	9.00	18.61	4.67
11-15	91	32.00	9.00	18.36	4.65
>15	273	34.00	9.00	19.00	4.74

In comparisons with general characteristics significant differences are found (appendix 8), as follows:

Nationality – statistically significant differences were found for several countries. The positive comparisons are shown (Table 12).

Table 12 - Manova test results for Nationality DEBQ (appendix 8)

Country comparisons	Test result diferences (MD) / significance
The Netherlands vs Italy	1.40; p=.021
Portugal vs Netherlands	1.76; p=.000
Portugal vs Spain	1.43; p=.015
Portugal vs Italy	3.17; p=.000
Portugal vs Sweden	3.22; p=.005
Spain vs Italy	1.73; p=.003
Denmark vs Italy	1.88; p=.004
Finland vs Netherlands	2.14; p=.002
Finland vs Spain	1.81; p=.024
Finland vs Italy	3.55; p=.000
Finland vs Sweden	3.60; p=.003
German Speaking Countries vs Italy	2.08; p=.002

Gender – statistically significant differences were found, male scoring higher than female (MD=0.7; p=.007).

Level of Education – significant differences were found between physiotherapists with a Professional diploma, bachelor students and bachelors scoring higher (meaning a more naïve epistemic belief) in relation to Master diploma and PhD students (Table 13).

Table 13 - Manova test results for Level of education (appendix 8)

Level of education comparisons	(MD) / significance
Professional Diploma versus PhD student	4.74； p=.001
Bachelor student versus Master diploma	1.75； p=.000
Bachelor student versus PhD student	3.88; p=.000
Bachelor versus Master diploma	3.17; p=.000
Bachelor versus PhD student	3.22; p=.000
Master student versus PhD student	1.73; p=.026

In the characteristics for age, gender and years of experience no significant differences were found.

CAEB

CAEB has a mean score = 63.38±12,77, corresponding to a level of medium sophisticated beliefs for the total sample. The scores per general characteristics are also presented on table 13.

Table 14 - Descriptive Statistics CAEB (appendix 7)

	N	Minimum	Maximum	Mean score	Std. Deviation
Total	1419	18.00	119.00	63.38	12.77
Per nationality					
The Netherlands	283	30.00	111.00	64,71	10,40
Portugal	277	27.00	111.00	62,58	16,24
Denmark	151	34.00	119,00	66.72	12.46
Italy	218	18.00	107.00	62.90	12.60
Spain	229	31.00	107.00	58.76	11.92
Finland	105	40.00	94.00	66.89	9.04
GSC	123	24.00	107.00	66.21	12.21
Sweden	33	48.00	83.00	63.24	8.95
Per gender					
Female	954	23.00	119.00	63.29	13.10
Male	456	18.00	111.00	63.57	12.07
Per age range					
20-29	589	18.00	108.00	62.49	11.89
30-39	359	30.00	119.00	63.31	12.95
40-49	192	30.00	109.00	64.05	13.67
>50	279	23.00	119.00	64.88	13.56
Per level of education					
Professional diploma	27	49.00	90.00	64.63	8.89
Bachelor student	321	18.00	107.00	61.90	12.03
Bachelor	672	23.00	119.00	63.09	13.03
Master student	78	27.00	108.00	66.12	14.14
Master	236	30.00	107. 00	64.82	12.65
PhD student	46	38.00	111.00	67.28	14.58
PhD	39	37.00	81.00	60.90	9.61
Per licensed years					
<5	255	31.00	119.00	63.49	14.02

5-10	185	18.00	119.00	63.25	12.19
11-15	91	30.00	111.00	62.48	12.26
>15	273	23.00	111.00	63.64	11.69

Table 15 - Descriptive Statistics CAEB Texture (appendix 7)

	N	Minimum	Maximum	Mean score	Std. Deviation
Total	1419	10.00	70.00	39.17	9.29
Per nationality					
The Netherlands	283	18.00	64.00	40.63	7.74
Portugal	277	12.00	66.00	36.94	11.21
Denmark	151	17.00	70.00	41.04	8.88
Italy	218	10.00	69.00	39.55	8.95
Spain	229	16.00	61.00	37.03	9.26
Finland	105	23.00	61.00	39.43	7.92
GSC	123	15.00	65.00	41.67	8.95
Sweden	33	21.00	53.00	38.94	6.55
Per gender					
Female	954	12.00	70.00	38.99	9.42
Male	456	10.00	69.00	39.52	9,03
Per age range					
20-29	589	10.00	69.00	39.05	9,21
30-39	359	13.00	70.00	38.87	9.01
40-49	192	12.00	63.00	39.35	9,95
>50	279	12.00	70.00	39.68	9.38
Per level of education					
Professional diploma	27	27.00	56.00	40.44	7.16
Bachelor student	321	10.00	65.00	38.00	9.16
Bachelor	672	12.00	70.00	38.86	9.32
Master student	78	16.00	64.00	41.41	9.39
Master	236	12.00	62.00	40.38	9.48
PhD student	46	16.00	64.00	41.83	9.91
PhD	39	20.00	51.00	38.21	7.20
Per licensed years					
<5	255	12.00	70.00	39.07	9.93
5-10	185	10.00	70.00	39.33	9.00
11-15	91	16.00	64.00	38.68	9.34
>15	273	12.00	66.00	39.36	8.65

Table 16 - Descriptive Statistics CAEB Variability(appendix 7)

	N	Minimum	Maximum	Mean score	Std. Deviation
Total	1419	5.00	35.00	15.23	5.36
Per nationality					
The Netherlands	283	5.00	34.00	14.93	4.89
Portugal	277	5.00	33.00	16.35	6.16
Denmark	151	7.00	35.00	16.53	5.28
Italy	218	5.00	35.00	14.65	5.32
Spain	229	5.00	35.00	13.13	5.11
Finland	105	8.00	28.00	16.16	3.95
GSC	123	5.00	32.00	15.95	4.95
Sweden	33	8.00	26.00	15.27	4.80
Per gender					
Female	954	5.00	35.00	15.34	5.45
Male	456	5.00	34.00	15.01	5.17

Per age range					
20-29	589	5.00	32.00	14.40	4.94
30-39	359	5.00	35.00	15.54	5.63
40-49	192	5.00	35.00	15.67	5.46
>50	279	5.00	35.00	16.29	5.54
Per level of education					
Professional diploma	27	5.00	29.00	15.74	4.85
Bachelor student	321	5.00	32.00	14.72	4.78
Bachelor	672	5.00	35.00	15.35	5.50
Master student	78	5.00	32.00	15.87	5.81
Master	236	5.00	33.00	15.37	5.42
PhD student	46	5.00	34.00	16.11	6.75
PhD	39	7.00	23.00	13.92	4.40
Licensed years					
<5	255	5.00	35.00	15.41	5.78
5-10	185	5.00	35.00	14.98	5.33
11-15	91	6.00	34.00	14.61	4.73
>15	273	5.00	33.00	15.38	5.04

In comparisons with general characteristics significant differences are found (appendix 8), as follows:

Nationality – statistically significant differences were found for several countries. The positive comparisons are shown (Table 17).

Table 17 - Manova test results for Nationality CAEB(appendix 8)

Country comparisons	MD / significance CAEB -total	MD / significance CAEB - Texture	MD / significance CAEB variability
Netherlands vs Spain	5.95; p=.000	3.61; p=.000	1.81; p=.003
Netherlands vs Portugal		3.70; p=.000	
Portugal vs Spain	3.81; p=.016		3.22; p=.000
Portugal vs Netherlands			1.41; p=.032
Portugal vs Italy			1.70; p=.009
Denmark vs Portugal	4.14; p=.025	4.10; p=.000	
Denmark vs Spain	7.96; p=.000	4.01; p=.001	3.40; p=.000
Denmark vs Italy			1.88; p=.016
Italy vs Spain	4.14; p=.012		
Italy vs Portugal		2.62; p=.035	
Finland vs Spain	6.12; p=.001		3.04; p=.000
GSC vs Spain	7.45; p=.000	4.64; p=.000	2.82; p=.000
GSC vs Portugal	2.14; p=.002	4.73; p=.000	

Age – The age group 20-29 years old score significantly lower in the total CAEB score compared to physiotherapists of 50 years and older. The age group of 20-29 socres significantly lower to all other ages groups compared to the factor variability (Table 18).

Table 18 - Manova test results for Age in CAEB(appendix 8)

Age group	(MD) / significance Total	(MD) / significance Variability
> 50 versus 20-29	2.39; p=.049	1.90; p=.000
40-49 versus 20-29		1.27; p=.021
30-39 versus 20-29		1.14; p=.007

Level of Education – significant differences were found in de CAEB-texture showing master students having a higher score than physiotherapists with a bachelor diploma (MD 2.3; p=.04)

No statistically differences were found in the general characteristics for gender, years licenced.

EBP questionnaire

EBP questionnaire offered a mean score = 49.56±7.23, corresponding to a moderate positive attitude for the total sample. The scores per general characteristics are also presented on table 19.

Table 19 - Descriptive Statistics EBP (appendix 7)

	N	Minimum	Maximum	Mean score	Std. Deviation
Total	1419	14.00	69.00	49.56	7.23
Per nationality					
The Netherlands	283	30.00	65.00	51.17	6.08
Portugal	277	33.00	67.00	52.23	5.92
Denmark	151	25.00	64.00	49.48	7.25
Italy	218	14.00	65.00	44.20	7.79
Spain	229	24.00	64.00	48.07	7.28
Finland	105	31.00	64.00	50.27	6.54
GSC	123	31.00	69.00	51.36	6.71
Sweden	33	40.00	62.00	50.40	5.26
Per Gender					
Female	954	24.00	67.00	49.64	7.25
Male	456	14.00	69.00	49.40	7.18
Per age range					
20-29	589	14.00	67.00	50.31	7.22
30-39	359	29.00	65.00	49.90	6.98
40-49	192	32.00	64.00	48.92	6.83
>50	279	24.00	69.00	47.98	7.56
Per level of education					
Professional diploma	27	31.00	57.00	44.85	6,56
Bachelor student	321	14.00	65.00	49.29	7.37
Bachelor	672	24.00	67.00	48.13	7.06
Master student	78	35.00	64.00	53.35	6.52
Master	236	32.00	69,00	51.94	6.57
PhD student	46	40.00	64.00	54.76	5.05
PhD	39	31.00	62.00	51.82	6.71

Per licensed years					
<5	255	25.00	67.00	49.97	7,26
5-10	185	14.00	65.00	48.66	8.02
11-15	91	29.00	69.00	49.37	6.72
>15	273	24.00	69.00	49.68	6.80

Table 20 - Descriptive Statistics EBP utility (appendix 7)

	N	Minimum	Maximum	Mean score	Std. Deviation
Total	1419	4.00	20.00	16.36	2.81
Per nationality					
The Netherlands	283	5.00	20.00	16.03	2.67
Portugal	277	9.00	20.00	17.19	2.34
Denmark	151	6.00	20.00	14.89	2.93
Italy	218	4.00	20.00	15.95	3.41
Spain	229	4.00	20.00	16.66	2.60
Finland	105	5.00	20.00	16.68	2.60
GSC	123	9.00	20.00	16.86	2.47
Sweden	33	12.00	20.00	16.64	2.60
Per Gender					
Female	954	6.00	30.00	21.65	5.78
Male	456	6.00	30.00	21.39	5.62
Per age range					
20-29	589	4.00	20.00	16.35	7.36
30-39	359	6.00	20.00	16.43	2.70
40-49	192	7.00	20.00	16.26	2.76
>50	279	4.00	20.00	16.37	3.17
Per level of education					
Professional diploma	27	12.00	20.00	16.33	1.94
Bachelor student	321	4.00	20.00	16.10	2.87
Bachelor	672	4.00	20.00	16.05	2.77
Master student	78	7.00	20.00	16.54	2.76
Master	236	7.00	20.00	17.00	2.72
PhD student	46	10.00	20.00	18.11	2.40
PhD	39	5.00	20.00	17.51	2.97
Per licensed years					
<5	255	6.00	20.00	16.46	2.79
5-10	185	4.00	20.00	16.32	2.97
11-15	91	4.00	20.00	16.18	2.87
>15	273	4.00	20.00	16.33	2.70

Table 21 - Descriptive Statistics EBP readiness (appendix 7)

	N	Minimum	Maximum	Mean score	Std. Deviation
Total	1419	6.00	30.00	21.56	5.73
Per nationality					
The Netherlands	283	6.00	30.00	23.10	5.09
Portugal	277	11.00	30.00	23.53	4.48
Denmark	151	7.00	30.00	21.97	5.38
Italy	218	6.00	30.00	17.53	5.54
Spain	229	6.00	30.00	19.35	6.01
Finland	105	6.00	30.00	22.41	5.62
GSC	123	9.00	30.00	23.43	5.42
Sweden	33	13.00	30.00	22.33	4.40
Per Gender					

Female	954	6.00	30.00	21.28	5.78
Male	456	6.00	30.00	21.39	5.62
Per age range					
20-29	589	6.00	30.00	22.20	5.64
30-39	359	6.00	30.00	21.62	5.84
40-49	192	6.00	30.00	21.12	5.72
>50	279	7.00	30.00	20.44	5.60
Per level of education					
Professional diploma	27	9.00	30.00	17.78	4.92
Bachelor student	321	6.00	30.00	21.51	5.71
Bachelor	672	6.00	30.00	20.22	5.77
Master student	78	11.00	30.00	24.54	5.04
Master	236	6.00	30.00	23.58	4.69
PhD student	46	18.00	30.00	25.89	3.62
PhD	39	10.00	30.00	24.38	5.16
Per licensed years					
<5	255	6.00	30.00	21.79	5.74
5-10	185	6.00	30.00	20.75	6.08
11-15	91	7.00	30.00	21.66	5.46
>15	273	6.00	30.00	21.74	5.56

In comparisons with general characteristics significant differences are found (appendix 8), as follows:

Nationality – statistically significant differences were found for several countries.
For the total questionnaire; Italy scores significantly lower than all other countries. Spain scores significantly lower compared to The Netherlands, Portugal, Finland and the German Speaking Countries. Denmark scores significantly lower compared to The Netherlands, Portugal and the German Speaking Countries.
For the factor utility; Denmark scores significantly lower compared to all other countries. Portugal scores significantly higher compared to the Netherlands and Italy.
For the factor Readiness; Italy scores significantly lower compared to all other countries. Spain scores significantly lower compared to The Netherlands, Portugal, Denmark, Finland and the German Speaking Countries (GSC). The positive comparisons are shown (Table 22).

Table 22 - Manova test results for Nationality EBP questionnaire (appendix 8)

Country comparisons	MD / significance EBP -total	MD / significance EBP utility	MD / significance EBP readiness
Netherlands vs Spain	3.11; p=.000		3.75; p=.000
Netherlands vs Portugal			
Netherlands vs Denmark	2.26; p=.018	1.13; p=.001	
Netherlands vs Italy	5.64; p=.000		5.56; p=.000
Portugal vs Spain	4.72; p=.000		4.19; p=.000
Portugal vs Denmark	3.86; p=.000	2.30; p=.000	
Portugal vs Italy	7.24; p=.000	1.24; p=.000	6.00; p=.000
Portugal vs Netherlands		1.16; p=.000	

Spain vs Italy	2.52; p=.002		1.81; p=.007
Spain vs Denmark		1.77; p=.000	
Denmark vs Portugal			
Denmark vs Spain			2.62; p=.000
Denmark vs Italy	3.37; p=.000		4.43; p=.000
Italy vs Spain			
Italy vs Portugal			
Italy vs Denmark		1.06; p=.006	
Finland vs Spain	3.08; p=.002		3.06; p=.000
Finland vs Italy	5.60; p=.000		4.88; p=.000
Finland vs Denmark		1.78; p=.000	
Sweden vs Italy	5.48; p=.000		4.80; p=.000
Sweden vs Denmark		1.74; p=.021	
GSC vs Spain	4.28; p=.000		4.09; p=.000
GSC vs Italy	6.81; p=.002		5.90; p=.000
GSC vs Denmark	3.43; p=.001	1.97; p=.000	

Age - significant differences where found between the younger age-groups 20-29 and 29-30 showing a higher score for the total questionnaire and the factor readiness. (Table 23).

Table 23 - Manova test results for Age in EBP questionnaire (appendix 8)

Age group	MD/ significance Total	MD / significance Utility	MD / significance Readiness
20-29 versus >50	2.33; p=.000		1.76; p=.006
30-39 versus >50	1.92; p=.004		1.17; p=.048

Level of Education - In general a trend is visible between level of education and a significant higher score on the EBP total and the factor readiness. The factor utility only show significant differences once physiotherpaists are master educated. The bachelor group does not follow this trend and the PhD group doesn't show this trend significantly for all lower levels (Table 24).

Table 24 - Manova test results for Level of education EBP questionnaire (appendix 8)

Level of education comparisons	(MD) / significance Total	MD/ significance Utility	MD/ significance Readiness
BSc-st. vs Diploma	4.43; p=.025		3.73; p=.012
BSc-st. vs BSc			1.29; p=.010
BSc vs Diploma			
MSc-st. vs Diploma	8.49; p=.000		6.76; p=.000
MSc-st. vs BSc-st	4.06; p=.000		3.03; p=.000
MSc-st. vs BSc	5.22; p=.000		4.31; p=.000
MSc vs Diploma	7.09; p=.000		5.80; p=.000
MSc vs BSc-st	2.65; p=.000	0.90; p=.003	2.07; p=.000
MSc vs BSc	3.81; p=.000	0.95; p=.000	3.35; p=.000
PhD-st. vs Diploma	9.74; p=.000		8.11; p=.000
PhD-st. vs BSc-st.	5.30; p=.026	2.01; p=.000	4.38; p=.000
PhD-st. vs BSc	6.46; p=.001	2.06; p=.000	5.67; p=.000

PhD-st. vs MSc-st.		1.57; p=.037	
PhD vs Diploma	6.97; p=.000		6.61; p=.000
PhD vs BSc-st.		1.41; p=.043	2.87; p=.032
PhD vs BSc	3.69; p=.022	1.46; p=.023	4.16; p=.000

No statistically differences were found in the general characteristics for gender, years licenced.

Correlations between questionnaires

Correlations are found between the two questionnaires related with sophistication of epistemological beliefs DEBQ-Certainty and CAEB-total (Pearson R = -0.99; p=0.000), Between DEBQ-Certainty and CAEB-texture (Pearson R = -.214; p=0.000) and between DEBQ-Certainty and CAEB-variability (Pearson R = .132; p=0.000). The negative correlations are explained by the opposite way of scoring in between DEBQ-Certainty and CAEB-texture.

Between EBP-total and CAEB-total (Pearson R = .113; p=0.000), EBP-total and CAEB-texture (Pearson R = .099; p=0.000) and the EBP-readiness with the CAEB-total (Pearson R = .057; p=0.033).

The factors within the different questionnaires shows consistent correlations (appendix 9).

Conclusions

This study aims to confirm the positive attitude and readiness towards Evidence-based practice and to explore the level of sophistication in domain specific epistemic beliefs in physiotherapy within Europe.

Utility and readiness for Evidence-based practice.

The expectation that physiotherapists have positive attitudes and show readiness towards evidence-based practice was confirmed. The internal consistency turn out to be satisfying for the whole sample using two factors.

In EBP questionnaire an overall mean score of 49.56±7.23 with a minimum 14.00 and a maximum of 69.00 corresponded to a moderate positive attitude and readiness for Evidence-based practice. The utility of evidence-based practice is considered to be very high throughout Europe with a mean score of 16.36±2.81 with a minimum of 4.00 and a maximum of 20.00. The readiness however scored lower with a mean score of 21.56±5.73 on a scale from 6.00 to 30.00. Physiotherapists in general are confindent of the use and benefit of EBP but feel less competent to do so.

Some small but significant differences within Europe were noted. Italy and Spain scored signifantly lower on the total questionnaire, however this is mainly due to the lower readiness while the perceived utility was comparable to the other countries. Portugal scored significantly higher on the perceived utility, compared to the Netherlands, Italy and Denmark. Denmark showed an opposite trend having a higher readiness for evidence-based practice but there was signicantly more doubts about the utility of the concept compared to the rest of Europe. The younger generations 20-39 felt signifantly more prepared to work evidence-based and with the increase of level of education, in general the readiness for EBP got higher. Only from a master diploma on, the utility of EBP was significantly higher scored then the lower levels of education.

Domain specific epistemic beliefs

A difference is shown in explicit (denotive) and implicit (connotative) beliefs how physiotherapists perceive the nature of knowledge. With a mean score of 18.72±4.82 on a minimum of 45 and a maximum score of 9 points on the DEBQ the sample showed a moderately high sophistication. Although the constructs of the DEBQ factor certainty/simplicity expectedly correlated (mildly) with the similar construct of the CAEB factor variability, the absolute scores were moderate low for the implicit epistemic beliefs with a mean score of 15.23±5.36 on a minimum of 5 and a maximum of 35 points. The difference justifies the conclusion that the implicit epistemic beliefs are less sophisticated than the explicit epistemic beliefs for this sample.

The general the score on the CAEB also showed a modernate low mean score of 63.38±12.77 on a minimum of 18 and a maximum of 119. The Northen and middle

European countries scored often, but not consistently, significantly higher in sophistication then the southern countries. One exception is Portugal, scoring signifcanlty higher in the CAEB factor variability then Italy, Spain and the Netherlands. Portugal scores signifcantly lower in the CAEB texture compared to several countries, scoring after Denmark highest in the CAEB factor variability but lowest in the CAEB texture.

The level of education show significant differences in the DEBQ factor certainty, showing the pattern that how higher the education, the more sophisticated the epistemic beliefs. The CAEB questionnaire didn't show that consistency, only the master students scored significantly higher than the bachelors. The differences between the two questionnaires together with the much lower score of the CAEB concludes for this sample that the current education influences the explicit epistemic beliefs, but do less influence the implicit beliefs.

For the CAEB-variability the sophistication of epistemic beliefs increase with age. So knowledge is perceived to be more flexible and dynamic when people get older.

Based on the small differences between the countries within the studied constructs we conclude that an European community of physiotherapy with a similar epistemic belief exists and that they are therefor comparable. This is relevant for developing further the framework and targeting interventions within evidence-based practice.

Discussion

The discussion first discusses the content followed by the methodological considerations and the consequences for further research and practice.

Content

The demands of the knowledge society and the inability to get new and relevant knowledge systematically in the profession necessitates more sophisticated epistemic beliefs (Beenen & Castro-Caldas, 2016). The epistemic beliefs show only moderately high sophistication for the explicit beliefs about the nature of knowledge. The more implicit beliefs seem to stay behind in sophistication. More research on what could influence epistemic sophistication is needed. The results of this study showed that the

higher the education the higher the denotive epistemic sophistication is. However for the more implicit, associative-evaluative, construct of beliefs this doesn't seem to be true. This is contrary to the results of the only other study found, measuring the epistemic beliefs in physiotherapists (Bientzle, Cress & Kimmerle, 2014).

Based on the results in this study it is hypothesized that professionals learn in school and practice to explicate better what their understanding of knowledge is, maybe instigated by the model of EBP, but this does have little effect on their more deep seated intuitive ideas about the knowledge.

Interventions towards epistemic literacy

The analysis suggests that more specific interventions are indicated to improve the sophistication in epistemic beliefs. Theory from the research area of 'conceptual change', assume that a dissonance and dissatisfaction between existing beliefs and new experiences can provoke change (Alexander & Sinatra, 2007). An integrated model of personal epistemic beliefs was suggested by Bendixen and Rule (2004), the model has interrelated components; epistemic doubt, epistemic volition and resolution strategies. In this model people start to doubt their beliefs, this leads to discontent, which focus the attention on a solution (volition) and strategies to get to this solution (Bendixen & Rule, 2004). Researchers in epistemic beliefs have been experimenting to provoke this doubt using refutational text, which refutes widely accepted assumptions with an alternative view. Transformative learning, according to Mezirov, can be very instructive to create this disequilibrium (Mezirov, 2000; Kekan, 2000). Also other concepts seem to strongly interrelate with epistemic beliefs; self-regulation and flexible cognition are described in the background of this article.

Shaffer and colleagues developed the concept of 'epistemic frames' (Shaffer, 2006).. In this theory they assume that professionals in a community (like the community of physiotherapists) have a common culture and framework of thinking. This frame is integrates the collection of skills, knowledge, indentity, values and epistemology (Shaffer, 2006). It is internalized through training and other socalization processes in which a professional becomes and develop as a member of the community. The epistemic frame is a holistic concept that determines how the individual professional ,and the community they belong to, are generally taking decisions and giving

justification of their practice. This concept is used in gaming to resemble as close as possible the complexity of daily practice. The strength of the concept lies in the relations between its constituent parts. These relations can be practical, conceptual, personal, moral or epistemological and can be measured through network analysis (Shaffer, Hatfield, Svarovsky, Nash, Nulty, Bagley, & Mislevy, 2009). Another benefit and potential of this concept of epistemic beliefs, is its focus on real life activities instead, which is often the case, of just focussing on the cognitive perspective (Knight, Arastoopour, Shaffer, Shum & Littleton, 2014).

The framework of evidence-based practice could be in itself also an intervention to improve epistemic beliefs and vice versa to improve the attitude and especially behaviour in EBP. This would necessitate an explicit reflection on the epistemic premises of the framework. It would be worthwhile to research how the adherence towards EBP tools like guidelines relates with the levels of sophistication in epistemic beliefs. Results could explain some of the difficulty with the implementation of these guidelines and defines epistemic belief as a determinant. In this respect it is of interest to research the epistemic beliefs of the developers of these guidelines and implementation strategies. Differences between level of epistemic sophistication between developers and practitioners could influence the adherence. In extension of the EBP-movement is implementation research often working from the premises of a knowledge-to-action gap. The epistemic beliefs can be characterized as more naïve, viewing knowledge as discrete, stable and transferable. Sophistication of these beliefs could be a trigger to innovate the used, often ineffective, strategies (Grimshaw, Eccles, Lavis, Hill & Squires, 2012; Greenhalgh et al., 2014).

More study and experiment is necessary to see how the three concepts of EBP and denotive and connotative epistemic beliefs interact and how this can positively influence the sophistication in beliefs for physiotherapists.

Readiness in Evidence-based practice

The relative gap between the high score in the utility of EBP and the lower readiness shown that, in most countries, physiotherapists are still not confident and able to integrate the necessary skills in their daily practice. A cognitive validity study could confirm this. It would be interesting to see if the lack in readiness is associated with

naïve epistemic beliefs, hypothesizing that the physiotherapist feels a friction between the complexity and dynamics of daily practice and the necessity to fit discrete and absolute knowledge claims.

European endeavour versus the specificity of the countries

When assuming that epistemic literacy is a determinant for evidence-based practice, it is relevant to see if these beliefs differ from one area to the other and between other subgroups. In the countries studied this does not seem to be the case, offering an opportunity to develop together much of the interventions described above. However some results demands more reflection in one of the subgroups and can demand a more specific intervention. Interesting is the differences measured in Portugal in the CAEB, with in comparison with the other countries a relative, high score in the factor variability but a relative low score in factor texture. Also the lower score of Denmark towards the perception of the utility of EBP compared to the high readiness should be further studied. It is suggested by the validation team of the questionnaires this could be due to the consistent criticism towards the EBP concept such as the study of Greenhalgh et al. (2014) and the issue of content validity discussed in Beenen et al. (2016C). The differences in scores between the level of education can be an indication to target different interventions per level of education. However in general, epistemic beliefs are on all levels only limited in curricula and once more incorporated in curricula this difference might be of less interest.

Methodology

The results presented here need to be interpreted with some caution. The construct validity of the questionnaires is not established and stable enough (Schraw, 2013; Beenen et al., 2016) which is shown by the low consistency for some of the factors found. However considering the general measurement problems in research on epistemic beliefs (DeBacker et al., 2008) the results of this study are promising. The factors of the CAEB could be replicated with acceptable reliability, as did the factor certainty/simplicity from the DEBQ.

The EBP–questionnaire had some problems with the internal consistency in the exploratory factor analysis in the cross-cultural adapatation study (Beenen et

al.,2016). The use of a confirmatory two factor solution in this study showed satisfying results and could be used in further studies.

Some of the groups in the sample turn out to be small, jeapordizing the statistical power, this is the case with the subgroup Sweden, and the level of educational groups ‘professional diploma, PhD and PhD-candidates.

The consistency in general is of a level that warrants for cautiousness. From the results it can be assumed that the overall Cronbach alpha of the instruments are underestimated. Cronbach alpha is grounded in the ‘tau equivalent model, which assumes uni-dimensionality and get influenced by the amount of items. As the standardised item Cronbach alpha of the CAEB and DEBQ factor certainty/simplicity are slightly higher than the normal Cronbach alpha, a check on the tau equivalent measurement is indicated for those instruments (Tavakol & Dennick, 2011).

Implications

The demands put on physiotherapists by the quickly developing knowledge society, the demand to work evidence based and the inherent complexity of the profession necessitates a high level of sophistication in epistemic beliefs. The results of this study indicates that this is only in certain extend the case in the community of physiotherapists in Europe. The uniformity of the community in respect to the attitude towards EBP and the level of sophistication of epistemic beliefs puts more research and experimenting with this concept firmly on the joint agenda.

More research needs to be done in the field of epistemic beliefs of physiotherapists; methodology needs to be improved both for measuring the concept and for intervention. The epistemic premises of the framework of EBP and its tools need to be scrutinized (Greenhalgh et al., 2014; Marks 2002) .

Physiotherapists show in this European sample a comparable positive attitude and readiness towards evidence-based practice. The epistemic sophistication of physiotherapists can be improved in this community. The results of this study shows that education have significant effect on the denotive epistemic beliefs and the attitude towards EBP. This can be formulate as a challenge for education. Even more

of a challenge is the improvement of the connotative beliefs, further research need to be done to see what could be interventions to influence these beliefs positively. Taking into account the context specificity and dynamics of knowledge in the practical field it seems advisible to focus on a critical knowledge stand in the early fases of formal learning but also integrate it closer to practice into informal and non-formal learning (Dall'alba, 2004; Dall'alba &Sandberg, 2006).

Final Discussion and Conclusions

In this part final conclusions are formulated towards the research done and the further development and implementation of the framework of Evidence Informed Practice is discussed.

The general conclusion is that in order to find solutions for the posed problem of the failing of physiotherapy to manage the knowledge innovation and knowledge circulation in its theory and practice, the frameworks and the way people think need to be made explicit and consistently targeted.
In order to make a step in this process an alternative framework for Evidence Based Practice was formulated. This framework of evidence informed practice is in its infancy. In such an overarching framework there is a lot to be done inside physiotherapy, in health care but as much outside of this often to 'siloed' domain. Many researchers, practitioners and patients, clients and managers are already developing knowledge that could strengthen and validate the framework. For this, 'Engaged scholarship' is a prerequisite, entailing collaboration, boundary crossing and arbitrage.

Diversity and language

Building an international 'networked intelligence' means that we need to be able to understand the theory and practice of different groups and cultures. The embodied knowledge in these environments is, in its diversity, a rich source for knowledge development. Learning languages, intercultural competences, digital skills and other 21st century skills are essential life-long and life-wide[5] learning goals in formal, informal, and non-formal learning[6] environments.

[5] Life-wide learning Learning, either formal, non-formal or informal, that takes place across the full range of life activities (personal, social or professional) and at any stage (CEDEFOP 2009).
[6] Formal learning: Occurs in an organised and structured environment (e.g. in an education or training institution or on the job) and is explicitly designated as learning (in terms of objectives, time or resources).
Informal learning: resulting from daily activities related to work, family or leisure. It is not organised or structured in terms of objectives, time or learning support.
Non-formal learning: Is embedded in planned activities and not always explicitly designated as learning (in terms of learning objectives, learning time or learning support), but which contain an important learning element. (CEDFOP 2009)

Research design and methodology

The way knowledge is created and processed is still largely based on the empirical-analytical paradigm, having an epistemology that assumes that only empirical data counts as valid in producing reliable knowledge, to the exclusion of other ways of knowing. Acknowledging a critical realist perspective has direct consequences for this methodology. It helps to emphasize more the importance of the research method as the starting point of research. Research questions need to come more from the practical situation or embedded in this practice in order to become more relevant. Methods like appreciative inquiry and human centered design can support these processes and avoid the deterministic trap to fragment and isolate aspects from reality too quickly (Brown, 2009, Matheson, 2013). Having a research question, the next step is to find what would be the most adequate research design and, mix of, methodology. Given the enormous amount of different approaches; frameworks and guidelines to help this process, like the key steps formulated for review methodology in chapter 3.1, can help in this process. Also applied en design based research models have a lot to offer in this.

Understanding of practice

The understanding of practice has the potential to be a significant determinant in the evolution from evidence based practice towards evidence informed practice. Little is researched in this area within physiotherapy, which offers potential for improvement. First and foremost the framework of understanding of practice, its key elements and its interactions needs much more elaboration and needs to be constantly scrutinized in practice. The key elements seem to influence each other consistently.
From other research areas we know the importance of an embodied understanding of practice in order to be able to develop expertise further. This doesn't develop spontaneously, but demands intervention within the development of the profession and professionals, focusing on a continuous 'becoming' professional rather than learning a set of competences. (Dall'alba, 2006; Barnett, 2009; Hager 2011).

The identity development of professionals is commonly considered to be of importance. However the conceptual framework and research in this area is still

rudimentary (Trede, Macklin & Bridges, 2012). One of the key elements where education works on is self-regulation, however the question is if, after the formal training, this remains an important issue in the development. To really incorporated self-regulation in the development of the physiotherapist, professionals need higher sophistication of their epistemic beliefs. Given the results in study four, which shows only minor development in sophisticated beliefs when people continue their education or gain more experience, it pays off to study and develop interventions aiming at influence epistemic beliefs towards more sophistication (Knight et al., 2014)

Knowledge is created and circulated in both individuals and communities of practice. The development of communities of practice has seen lots of developments. Physiotherapy only scratches the possibilities of identity development through communities and the creation and circulation of knowledge through networks.
(Wenger 2010; Wenger-Trayner et al., 2015).
Physiotherapists need to learn more 'to think out load' as this is the only way to gain inside and progress in how to tackle the complexity of the daily practice and to start learning from the tacit knowledge of experts. In order to cumulate this valuable knowledge more interpretative and critical research needs to be published. Theories, frameworks and knowledge need to be taken more serious, made explicit, be more specific to practice (embodied) and constantly tested in practice and towards other theory.
The separately discussed key elements of understanding of practice are substantially interrelated. The development of research and intervention need to incorporate this in their (theoretical) frameworks.

A climate for change

Health care is in the Western world big business, illustrated by the substantial parts of GDP spent on health care. For example; The Netherlands are around the middle with 12% of GDP spent on health care (WHO, 2015). The way health policy is organized towards care for (infectious) diseases and the neglect of the consequences of ageing and lifestyle gives the prediction that, if unchanged health care would consume in the Netherlands up to a staggering 31 percent of GDP by the year 2030 (CPB, 2011). This demands innovation of health care systems and an urgent focus on what limits innovation at the moment. One of the limitations is the central problem of failing to

manage the knowledge innovation and knowledge circulation in its theory and practice in physiotherapy. This however is obviously the case for all professionals in health care. To many specialists still work separately on the same problems. Another limitation described in chapter 1 is the power distribution in health care and the resistance to change resulting from this. A good example in the context of this study is the creation and existence of a whole new implementation research area. This mirrors beside the good intention to get knowledge into practice also subtle mechanisms to retain control over knowledge creation and what counts as valid knowledge (Beer 2001, Ferlie and Wood 2003, Greenhalgh & Wieringa 2011).

Further future considerations

Dismissing a seemingly successful framework as Evidence Based Practice as a failure and to offer an alternative model seems overly ambitious not to say slightly arrogant. However I strongly believe in what Einstein pointy stated as: "No problem can be solved from the same level of consciousness that created it". This seems to be very much the case in how we deal with knowledge in health care though. "Greenhalgh (2010) reflects on this: "The notion that knowledge translation and exchange is an impoverished framing of the theory-practice challenge, compared with knowledge generation via academic-practitioner dialogue, is not new. Jonathan Lomas once described the former framing as "the sound of one hand clapping" (Lomas 1997)" (Greenhalgh, 2010). A critical understanding of practice has the potential to, slowly determine how an individual within his 'average everydayness' anticipates (new) knowledge (Dall'alba, 2008). "We persist in only adding facts to our personal store of knowledge that jibe with what we already know, rather than assimilate new facts irrespective of how they fit into our worldview." (Abersman, 2013).

In writing this framework and thesis I gradually started to see more shades of grey and nuances, as often, leading to the conclusion that the fundamental changes proposed can't be changed overnight. However the urgency of the problems we are facing in, at least, health care asks for more disruptive measures. For this paradox, evidence informed practice should be firmly put on the agenda of not only practitioners and researchers, but also on the political agenda.

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Appendices

All the appendices mentioned along the thesis and the studies are organized and available on the attached CD.